

ABSTRACT

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FATIH PROJECT

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The purpose of this research study is to analyze the advantage and disadvantages of integrating technology in Mathematics' classroom for teachers and students and to explore the essential steps that are to be taken to train mathematics teachers so that they can integrate technology in their teaching. Mainly the project of Turkey that is FATIH project is discussed in this thesis. One of the main purpose of this research work is to analyze and understand the concept how various projects in United States and other countries have been successful in integrating technology in mathematics. Research findings of this study mentioned that there are different advantages and disadvantages of integrating technology in the mathematics classroom. The findings of the research mentioned that there is a need of the teachers' courses thorough which

they will be able to effectively implement the technological integration in the mathematics classroom.

TECHNOLOGY INTEGRATION IN THE MATHEMATICS CLASSROOM
AND THE FATIH PROJECT

By

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TABLE OF CONTENTS

ACKNOWLEDGEMENTS	i
TABLE OF CONTENTS	ii
CHAPTER I: INTRODUCTION	1
1.1. Research Background.....	1
1.2. Problem Statement	3
1.3. Purpose of the research	4
1.4. Research questions	5
1.5. Rationale of the study.....	6
1.6. Outline of the Research strategy	7
1.7. Significance of the research	7
1.8. Structure of the Research	8
CHAPTER II: LITERATURE REVIEW	9
2.1. The Role of Technology in Mathematics Education	10
2.2. Affordances and Constraints of Technology in Mathematics Education	12
2.3. Accounts of Technology Integration in Teaching Mathematics.....	15
2.4. Framework for Technology Integration in School Mathematics.....	17
2.5. Technology as a pedagogic cultural artifact	18
2.6. Technology Support Systems for Teachers	20
2.7. History of Educational Technology in Turkey and the FATİH Proje	23

2.8. Successful Projects of United States and Other Countries in Integrating Technology in Mathematics.....	27
2.8.1. Technology integration projects	31
CHAPTER III: RESEARCH METHODOLOGY.....	35
3.1. Research Design.....	35
3.2. Purpose of the Research.....	37
3.3. Research Approach	37
3.4. Research Philosophy	38
3.5. Research Technique	39
3.6. Data Collection Techniques	40
3.7. Exclusion and Inclusion Criteria.....	41
3.8. Justification of the Research Method.....	43
3.9. Data Analysis Technique	44
3.10. Limitations of the Research	44
CHAPTER IV: RESEARCH FINDINGS AND DISCUSSION	46
4.1. Technology integration through FATIH project.....	46
4.2. Advantages and disadvantages of integrating technology in Mathematics' classroom for the Students	51
4.3. Advantages and disadvantages of integrating technology in Mathematics' classroom for theTeacher	56

4.4. Essential steps to train mathematics teachers for technology integration in mathematics classroom	60
4.5. Meanings of Successful Technology Integration in Mathematics Teaching	63
CHAPTER 5: CONCLUSION AND RECOMMENDATIONS	67
5.1. Summary	67
5.2. Conclusion	69
5.3. Recommendations.....	71
5.4. Recommendations to Future Research.....	77
APPENDIX.....	82
REFERENCES.....	89

Technology Integration in the Mathematics Classroom and the FATIH Project

CHAPTER I: INTRODUCTION

1.1. Research Background

Many education reformers have advocated the use of modern technologies under the assumption that it has the potential to profoundly shift the focus of mathematics education from facts and procedural thinking to problem solving, reasoning, and reflective thinking; from paper-and-pencil computation to model building and conceptual learning; and from verbal, static mathematics to a rapidly evolving new mathematics that is highly visual, dynamic, and interactive (Kaput, Hegedus, & Lesh, 2007). Technology is promoted as a way to produce a meaningful view of mathematics. It offers novel means to carry out mathematical activities, as technology can be a “thinking tool” that facilitates mathematical investigation and concept development by enlarging opportunities to “play” with mathematics (Filho & Manaos, 2012). The encouragement for technology integration in teaching and learning mathematics is also reflected in recommendations from numerous organizations such as the Conference Board of Mathematical Sciences, the International Society for Technology in Education (ISTE, 2007, 2008), the Mathematical Sciences Education Board, the Mathematical Association of America, the National Council of Teachers of Mathematics, and the National Council for the Accreditation of Teacher Education. As stated in the “Technology Principle” of the NCTM’s six principles for high-quality mathematics instruction, “Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students’ learning” (NCTM, 2000).

Since teachers are seen as key agents for accomplishing the reform-oriented goals of technology integration in teaching, attention to teacher learning and practice associated with educational technology has dramatically increased. A number of studies indicate that, under supportive conditions, teachers' sustained use of technology encourages a student-centered teaching and learning environment. Yet, typical uses of technology tend to merely complement traditional teaching instead of making fundamental changes to the dominant teacher-centered instructional paradigm. Despite the widespread availability of technology in schools and the considerable effort to provide teachers with adequate concepts and skills for teaching with technology, many teachers fall short in their use of technology in the classroom (Plair, 2008). Too few teachers feel adequately prepared to use technology for instruction, regardless of the teachers' beliefs about their effectiveness and professed desires to use it (Casey, 2010).

Teachers need to experience education with technology in order to teach successfully using technology (Shafer, 2008); however, having this type of experience does not guarantee that they will use technology or know how to use it effectively for mathematics instruction. The complex process of teaching mathematics with technology, which involves rethinking the format of activities and what counts as an acceptable explanation and solution, is challenging for teachers and can inhibit their using technology in their classrooms. In addition, teaching with technology depends on a multitude of factors that affect teachers' practice in a unique way (Stein, Remillard, & Smith, 2007). As a result, many researchers have sought to examine and identify both opportunities and barriers to teachers' use of technology for instruction in order to better understand the complexity of their practices and to provide some explanation for their

difficulty in implementing technological tools in a meaningful way. However, the field's understanding of how these factors affect actual technology integration at the classroom level is deficient. In light of increased calls for more sophisticated integration of technology into classrooms, discussions about the successful use of technologies permeate the discourse in mathematics education (Kersaint, 2007). While researchers continually seek out “appropriate” and “effective” technology integration, these words are now taken for granted, as they have become a mandatory attachment to almost every study associated with technology integration (Cady & Rearden, 2009).

Yet, little research on educational technology appears in mathematics education literature, especially research that addresses actual teacher accounts of technology utilization and the complex nature of their working lives that inform these accounts. Although a number of researchers have provided some guidelines for meaningful uses of technology in mathematics teaching (Garcia et al, 2006), to date, a comprehensive picture of meaningful uses of technology in mathematics teaching is lacking. Hence, little is known about what it means to teach appropriately and effectively with technology.

1.2.Problem Statement

Education and learning is an important part of an individual's life. These factors play immensely valuable role in the development of an individual and play their part in shaping the life of an individual. Education sector in Turkey is governed by a national system. This system is designed in a way to produce skillful professionals so that they in turn can provide their services in the economic and social institutions of the country. In Turkey, primary education is compulsory for the children between six and eighteen.

Primary and secondary education is free in the public schools in Turkey. The system of secondary education can be classified as General high Schools and Vocational and Technical high schools. Adaptation of innovative technologies and methodologies in education and in classrooms ensures interactive, effective, and efficient learning and it also lends a helping hand to students to develop understanding in a practical and profound way. To do the same, the Turkish government has started a special project designated the “Movement of Enhancing Opportunities and Improving Technology”, also known as FATİH. This project is considered as one of the most significant investments that the Turkish government has made in the field of education. The aim of this project is to introduce the concept of smart class and implement it in all the schools around Turkey. With the help of this project almost 42,000 schools and 570,000 classes will make use of the latest technology to gain information and to understand the concept. Through the FATİH project, technology can be integrated in mathematics teaching. The purpose of this research is to explore the integration of technology in teaching mathematics. To achieve this purpose of the study, various projects would be evaluated in United States and other countries.

1.3.Purpose of the Research

The purpose of this research study is to analyse the advantage and and disadvantages of integrating technology in Mathematics’ classroom for teachers, students and administration of an educational institute and to explore the essential steps that are to be taken to train mathematics teachers so that they can integrate technology in their teaching. This research study will also deal with different ways through which

technology can be integrated and incorporated in the mathematics classroom through different projects all over the world. Mainly the project of Turkey that is FATİH project is discussed in this thesis. One of the main purpose of this reserch work is to analyse and understand the concept how various projects in United States and other countries have been successful in integrating technology in mathematics.

1.4.Research Questions

Research in this study utilized the qualitative research methodology and, through this method, research has acquired the available secondary information regarding the advantages and disadvantages of integrating technology in Mathematics' classroom for the teachers, students and administration of an educational institution; steps that are important to train mathematics teachers so that they can integrate technology in their teaching; different ways through which technology can be integrated in the mathematics' classroom through the FATİH Project in Turkey; and various projects in United States and other countries that have been successful in integrating technology in mathematics. As according to Saunders et al., the research questions basically initiates from the main ideas and information related to the research which is much more able to attain the significant research objectives. In order to achieve the objectives of this research, the main research question of this thesis is:

1. What are the advantages and disadvantages of integrating technology in the Mathematics' classroom for the teachers and the students?
2. What are the essential steps that need to be taken to train mathematics teachers so that they can integrate technology into their teaching?

3. What are the ways through which technology can be integrated in the mathematics' classroom through the FATIH Project in Turkey?

1.5.Rationale of the Study

The topic “Technology Integration in the Mathematics Classroom and the FATIH Project” has been chosen for this research work because it is considered as the one of the most important and vital topic and there are also not that much research are available on this particular topic. The motivation to undertake this research came from the concept that the use of technologies is increasing with the passage of time. Different researches mentioned that teachers and instructors also use technology in their classes and they also considered technologies as a useful source to educate their students in an effective and efficient manner. The integration of technology in the mathematics classroom is very effective for both teachers and students. Different projects are offered by different countries in order to integrate technologies in the mathematics classroom of the school. This research study offered and provided that detailed information regarding the technology integration and different projects related to the technology integration from all overall the world. The research is mainly focusing on the FATIH project of Turkey for the technology integration in the mathematics classroom. As it is noticed that this research is very significant, therefore, with the help of this research study, the researcher will be able to investigate the impact of different technology integrations in the mathematics classroom on students and teachers as well.

1.6.Outline of the Research Strategy

As, this research has been conducted for the academic purpose the research experiences different issues in accomplishing reliability and validity procedures of the research study. Allocation of proper steps would surely have allowed the researcher of the study to complete the research work in more significant and effective way. However, the following steps are used for developing the complete research report:

- Identification of problems, aims and objectives of the research.
- Searching for relevant literature review and past researches.
- Selecting proper research methodology for the research.
- Collection of qualitative data and information for the research study.
- Processing of quantitative data.
- Analysis of Qualitative data with the help of content analysis method.
- Presentation and discussion of the relevant collected data from the research work.
- Writing proper conclusion and recommendations related to the research.
- Final step of the research strategy is the writing of the final thesis.

1.7.Significance of the Research

With the research study undertaken and finished, it shall assist the researcher of the study to understand and comprehend the concept related to the technology integration in the mathematics class room and mainly it will analyze different projects like FATIH project to integrate technology in the classroom. Additionally, the research study would also be capable to analyze and give out precise and concrete conclusion regarding the

different factors, measures, tactics, and steps and strategies could be implemented and adopted in order to integrate technologies in the mathematics classroom.

1.8. Structure of the Research

The structure of the thesis of this research study is:

Chapter 1 examines the research background, aims and objective. It also highlights the key questions of the research on which the assumptions of research can be made.

Chapter 2 emphasizes on the important reviews of past literatures and different theories that are relevant to the aims and objective of the research.

Chapter 3 highlights the methodology of the research including research design, approach, philosophy, techniques of data collection, sampling, and data analysis related to the aims and objective of the research.

Chapter 4 offers the in-depth information regarding the attain data from the research and detailed analysis of the research were also done in this chapter.

Chapter 5 emphasizes on the conclusion of the research and suggestions for further researches on the identical area of study.

CHAPTER II: LITERATURE REVIEW

According to the National Council of Teachers of Mathematics, technology is critical to both the teaching and learning of mathematics. It influences not only what is taught but also enhances student learning. This literature review begins to uncover and explore accounts of successful uses of technology from the viewpoint of mathematics teachers. It also examines their methods of technology integration in the classroom and different factors that shape their practices. This study seeks to understand the complex and dynamic nature of teachers' views regarding what it means to successfully use technology in their mathematics classrooms and the factors that influence these views (Burgess, 2007). This study drew on literature from three main areas: (1) accounts of teachers' technology practices in the mathematics classroom, (2) the use of technology in mathematics education; and (3) factors affecting educational technology integration. The following subsections briefly elaborate theoretical contributions from each literature domain, while the last subsection provides the conceptual framework for the study derived from all domains (Ball et al, 2008).

Technological environments offer novel ways to carry out mathematical activities (Laborde et al., 2006; Zbiek et al., 2007), particularly those associated with visualization, symbolization, intuition, and informal reasoning. The integration of technological tools in teaching potentially produces a new kind of mathematics and changes the way that mathematics is taught. In order to elaborate upon the relationship between the use of technology and the teaching of mathematics, I review the role of technology in mathematics education. I then explain how technology promotes changes in mathematics education and how its capabilities are limited. I also provide information about

technology integration in teaching mathematics with the focus on some technological tools that are often used in mathematics classrooms.

Finally, I will summarize educational technology for mathematics in Turkey and examine the technology use for mathematics for different countries.

I obtained articles for this literature review from the University of Maryland Library, utilizing the EBSCO host. Databases accessed include ERIC (Educational Research Information Center), Education Research Complete, and Academic Search Complete.

2.1. The Role of Technology in Mathematics Education

Traditionally, mathematics has been presented via various interrelated forms of physical actions or actual objects, static graphs or diagrams, signs or symbols, and statements in a rigorously well-organized deductive system. These different forms are rooted in the view of mathematics as a finished product, an infallible record of knowledge, or a conglomerated mass of signs, symbols, or disciplines. Given such a view, it is not surprising that school mathematics has long been taught in a teacher-directed manner where teachers require students to memorize mathematical rules and facts.

Nonetheless, the purported outcomes of the traditional ways of mathematics teaching have become a controversial issue. For example, several research studies argue that students do not gain what teachers have to offer from direct teaching because, in such an isolated fashion, the axiomatic systems used for introducing mathematical concepts may be at a level beyond the students' understanding. The increased concern about the

quality of mathematics education results in an attempt to bring more meaning and understanding to mathematical concepts rather than to emphasize their abstraction. This attempt, in turn, gives rise to the current reform movements that urge a meaningful focus and view of mathematics as a fallible construct and a product of human creation as opposed to a fixed artifact of disciplines and a precise technical language. One of the most important catalysts for the mathematics education reform movements is the growing availability of powerful technology (Van der Sandt, 2007).

Changes in mathematics and mathematics education interacted, and continue to interact, with changes in the technology itself. As several authors claim, sophisticated technology helps simplify mathematical calculations and representations in ways that supplant unnecessary and tedious calculations, the rote memorization of rules and facts, the drill and practice of mathematical skills, and the traditional teaching method of routinization by higher-order thinking activities. The impact of technology on mathematics education involves a shift in content focus from mathematical facts and procedural, deductive thinking to problem solving, reasoning, and deeper mathematical thinking; from paper-and-pencil computation to mathematical model building and conceptual learning; and from verbal, static mathematics to rapidly evolving mathematics that is highly visual, dynamic, and interactive (Kaput et al., 2007). Hence, technology is a medium for approaching mathematics differently from what is traditionally done (Arcavi, 2003). It transforms what mathematics is as well as how it can be taught and studied. In addition, technology can alter the order and the significance of different mathematical content areas taught in schools, as it allows more complex calculations and more concrete ideas to occur. Technology-supported mathematics can also be easily connected to other

disciplines and to real-world situations due to the ease and flexibility of dynamic, meaningful representations and inductive explorations that technology offers.

Accompanying the content shift is a pedagogical shift from direct teaching to more active engagement of students, as well as to increased student-student and teacher-student interactions. The interactive nature of technology provides natural situations for this transformation by setting the stage for investigation, reflection, interpretation, concept development, and further action while students react to technological tools and play with mathematics. Therefore, technology is a thinking tool that offers ways to radically alter mathematics and mathematics education in students' lives. Unsurprisingly, the current reform efforts advocate the use of technology as an approach for transforming the view of mathematics and its teaching. The underlying assumptions of this movement are that technology has the potential to make students actively engaged or to intrinsically motivate students to engage in mathematical thinking and learning (Zbiek et al., 2007), to provide students with opportunities to experience the real mathematical activities that mathematicians do, to de-center classroom authority from the teacher and the text to individual students, to promote students' reflective thinking, and to enrich students' mathematical thinking and understanding (Zbiek et al., 2007).

2.2. Affordances and Constraints of Technology in Mathematics Education

Technology serves a vital role in facilitating a combination of physical manipulations of mathematical objects, graphic visualizations, as well as numeric and symbolic representations through its dynamic, interactive environment that promotes more engagement with, and deeper understanding of mathematics. Its dynamic notations

and flexible human-computer-interaction interfaces also support students' mathematical explorations, explanations, communications, and understandings and, in turn, offer holistic grasps and intuitive, inductive understandings of mathematics (Konold & Lehrer, 2008). Given that the development of high-level theoretical concepts of mathematics rely on the fallible processes of intuition and inductive thinking, which are the processes that mathematicians use as they strive to derive their concepts, technology clearly offers a powerful way to foster mathematical thinking and learning. In other words, technology not only supports intuitive understanding or inductive reasoning, but also offers the basis for building formally presented deductive arguments. Several affordances of technology enable deep changes in the experience of doing and learning mathematics. The main affordance is the unique potential of technology for representations that bring into play the dynamic, interactive, animate, linked, and multiple representation capabilities of technological displays (Kaput et al., 2007).

Technology allows users to flexibly represent a mathematical concept in different systems, incorporate these various representation systems into the teaching and learning of mathematics, and interpret the relationship among the representations (Zbiek et al., 2007). Different representations (e.g., equations, tables, numbers, symbols, and graphs) of the same concept provide different aspects of the concept and refer to different approaches (e.g., graphical, algebraic, and numeric approaches) for acquiring the idea. As a consequence, the representational affordance of technology potentially helps students explore various approaches that give meaning to the same mathematical idea, encourages them to connect different representations of the concept, and hence supports them in achieving a robust understanding of that concept (Zbiek et al., 2007). In addition, the

significant feature of interactive linking across different representations of data in most educational technologies externalizes the thinking processes and makes them explicitly available for analysis, modification, reflection, and discussion (Zbiek et al., 2007). These external representations make it possible to explain the processes of mathematical thinking and consequently to scaffold the development of students' understanding through the off-loading of routine computations to technology, so that the emphasis can be placed on more meaningful aspects of mathematics.

Multiple linked representations provided in the dynamic and interactive environment of technology also offer a means to engage students in conceptual conversations about mathematical solutions, relationships, and concepts, which in turn promote deeper understandings of mathematics. In this case, technology makes mathematical phenomena become visible to the class and thus encourages teachers and students to share their mathematical experiences in the social space of the classroom (Kaput et al., 2007; Zbiek et al., 2007). However, the extent to which technology can foster mathematical thinking and learning is limited. Affordances of technology may serve different forms of mathematics that are manipulable, visual, and symbolic in a naturalistic and inductive way, but they do not directly support the well-organized deductive system in formal mathematics. Moreover, intuition or induction supported by a technology-rich environment is preferable to deduction and may inhibit the need for formal, deductive thinking in mathematics due to its features of common sense and obviousness.

2.3. Accounts of Technology Integration in Teaching Mathematics

The research on integration of technology into teaching has suggested that teachers' knowledge of technology is intertwined with their knowledge of both pedagogy and content. To establish a conceptually based theoretical framework for informing and guiding teachers' practice in technology use, a group of researchers has advocated the development of a body of knowledge based on Shulman's (1986, 1987) identification of "pedagogical content knowledge" (PCK), extending it to include the integration of technology. This extended body of knowledge is introduced with different terms, such as "PCK of educational technology", "ICT-related PCK" (Angeli & Valanides, 2005), "technological content knowledge" (Slough & Connell, 2006), and "technological pedagogical content knowledge" (TPCK) or "technological pedagogical and content knowledge" (TPACK) (Mishra & Koehler, 2006). Regardless of the term used, effective teaching with technology requires teachers to develop an understanding of, a fluency with, and a cognitive flexibility not only in each of the three domains of knowledge (i.e., content, pedagogy, and technology), but also in the associations of the three domains, so that teachers can provide context-specific, content-based teaching strategies and representations for their students (Harris, Mishra, & Koehler, 2007).

However, the existing views of PCK extended to include technology integration do not point to a rigid solution for appropriate and effective uses of technology in teaching (Harris et al., 2007). A number of studies have provided some broad guidelines for the successful use of instructional technology. For example, most frameworks for technology utilization in teaching proposed in the literature emphasize a progression from teacher-directed to student-centered activities (e.g., Hall & Hord, 2006).

In these frameworks, successful integration of instructional technology is deemed to involve the employment of technology as a tool for supporting and extending students' understanding of subject matter; a medium for helping students solve authentic, real-world problems; and a facilitator for restructuring the curriculum to reflect technology-based educational reform goals. In addition, the reviews of literature by Ferdig (2006) and Hooper and Rieber (1995) also propose various principles to guide successful technology-based teaching on the basis of these perspectives. Some authors have provided further details by identifying key characteristics of appropriate and effective technology integration in mathematics education. Studies conducted by Garofalo and colleagues identify the following features as proper technology uses in mathematics instruction (Ball & Forzani, 2009):

- introducing and illustrating technology in the context of meaningful content-based activities;
- addressing the worthwhile nature of mathematics with appropriate pedagogy;
- taking advantage of technological capabilities to enhance competence in teaching and learning;
- interconnecting mathematical concepts as well as connecting mathematics to real-life situations; and
- incorporating various representations of mathematical concepts.

In the context of geometry, Powers and Blubaugh (2005) noted the following practices as appropriate uses of interactive geometry software:

- recognizing potential uses of the software for each geometry course (e.g., successful uses of the software can reinforce geometric properties in students'

minds, the interactive component of the software allows students to see geometric properties),

- having students discover geometric concepts by taking advantage of the software capacities (i.e., creating a student-centered learning environment); and
- transferring the knowledge acquired through the software to problem situations that are not bound to any technology-based context.

Nevertheless, it is surprising how little research in this area appears in the literature. Many studies call for the successful use of technology, while only a small number of research studies have made extensive efforts to define the features of such a use. Contemporary dialogues mainly focus on preparing teachers with adequate knowledge for technology-based instruction rather than defining key characteristics required for the meaningful integration of technology in teaching mathematics. Moreover, these features seem to be diverse, impractical, and often ambiguous. Thus, research in the field still “struggles to tackle the complexity of the integration of the evolving technologies”. To date, there is no consolidated view of how to integrate technology appropriately or effectively into mathematics teaching (Alexander et al, 2007).

2.4. Framework for Technology Integration in School Mathematics

The aforementioned literature provides a helpful discussion of some specific constructs for the use of technology in mathematics education. First, scholars have suggested that the features of successful technology integration in mathematics education include the practices of introducing, illustrating, and taking advantage of technology in order to:

- incorporate multiple linked representations of mathematical concepts and interpret the relationship(s) among these representations;
- facilitate the development of formal mathematics through intuitive, reflective thinking and learning;
- provide opportunities for constructive learning, social collaboration, and conceptual communication;
- interconnect and transfer the acquired knowledge via technology to mathematical concepts; and
- link the acquired concepts to real-world situations.

Second, scholars have recommended that mathematics teachers use technology in their classroom to:

- create a student-centered teaching and learning environment and
- enhance their existing, traditional teaching practice.

Finally, scholars have indicated two categories of factors that influence teaching with technology:

- Factors directly related to teachers (e.g., their knowledge, experiences, and pedagogical beliefs); and
- Factors associated with teaching environments (e.g., time and opportunity, support in schools, learning communities).

2.5. Technology as a Pedagogic Cultural Artifact

Results illustrate teacher accounts of technology practice that portray the complex interrelationships among different aspects of teachers' knowledge of mathematics,

pedagogy, and technology, and their relationships to social and context-bound classroom practice (e.g., equity in education, relationship with colleagues, support from schools and districts, class size, curriculum and social pressure, teachers' personal life, etc.). Indeed, this complexity suggests that it is critical for teachers to come to view technology as a “pedagogic cultural artifact,” whose usefulness in mathematics teaching is simultaneously thoughtful and adjustable based on social interaction and pedagogical content knowledge. As Matthew argued, Part of the role of technology in the classroom is deciding when technology is important. You know, you're not just always gonna use technology. And, so as a teacher you have to decide, you know, I need to teach my kids, when is technology important? The act of teaching is situated in social and physical contexts, and distributed across individuals and tools (Jacobs et al, 2007).

Similarly, technology is not neutral. Its affordances, constraints, and biases make some technological tools more appropriate for some circumstances or certain mathematical ideas than others; hence, knowledge about mathematics, pedagogy, and technology is essential but cannot be separated from teaching contexts. Therefore, technology can productively be viewed as a pedagogic cultural artifact, whose use in teaching and learning mathematics is dynamic, changing over time, and dependent on the distinct contexts of teachers' experiences, social settings, and interactions with others. To be concise, there is a need to view technology as both a cognitive tool “that helps transcend the limitations of the mind . . . in thinking, learning, and problem-solving activities” and a cultural infrastructure developed in response to particular social systems (Kaput et al., 2007). When considering how to appropriately or effectively integrate

technology into mathematics education, technology needs to be re-positioned from a catalyst for change to a pedagogic cultural artifact.

2.6. Technology Support Systems for Teachers

The meanings teachers associated with the successful use of technology varied depending upon the ways that they chose to implement technology in their classrooms, and these implementations were, in turn, limited by many factors associated with the subjective characteristics of teachers and their working environments. One important factor that yields a positive association with teachers' use of technology in teaching practice is professional development, especially when it helps teachers become more familiar with and competent in different software and hardware tools to teach mathematics. Nevertheless, results show that teachers do not have adequate training on technology-based teaching, in general, and on the appropriate use of technology in mathematics teaching, in particular. Not surprisingly, and despite considerable money put into the educational system to provide technology resources in schools, many teachers feel unprepared to incorporate technological tools into their instruction, and many who do integrate them fall short in their ability to meaningfully use the technology in the classroom or to transform their teaching of mathematics (Larreamendy-Joerns, J., & Leinhardt, 2006).

Thus, the results raise a call for professional development to deepen teachers' subject matter with respect to technology. As Matthew argued, What I think teachers need to know how to do with technology is figure out ways to use it that will help their kids learn mathematics in a good way you know and so but to be able to do that you have

to learn how to use the technology, on one hand, but you also have to learn the math at the same time I mean some teachers are very weak in the math. As with other studies providing support for extensive and content-focused professional development, the findings in this study suggest that more extensive, content-focused professional development with technology would have beneficial effects. Professional development that affects teachers' knowledge appears to reinforce their teaching practice (Sowder, 2007).

Simply telling is inadequate to support teachers in building the necessary knowledge and skills for the effective integration of technology into their teaching. To make thoughtful pedagogical use of technology, teachers must develop "an overarching conception of their subject matter with respect to technology and what it means to teach with technology" (Niess, 2005, p. 510). One way to help deepen teachers' knowledge of mathematics with respect to the use of technology may be to engage them in explicit discussions about the appropriate use of technology in teaching mathematics. The findings of this research also raise questions for the issue of equity, a problem that is often ignored in professional development (Leavy, 2006). Many factors can inhibit teachers' participation in technology-based professional development.

The aforementioned analyses suggest that some of these factors include availability of technology resources, school support, teaching domains, curricular materials that teachers use, teachers' length of teaching experience, social pressure, and time. These factors vary from teacher to teacher and from school to school. Thus, perhaps, one of the greatest challenges facing technology-rich professional development programs is providing quality professional development for all teachers in all schools. A

starting point toward ensuring equity may be to gain an awareness of the inequities that can be created when learning opportunities are inequitably offered to teachers. The factors listed above also warrant further consideration when deciding upon technology-based professional development programs. As Loucks-Horsley et al. (2003) argue, professional development is complex and involves multitudinous and complicated factors related to changing knowledge and beliefs, context, critical issues, and strategies that support and influence professional development, which is dynamic in nature (Leavy, 2006).

By failing to address or to take into account these important factors relevant to professional development with technology, such programs may not be effective. The results from this study thus reinforce what other researchers have suggested about the coherence of professional development with other influences on teachers' practice, and at the same time point to the need for more complex analyses of additional factors affecting professional development and practice. The findings suggest that technology-based professional development projects should take these factors into account when planning, implementing, and evaluating professional development and other interventions. Specifically, it is important for professional developers to understand what works for which groups of teachers and stakeholders under what circumstances. In addition, closer investigation reveals other issues about teaching conditions that can inhibit the use of technology for creating and facilitating student-centered learning (Leavy, 2006).

For example, the aforementioned findings indicate that the issues of limited access to technology in schools and large class sizes hinder teachers' efforts to use technology in classrooms or force them to use it in a way that does not require students to

have much technology access (e.g., only using technology for demonstration in front of the classroom). School or district support, although promoting the use of technology in schools, does not seem to substantially enhance technology use for facilitating student-centered environments. Thus, findings in this study address the need to revisit the design of support systems, activities, and policies that are provided to teachers. Not only must professional developers be aware of the obstacles that can be created when professional development opportunities are offered to teachers, but school, district administrators, policy makers, and other stakeholders must also take these issues into account in order to promote appropriate and effective integration of technology in mathematics classrooms.

2.7. History of Educational Technology in Turkey and the FATİH Project

The notion of making use of an array of technological advance for educational purposes dates back the founding years of the modern Turkish Republic which has a vision to modernize the country's education system. Turkish government began to emphasize the use of technology in primary and secondary schools alike. Turgut Ozal, the then Prime Minister of Turkey, remarked that the government was going to distribute a million microcomputers to schools around the country over a period of the next ten years. Prior to the FATİH Project, this was the country's most ambitious and expensive educational program with an estimated cost of USD \$600 million. In the year, 1984, the Ministry of National Education(MNE) began a pilot program that would test the use of computerized education at 24 universities. 750 teachers from a variety of schools were given training on how to integrate curriculum with computer. For this, the government provided 2400 computer were disseminated to 121 secondary level schools. Evaluation of

the project was termed as feasible, following which the MNE enter an agreement with nine computer manufacturing companies to kick-start the government's program to modernize education. The companies under contract were tasked with the development of coursework packages and to impart training and knowledge to teacher that would be using the coursework packages during the academic year of 1989-1990.

The General Directorate of Educational Technologies (EGITEK) was established in 1992 under the responsibility of MNE. EGITEK had the objective of integrating educational technology in schools, training teachers and making improvements in the existing computer-based curriculum. EGITEK was also responsible for supplying educational content such as graphs, pictures, videos, audio and excerpts and other interactive material such as internet radio and television. The year 1995 saw the MNE collaborate with the Scientific and Technical Research Council of Turkey (TUBITAK) to design and develop educational software Turkish language, history, science and geography. By 1999, all schools and universities in Turkey had been linked through the Internet, courtesy of MEBSIS. MEBSIS allowed institutions to share information in an efficient and timely manner among teachers, principals and students. In 2003, the MNE reached an agreement with the Turkish Telecommunication to string together the 42,534 educational institutes all over the state using DSL. This project was able to integrate 20000 institutes and 300,000 computers to the Internet which represents 86 percent schools and provided 95 percent of the students with the facility of DSL.

The ministry also works closely with multinational firms to increase the use of the Internet and computers at schools. The ministry's agreement with Intel Corp. is one such example through which the government has introduced the educational portal called

“Skool” for mathematics education. Also in 2009, 1:1 eLearning known as one computer per child has been taking place in Kocaeli, which is sponsored by Kocaeli Metropolitan Municipality with support from Intel Corp. In each year from 2009 through 2011, the government distributed 27,000 computers to students and their teachers. The teachers also had professional development courses which included three-hour training on basic ICT skills.

The FATİH project signals the initiation of a new era of educational innovation in Turkey. The Turkish Prime Minister Recep Tayyip Erdoğan inaugurated the program at the beginning of the second academic term in Turkey in the 2011-2012. The test phase of the revolutionary project has gathered favorable reviews from educators and was launched when smart boards and tablets were distributed to 52 schools all over the country. The Prime Minister, at the inauguration ceremony, compared the project to the Middle Ages when Fatih Sultan Mehmet (the leader after whom the project is named) conquered the city of Istanbul in 1453. The program is seen as a gateway to a modern and technologically advanced education system in Turkey, leaving behind the conventional system that was previously employed. The FATİH project aims to expand its benefits to all areas associated with the educational system in the country and would help mold the educational system in Turkey by altering the means of imparting information and align the children with the rapid pace at which the world is changing.

The implementation of the FATİH project saw students manifesting excitement seeing their teachers introducing them to the newly employed tablets and smart boards at the 52 schools. In the first phase of the project, high schools have been provided with smart boards along with the 12,800 tablets in 17 different provinces. The project has been

deployed in the provinces of Balıkesir, Ankara, Erzincan, Diyarbakir, Hatay, İzmir, İstanbul, Erzurum, Kayseri, Karaman, Mersin, Samsun, Kocaeli, Yozgat and Usak.

The FATİH project is estimated to cost approximately TL 3 billion (approximately \$1.6 billion), which would be paid for from the Government Budget. This amount highlights the single largest resource allocation (in terms of funds) for educational improvement in modern Turkish history. The FATİH project would eliminate the use of textbooks with students being able to access their course texts through their tablets.

The FATİH program would be employed in 570,000 classrooms in 42,000 Turkish schools. The smart board technology would allow teachers to browse and project information on the interactive device installed in the room. Another technological benefit of the program would be the ease of imparting education through the distance-learning program. Students would be able to receive course texts and materials on their tablets and would be able to study without having to be physically present in class. The tablet also has a protection system that locks the device permanently if it is not connected with a smart board for two weeks. This ensures that no information is stolen or copied. This is also the final component of the program that guarantees protection of the network from cyber-attacks.

The use of technology in the FATİH project would enable students to understand the basics of the subjects from an early stage in their educational life. Elementary mathematics, which involves basic mathematics and algebra, can be taught using the interactive smart board. Students can learn through visual representation of the problem on the board. For secondary students, visual representations may vary, however they

would have the same impact on the learning of students. With students being provided tablets, information would only be a touch or a swipe away. Students can gain access to the course material by browsing through a class group formed and moderated by the teacher. In case a student fails to solve a mathematical problem at home, he/she can login to the class group and review relevant or assistive text to understand and execute the problem at hand.

2.8. Successful Projects of United States and Other Countries in Integrating Technology in Mathematics

The National Council of Teacher of Mathematics (NCTM) in the United States is known to have set the revolution for mathematics education reforms in motion in the country. The quest to integrate technology in mathematics education in the United States began in the mid 1970s. The movement began by highlighting the benefits of technology and how it can be used effectively to attract children toward mathematics by breaking free from the conventional methods of teaching. The aim of the movement was to only instill technology in math classrooms but also to provide teachers with the opportunity to move in alignment with the rapidly changing teaching environment. The efforts of the NCTM were recognized and appreciated by the federal government.

Technology motivates the students towards learning with enabling them to complete their tasks without requiring any sort of pencil or paper. It also generates innovative and creative capabilities in students for solving their problems within a risk free environment of learning and exploring the world of mathematics. The findings of this research revealed that Mathematics students have the quest for knowledge, and they

become active and sensible learners with this mode of technology integration (Kozma, 2003). The analysis of data in this regard is based on the secondary research that yields the impact that students are greatly assisted in their learning phase with the use of tablets in their mathematics classrooms. Throughout the United States of America, students and teachers have been developing this technology based education practice based on the opportunities this technology offers to the mankind. Based on the research, there is an increasing body of supporting evidence towards the potential impacts of technology in improving the student's outcomes and enriching the learning experience. Using technology yields positive impacts in motivating the students, together with their interaction and efficacy towards solving the mathematics problems (Kozma, 2003).

The analysis process includes the understanding of students' experiences, backgrounds, and their personal characteristics. It helped in evaluating the factors that are the most challenging for both the students and teachers. Students were observed to suffer with the solutions of mathematical problems at their own. The questions they were posing reflected the nature of their problems, and the extent of their learning attitude. The tests conducted without letting them use technology yielded conflicted results (Law et al., 2000). Students were not able to rectify the concepts behind the problems as they focused on calculations. These aspects urge the integration of technology in the math classrooms so that students might think critically towards the problems.

Based on the data collected in this regard, it is observed that the test outcomes of students are much improved as compared to the expected ones. This technology integration in secondary classrooms provides the students higher level of understanding of the complicated problems of mathematics. This response supports the idea that

technology does not make the students lethargic, but it helps them in manipulating and linking various representations as their main focus is on concepts instead of calculations. The critical thinking of students is found to be developed (Means et al., 2001). The results of focusing on a single tool in the classroom such as iPods, interactive whiteboards, mainly tablets are found supportive in a considerable manner. A pilot study based on the solution of algebraic sums was conducted. Students were given the assistance of tablets for solving their problems rather than their textbooks for their guidance. The academic results were brilliant with substantial effects on their achievements as students felt motivated and engaged in the entire learning process. Using tablets captures the attention of students and they are capable of understanding the concepts of mathematics that come alive with the aspects of technology as compared to the traditional text of books (Means et al., 2001).

The research findings related to the successful projects of technological integration in the mathematics classroom identified that, the technological integration in learning processes emphasizes the processes of connectivity and collaborative efforts among the students and teachers. The development of the learning environment is considerably supported by the integrating of technology within the classrooms. Most of the students of USA have their tablet with them. They need to utilize their technological innovations in a creative manner. These are not for entertainment and amusements only, but they are full of the benefits and advantages associated with learning and knowledge building applications (Bransford et al., 2000).

The tablets are being used in more than one and a half million educational institutions of the world, including more than thousand programs based on one-to-one

access of tablets. These institutions have been focusing on the fact that technology provides the best solution towards problems-based learning. However, the institutions that do not use tablets in their mathematics classrooms are of the view that they do not want their students to play games on their tablets rather than learning as they cannot supervise them by keeping track of tablets' use. Using tablets make the students independent and they do not pay heed to the instructions of their teachers during the class. Therefore, teachers make their students learn the calculation of mathematical problems rather than the concepts behind those solutions by using paper and pencil. According to research, the possible threats or worries associated with the technological integration in the classroom need to be limited (Bransford et al., 2000). For better utilizing, the advantages of technology, tablets are set with certain limits as students cannot download the content that will divert their concentration from studies. All the tablets are installed with the software packages of Class link and Curriculum Loft that facilitates the students and maintain the teachers' trust in students. These tablets are definitely the replacement of desktop and laptop computers; therefore, they come up with limited but productive software installed. If the students are asked to generate the geometric form of any complicated thing, they are at ease of searching the relevant material and elaborate the questioned theme in a better way. The tablets provide them feasibility of searching, defining, and calculating, analyzing and even plotting the generated results. Students show their results to their teachers with the best way of presenting their efforts, where they are easily guided, and all their errors or flaws are easily rectified.

The educational institutions that limit the use of tablets to certain applications are actually putting a limit it to the true potential of tablets in assisting the learning process. As all students are working over the similar problems of mathematics, they are going to think in different ways; therefore, all of them will reach the desired solution with the help of different tools and techniques. If the applications are limited, this will not generate innovative and creative capabilities in the learners (Schofield and Davidson, 2002). They cannot become independent learners in a synchronized environment, but they require critical thinking for solving the problems of mathematics. Once the students are trained to use tablets for their educational concerns, mainly the solutions of mathematical problems, they will develop competitive skills meeting the technological demands of the society. These technological aids have been serving the educational institutions in a substantially positive manner with increased engagement of students in learning practices (Means et al., 2001).

2.8.1. Technology integration projects

Some of the successful projects of United States and other countries in integrating are given in this section. The integration of technology in the learning processes and procedures focuses on the overall complete processes of the connectivity and collaborative efforts among the students and teachers of the school. The development of the learning environment is considerably supported by the integrating of technology within the classrooms. Most of the students of USA have their iPods; tablet and iPads with them. They need to utilize their technological innovations in a creative manner. These are not for entertainment and amusements only, but they are full of the benefits and advantages associated with learning and knowledge building applications (Harris, Mishra

and Koehler, 2009, pp. 393-416). Different projects are introduced in United States of America for the integration of technology in the mathematics classroom. There are different technology integration projects available in the United States. United States is considered as the big and diverse place with a much-decentralized system of education. The decisions regarding the purchasing of technology are not made at the national level, but these decisions are made at the state level, or more frequently made at district level, which tends to complicate the attempts of other countries in order to utilize the tablets and laptops for educational purpose against United States. The most famous project of US is the BYOT (Bring your own technology). It is perhaps also worth mentioning that many school districts the U.S. are increasingly promoting “bring your own technology” (or “BYOT”) initiatives (also known as BYOD, or “bring your own device”) as a way to increase the access to laptops and tablets within schools, which raises sets of additional questions worth considering related to things like (among others) equity, costs, maintenance and digital safety (Ballagas, Rohs, Sheridan and Borchers, 2004). Another successful project of United States of America is the PTMT project. The “Preparing to Teach Mathematics with Technology” project has been funded through grants from the National Science Foundation since 2005. The PTMT project has impacted the practices of about 80 faculties in teacher education programs across the U.S. and Canada, and PTMT materials have been used with an estimated 1,500 prospective and practicing mathematics teachers (Lee and Hollebrands, 2008, pp. 326-341). Thus, the goals of this longitudinal project are to create instructional materials, to implement and sustain the use of new instructional strategies in teacher education programs, to develop faculty

expertise, and to evaluate and research the effectiveness of the PTMT approach (Lee and Hollebrands, 2008, pp. 326-341).

The educational system of Singapore began the IT master plan for education project in order to integrate technologies in the classrooms. This project aimed to offer a blueprint for the utilization of the information technology in schools and access to an information technology enriched environment of learning for every student of the Singapore (Koh and Koh, 2006, pp. 1-15). There are also some of the significant technology integration projects of Texas. The most famous one is the technology immersion program (TIP). The TIP project is groundbreaking a completely new impression in educational technology entire captivation of students and faculty in technology (Means, 2010, pp. 285-307). Technology Immersion Program steps beyond 1:1 computing experiments and as an alternative totally and entirely envelops participants in technology and specialized expansion and advancement. A technology immersion bundles six critical technology resource into one package and provides that package to all teachers and all students on a campus at the same time (Means, 2010, pp. 285-307). On the other hand, there are some of the technology integration projects of Peru. It is observed that around one million OLPC XO laptops have been given to different students of Peru. This project of distributing laptops began in order to integrate technology in mathematics classroom. This project began in the year of 2008, focusing initially on small schools in poor (and often rather remote) communities (Kramer, Dedrick and Sharma, 2009, pp. 66-73). Examining the Peruvian experience, colleagues at the Inter-American Development Bank (IDB) has been engaged in the first large-scale randomized evaluation of the impact of the OLPC (One laptop per Child) program. The results so far

should provide much food for thought for educational reformers and technology proponents in other countries who feel that large scale introductions of new technologies will, in and of themselves (and perhaps magically), bring about a variety of promised positive changes in educational systems (Kramer, Dedrick and Sharma, 2009, pp. 66-73). These projects and technological aids have been serving the educational institutions in a substantially positive manner with increased engagement of students in learning practices.

CHAPTER III: RESEARCH METHODOLOGY

This chapter entails the methodology that would be employed to conduct research. In this chapter, the researcher provides a clear demonstration of the applied research methodology in order to fulfill the requirements of the research. Creswell in 2007 mentioned research methodology as a most significant part of any type of study. Alternatively, proper and appropriate selection of methodology for the research is the most crucial aspect of research because all the outcomes and findings of the study are based on the recognition of the effectual methodology of the study (Kumar and Phrommathed, 2005). Therefore, this chapter of the research will provide the overall picture of the implemented research methodology, the approach of the research, the philosophy of research, and the different techniques associated with efficient research. The design of this study is based on the aims and objectives of the research.

3.1. Research Design

Research methodology and design of the research are considered the most important and significant parts of the research. In any form of research, the methodology of the study is the organized method in which in-depth details and data is collected so that the questions and hypothesis of the study are proved or justified (Saunders et al, 2009). For this particular study, secondary qualitative research method were utilized by the researcher. The aim of secondary research is to accumulate the information via different sources. Secondary research is generally based on the information that is already available and so is known as desk research. Secondary research is the content analysis of the available information. Secondary research is usually the starting point of the research.

This method is based on the sources of secondary information. Secondary research is a method that reuses existing data that were collected for another project, often by another researcher.

The qualitative research method consists of data and information that is not quantifiable and, accordingly, cannot be considered and valued in numerical values. According to Monique, Inge and Ajay the qualitative research is an approach in which the researcher adopts various technique so that ideas, opinions and experiences in an in-depth way. By adopting this approach, a researcher can explore ideas and experiences related to the issue that are to be explored through research (Monique, Inge and Ajay, 2010). Research in this study utilized qualitative research methodology and through this method research has acquired the available secondary information regarding the advantages and disadvantages of integrating technology in Mathematics' classroom for teachers, students and administration of an educational institute; steps that are important to train mathematics teachers so that they can integrate technology in their teaching; different ways through which technology can be integrated in mathematics' classroom through the FATIH Project in Turkey; and various projects in United States and other countries that have been successful in integrating technology in mathematics. Saunders et al (2009) mentioned that qualitative research design is the most significant and appropriate method to obtain accurate and truthful details from numerous resources. It is also illustrated that the gathering of relevant secondary information for this study enabled the research investigator to enhance the understandings and concepts of the concern issues and gain the most effective outcomes for the present study. The researcher was engaged in gathering of secondary data which was based on past reviews of the literature

and different theories related to the research topic in order to enhance the concepts and understanding of the research. It is also revealed that collection of secondary data for this research had enabled the investigator to improve the concepts and understanding of the issue and acquire the effective results for the research.

3.2. Purpose of the Research

The purpose of this qualitative secondary research is to examine and analyze the concept of Technology integration in the Math class. This research utilizes the past literature and data from the other secondary sources related to the research topic. This qualitative secondary research also explored the different aspects and accounts of successful uses of technology from the viewpoint of mathematics teachers. It also examines their methods of technology integration in the classroom and different factors that shape their practices. This study seeks to understand the complex and dynamic nature of teachers' views regarding what it means to successfully use technology in their mathematics classrooms and the factors that influence these views.

3.3. Research Approach

The study of Ghauri and Gronhaug (2005) identified that the deductive research approach and inductive research approach are widely accepted among numerous researches. The approach of the research is based on the organized methodology of the research. Ghauri and Gronhaug in 2005 defined the deductive research approach as the research start with the common concepts and foundation of the research in order to sustain certain outcomes that validate the research question and research hypothesis. The deductive research

approach is also known as the “Top-down Approach”. On the other hand, Ghauri and Gronhaug (2005) defined inductive research approaches as the bottom-up research approach. In this approach, research begins regarding any particular research with their initial interpretation. This research is also used by many researchers in order to compare and differentiate different findings and theories related to numerous academic studies and researches to form a good start for the research (Ghauri and Gronhaug, 2005). In this particular research related to the technology integration in the math classroom, the researcher utilized the inductive research approach. With the help of this approach, the researcher abstracted the required data from past theories and researches related to the topic of the research. For this research, the researcher started the work regarding the study with their preliminary interpretation. Therefore, the Inductive research approach is the most significant approach for secondary research design.

3.4. Research Philosophy

In 2003, Cooper and Schindler identified three different types of research philosophies that are extensively implemented among different forms of research. These three different types of research philosophies are “realism”, “Positivism”, and “interpretivism” (Cooper and Schindler, 2003). The philosophies related to the research are adopted by the researchers on the basis of ideas and nature of the study. According to Cooper and Schindler (2003), positivism philosophy is defined as the research philosophy in which the outcomes and details regarding the research are built on the ideas that are consistent with the observations, facts and objectives of the research. On the contrary, interpretivism research philosophy is defined as the philosophy in which in-depth learning is needed

with the assistance of investigation of ideas and opinions of the research participants i.e., focus groups, survey, and interviews (Cooper and Schindler, 2003).

Realism research philosophy is defined as the philosophy which is based on the general concept that, in the social environment, the reality is present, but there are numerous factors that are influencing the perceptions about the reality of the people. Therefore, for this particular research, the researcher adopted the realism research philosophy. With the help of this research philosophy, the research obtained the required information and data by in-depth analysis of the information related to the technology integration in the math class. The main aim of this philosophy is to explore the rule and truths about the social and the natural world. Consequently, realism argues that there is an experimental reality of the society that directly influences people and, as a result, the rules that manage this form of reality need to be explored (Crossan, 2003).

3.5. Research Technique

According to the research design that is selected above, the research technique that would be adopted for this study is an exploratory study. Exploratory research chiefly provides qualitative data. This method is flexible, unstructured and qualitative. Exploratory research is used for various purposes: to better define a problem, suggest hypotheses to be tested later, generate ideas for new products, and to gather feedback on a new concept first. The reason to select this type of study is that in this research, different projects would be reviewed and, on the basis of the review, suggestions and ideas would be generated for the FATIH project to integrate technology in teaching mathematics.

3.6. Data Collection Techniques

In 2007, Davies mentioned research methodology as the most significant and important part of the research. Researchers for different studies use a different form of research collection method to collect both primary and secondary data relevant to the research topic. For this particular research, the researcher has adopted the secondary technique for collection of data. During the research, data was gathered by accessing and exploring different libraries over the internet. Accordingly, in the research regarding the technology integration in the math class, only authentic and reliable information and findings was accessed. ProQuest, Oxford, Emerald, Jstor, and Phoenix are the public and private libraries that were accessed for this research. According to Neuman, secondary data collection assisted the research in order to collect the appropriate and authentic required data that was already published in well-known journals or libraries. In addition, it was also noticed that the collection of secondary data was comparatively less time consuming and less expensive than evaluating the primary information collection. In this study, reliable and authentic secondary data were gathered.

On the other hand, it is important and vital for the researcher to measure the validity and reliability of the secondary information that has been collected from different authentic resources. The researcher has managed to remain unbiased throughout the collection of the reliable secondary data. Throughout the collection of secondary data, the researcher managed to remain unbiased, and justice has been given to the selection criteria. Special projects that were implemented by the governments in the United States, Singapore, and Finland would be reviewed in this research. Moreover, this study would also scrutinize the findings of researches that are conducted on the effectiveness of these projects.

3.7. Exclusion and Inclusion Criteria

The inclusion and exclusion of data play a significant role with the purpose to impose certain forms of restrictions and limitations on the inclusion of proper information and similarly implement specific principles for the exclusion of data to avoid inappropriate and erroneous data. In this research, both inclusion and exclusion criteria are considered by the researcher in order to attain the required effectual data to prove and justify the aims of the research. The exclusion and inclusion of the study has focused on the assortment of reliable and authentic websites, research articles, and published databases. All the way through the process of the research, the study encountered different sources and databases out of which the investigator excluded and included only the most relevant information related to the research topic of “Technology integration in Math Class”.

According to the research of Levy and Leme show (2008), the researcher should identify and design the inclusion and exclusion criteria before beginning the research task in order to save time and obtain the most effective and efficient information. At the same time, for this study, the researcher of the study made certain criteria for the inclusion and exclusion that permitted the investigator to obtain only the most accurate data or information related to the research topic.

It was also observed that the implementation of the appropriate criterion for the inclusion and exclusion of the data gives comprehensive and unambiguous findings and literature. Therefore, the investigator, with the intention to enhance the research integrity, assessed only authentic and reliable resources for data gathering as articles, research papers, journals, published books, and other authentic online websites. As in this particular research work, qualitative research method was selected as the primary data collection

with the help of past literature and theories related to the research topic of “Technology integration in Math Class”. The researcher set out certain criteria for the exclusion and inclusion of the secondary data in order to obtain the most proper, authentic, and pertinent information and data. The inclusion and exclusion for this particular research is given as follows:

Inclusion Criteria	Exclusion Criteria
It was made sure that the articles and research material referred are up to date and for this purpose the references from the last twenty years were selected.	The commentary and the general reviews that could not be authenticated and whose validity and reliability could not be counter checked were excluded.
This secondary research only incorporated those researches that were published.	The studies and articles that were found in any other language than English and Turkish was excluded.
Every article and research paper referred incorporated were written using the primary research technique.	Papers and article that did not provide comprehensive evaluation and did not address the real topic of the current study were excluded.
Only those papers were referred that were found in the medium of English and Turkish.	The unpublished literature was not incorporated in the current secondary research.
All the national as well as international studies were consulted in order to provide	The studies and articles published earlier than 20 years of the time period were

a wide and comprehensive account on the current topic of study.	discarded from the review of literature and the discussion section of the research.
The current primary original articles that were published were incorporated.	Relevancy was the basic criteria followed in the current research. Irrelevant articles were also excluded from the current study.

3.8. Justification of the Research Method

It is considered significant for researchers to encompass their research on the basis of the qualitative and quantitative means of research (Zikmund, Carr and Griffin, 2012). This research is based on the collection of secondary data and information from different relevant secondary resources which are vital and significant for the developing the theme of the study by mentioning and identifying different online journal articles, research papers, magazines, and authentic websites. The secondary sources are important as they are depended on the past happenings linked to the research topic so that the researcher can scrutinize the swings happening during a particular frame of time. In the research, it is significant to include the secondary data or information because they are in huge quantity and subsequently they are also capable to offer the point of view from diverse angles (Zikmund, Carr and Griffin, 2012). Therefore, the secondary data enable the investigators to offer an enhanced understanding about the topic of the research, its aims and objectives, and whether the research hypothesis is based on assumptions and whether they will be rejected or accepted.

3.9. Data Analysis Technique

The interpretation and analysis of the research data and information are also the main part of the research. In the research work, all the results and outcomes of the research are based on the interpretation and analysis of the collected data. Content analysis techniques have been used for this research in order to explore and further analyze the concepts related to the Technology integration in the Math class. By utilizing the qualitative means of research methodology for the study, the investigator obtained the non-quantified data than can be effectively interpreted and evaluated by utilizing the method of content analysis. In accordance with the research of Scanlan (2001), content analysis technique is the one which can be used to completely comprehend and understand the information and after efficiently understanding, the investigator of the study interprets the collected data (Scanlan, 2001). With the help of this data analysis technique, the researcher of the study can drive the outcomes of the research through different literature reviews and past theories related to the research topic. Analysis of collected secondary data enables the researcher to improve the understanding of the research. Therefore, content analysis technique has been utilized by the researcher for this particular research to analyze the qualitative secondary data.

3.10. Limitations of the Research

For the research, it is very simple to collect the secondary data; however, there are a number of limitations which are linked with the utilization of data based on the secondary research method. If someone disregards the secondary research design limitation, the different issues and problems will arise. Different limitations are associated with the secondary data use; first, the secondary data depends on

generalization, second, the information gathered is restricted to the opinion of the researchers, thus it is possible that the information gathered may be somewhat biased, and third, research on one topic might not be pertinent on other research areas (Kothari, 2004). The reliability and authenticity of the research is also very challenging to justify related to the information based on the secondary research regarding research topic. The data which is collected from secondary data sources may, at some time, be general and vague and generally not useful for the institution in the decision making process. It was also observed on a continuous basis that the sample utilized for the data generation from the secondary sources might be undersized and small (Kothari, 2004).

CHAPTER IV: RESEARCH FINDINGS AND DISCUSSION

This study is based on the secondary qualitative research methodology. The main aim of this research is to examine the role “Technology Integration in the Mathematics Classroom and the FATİH Project” also, and necessary step for teacher education (professional development). The significant aims and objectives of the study are to examine the advantages and disadvantages of integrating technology in Mathematics’ classroom for teachers and the students; essential steps that are to be taken to train mathematics teachers so that they can integrate technology in their teaching; different ways through which technology can be integrated in mathematics’ classroom through FATİH Project in Turkey. Researcher in this study utilized the relevant secondary data related to the topic of research with the intention to comprehend the main objectives of the research.

4.1. Technology integration through FATİH project

The findings of the research also identified different ways through which technology can be integrated in mathematics’ classroom through FATİH Project in Turkey. In Turkey, FATİH project signals the start of a new time period of the educational innovation. FATİH project is considered as a gateway to the modern and technologically advanced system of education in Turkey. It was identified during research that the main aim of this FATİH project is to offer the “ICT instruments” to classes with the intention to attain the ICT maintained environment of coaching and teaching until the finish the school year of 2013- 2014 in associated to the objective that occurred in the “Strategy Document of the Information Society”, “Ministry strategic plan”, “ICT policy report”, and the “Development report” that have explained all

functions of Turkey in the procedure of being an information society and have been formed within the extent of the e-transformation of Turkey. However, according to Minister of Education 2012 development report FATİH project may not completed on time. In addition we do not have any official announcement about delay and update about deadline. The research findings mentioned that this project would assist the educational system in Turkey by altering the means of imparting information and align the children with the rapid pace at which the world is changing. The idea of FATİH project also has drawn criticism from different sectors with opponents claiming that the integration of technology would nullify the role of teachers in the classroom and the learning process of students. Proponents have been swift in defending the project with the Prime Minister promising to ensure the role of teachers remains essential as in a conventional educational system (Lee, H.S., & Hollebrands, 2011). The statistics related to the FATİH project for the integration of technologies in the classroom of mathematics are mentioned this program would be employed in almost 620000 classrooms in 42000 Turkish schools. FATİH project is introducing the technologies like smart board technology through which teachers are able to browse and information of the project in the interactive device installed in the classroom. Another technological benefit of the program would be the ease of imparting education through distance learning program. With the help of FATİH project of technology integration in the mathematics classroom students are able to receive the course materials and text on their tablets and would be able to study without having to be physically present in the class. The tablet also has a protection system that locks the device permanently if it is not connected with a smart board for two weeks. This ensures that no information is stolen or copied. This is also the final component of

the program that guarantees protection of the network from cyber attacks. The findings also identified that government of Turkey also already set up 110 training centers that would be connected to each other through the internet across the 81 provinces of the country. However, not all seems to be smooth with the FATİH project. The Ministry of National Education 2012 Activity report (2013) showed that the project is behind the schedule. According to the report, only 3,657 schools have the new smart board instead of 21,689. MNE was planning to renew 21,689 servers and computers but only 216 of them have been renewed. The number of new smart classes should be 295,000 but there were only 84,921 ends of 2012.

One of the component of FATİH project is 'Educational and Informatics Network (EBA)' which include "Enabling and Management of the Education e-Content" which will serve to 700.000 teachers, 17 million students and also some part of the portal will be open to the public. EBA portal has eight different modules which include News, e-books, Journal, Visual, Voice, e- lesson, e-content, Discussion. Also EBA portal has a lot of good tools to teaching and learning Mathematics. For example, Mathematics Tools which created for 9 to 12 grade students is special application for Android and it also can work with web based. EBA also include GeoGebra, PHET, and Microsoft Mathematics software. EBA portal has all of the textbooks and they can be downloading without any charge. EBA portal contents are very rich and developing every day.

The findings of the research revealed the significance of the FATİH project for the technology integration in the mathematics classroom. There are numerous advantages of FATİH project. This project would permit students in understanding the concept of mathematics in an efficient and effective manner. The proper and adequate utilization of

technologies in this project would enable the classroom students to comprehend and understand the subject matters from start of their educational life (Strudler and Wetzel, 1999). Elementary mathematics which involves basic mathematics and algebra can be taught using the interactive smart board. Students can learn through visual representation of the problem of the board. For secondary students, visual representations may vary, however they would have the same impact on learning of students. With students being provided tablets, information would only a touch or a swipe away. Students can gain access to use course material by browsing through a class group formed and moderated by the teacher. In case a student fails to solve a mathematical problem at home, he/she can login to the class group and review relevant or assistive text to understand and execute the problem at hand. It is also revealed that from the beginning of the project, the interest of students and teachers are increasing with the passage of time for technology integration in the classroom. The main advantage of FATIH project for the integration of the technology in the mathematics classroom is the improvement of collaboration and communication mainly in the technological issues among students and teachers.

The technology of Smart Board is also integrated by the FATIH project in the classroom. With the help of integration of Smart Board into the classroom, the students and teachers encountered a more effective and audio-visual instructions as the most significant positive influences of the FATIH project. It is revealed that the use of tablet in the project some of the negative impact in the classroom. FATIH project also offered numerous models related to how to incorporate different forms of technologies into the mathematics classroom in order to enhance the effectiveness and quality of learning and

teaching. The past literature regarding the technology integration in the mathematics classroom, the model of “Technological Pedagogical Content Knowledge” (TPACK) highlight the concept that for the reason that the technology single-handedly is not sufficient craft such a desired influence, teachers require to allow for a form of pedagogy that operates effectively for the particular content lesson (Usluel, Mumcu, & Demiraraslan, 2007). The research results and findings mentioned that the teachers require proper form of training in order to integrate technologies with the help of FATIH project. However; teacher training courses for FATIH project content is very limited. It just covers basic computer skills. Adiguzel (2011) mention that the teachers need training about how to uses Smart Boards. Most of the perspective teachers believe that they are not being adequate to implement FATIH project (Dincer, 2011). Teachers should be effectively and properly trained about how to utilize different technologies offered to teachers within the framework and circumstance of the FATIH project in order to attaining technical and any form of helpful and encouraging services. On the other hand, the main issue for the properly and effectively implement the procedure is that the students and teachers must consider in the possible advantages of utilizing technologies (Clifford, & Frieson, 2002). For that reason, there is a need for students and teachers who contributed in the FATIH project to identify which form of contribution different innovative technologies offered for the purpose of FATIH project would make to them all through the procedure of learning and teaching with the demonstration of the models and researches. The technology integration with the help of FATIH project is considered as the largest determinant of change across the higher education is the advent of new and emergent technologies. Research mentioned that technologies and their impact are

increasing with the passage of time. Perhaps the largest determinant of change across higher education is the advent of new and emergent technologies. We are living during one of the greatest times in history, as never before have we had the power to gain knowledge right at our fingertips. The Internet, and all other forms of electronically mediated learning continue to thrive across all levels of higher education, and are increasing on a daily basis. According to the Babson Survey Research Group, online education is expanding at nearly three times the rate of overall of higher education enrollments. However, despite the increased use of technology in higher education, interest in computer science as a career is declining. American Society for Quality (ASQ) reveals that educator anticipates the concept to focus on technology, innovation, and life and career skills for students to succeed. For this purpose, the training of teachers in order to integrate technologies in the classroom is also important. FATİH project of Turkey is playing an important and significant role in this context. In addition, families play a vital role in the student's education. Research shows that 92 percent of the society in Turkey never has taken courses about technology. Also 62 percent of the society in Turkey has no idea about internet (Bilici, et al. 2011). In this perspective training for teachers and students might not be enough to be success of this project.

4.2. Advantages and disadvantages of integrating technology in Mathematics' classroom for the Students

Technology offers ways to radically alter mathematics and mathematics education in students' lives as it allows for more complex calculations and more concrete mathematical ideas. Several affordances of technology enable deep changes in the

experience of doing and learning mathematics. The main affordance is the unique potential of technology to enable representations that bring into play dynamic, interactive, animate, linked, and multiple representations of mathematical concepts via the capabilities of technological displays (Kaput et al., 2007). The representational affordance of technology potentially helps students explore various approaches that give meaning to the same mathematical idea, fosters their ability to connect different representations of the concept, and hence supports them in achieving a robust understanding of the target concept (Zbiek, Heid, Blume, & Dick, 2007). In addition, the significant feature of interactive linking across different representations of data in most educational technologies makes mathematics explicitly available to students for analysis, modification, and reflection (Zbiek et al., 2007). This feature also offers a means to encourage teachers and students to share their mathematical experiences in the social space of classrooms, which in turn promotes deeper understandings of mathematics (Kaput et al., 2007). However, technology does not have a mind of its own, so its power to intensify and reinforce mathematical understanding is affected by any bias that users bring to it. In light of the increasing support for the integration of technology into the teaching of mathematics, technologies are now widely used in schools as mediums for constructing knowledge with the hope to transform mathematics instruction into active, constructive, subjective, and social experiences.

Several authors have noted that teachers can and do use technology to promote more active engagement of the students as well as increased student-student and teacher-student interactions (Garrison et al, 2010). These teachers tend to use technology as a resource for students to find information, publish results, and create products, and as a

medium for themselves to change their role from a provider to a facilitator of information. They consistently use technology in various instructional activities to address students' learning needs and styles with more small-group discussion and independent work (Garrison et al, 2010). Thus, the use of technology in and of itself, as important as it can be, should not be prioritized over the teaching and learning of mathematics if the goal of technology is to provide students with more access to meaningful views of mathematical concepts. By placing such attention on technology use and its co-constitutive relationship with teaching and learning, the role of other educational strategies is left unconstrained. While many researchers have advocated the use of technology in the classroom, there has been growing criticism and debate on the position of technology in education and its effect on quality learning outcomes (Schrum et al., 2007). This is not to say that technology should not be used. In fact, results presented here suggest that technology is extremely beneficial when the students' learning of mathematics is truly considered as the ultimate goal of the use of individual hardware and software tools. Hence, this study proposes an emerging conceptualization of technology integration that should be shifted from characteristics of technology use for instruction on how to better incorporate diverse technological tools to complement the teaching and learning of different mathematical concepts.

Research findings of this study mentioned that there are different advantages and disadvantages of integrating technology in the mathematics classroom (Yang and Wu, 2012). The foremost advantages of technology are that it has the capability to bring the conceptual and insubstantial to life. There is a huge importance of technology in the mathematics. The technology integration in the mathematics prolongs to assemble

enhance cognitive solution of problems, reasoning skills and logic. The other advantage of technology integration in mathematic classroom is that it encourages the class students to offers effective ways for problem solving, learning opportunities, and completion of tasks in an interesting way and also provides a safe environment for students in order to analyze and understand the in-depth knowledge related to mathematics. It is also observed that students are more confident in an undisrupted computer or technological environment of learning. With the help of recent and appropriate technology errors are effectively edited or corrected, forming a refined product that students are conceited of and are enthusiastic to share (Niess, 2005). The integration of technology is significant in order to support the learning skills of students in the mathematics classroom (Bennison and Goos, 2010). The findings of the research also revealed that technology integration in the mathematics classroom is the source which can improve the concepts of students related to mathematics understanding, and it can also enhance the achievements of the students. Moreover, the use of the technology has been found to enhance the students' classroom experiences (Walker, & Dugdale, 2004). It is also identified in this research that that utilization of technology in the mathematics classroom has enabled the class students to envision the concepts of mathematics, verify conjectures, appoint in active strategies of learning, have positive attitudes, and also enhance the confidence of the students in order to accomplish their task related to the concepts of mathematics. The findings of this research revealed that if the existing technologies are perfectly planned and organized then there is a possibility to built strong social associations, positive results, and modifications in the styles of teaching, and enhanced motivation and learning of students (Roblyer et al., 2006). According to Speaker (2004), number of students feels

their concepts and learning are enhanced by the technological integration into education. The study of Ayas (2006) mentioned that technologies in the mathematics classroom have unavoidably become influential in the mathematics classroom as these technologies modify and alter the way we learn and teach. It was revealed that technology in the classroom makes the whole process of teaching and learning more effective, interactive, interesting and enjoyable.

The findings of the research also mentioned some of the disadvantages associated with the use of the technology in the mathematics classroom. It was identified that, there is a serious problem that the use of technology in the classroom negatively influence the actual learning of the mathematics (Attard and Northcote, 2011). For instance, it is noticed that teachers may spend more of their precious time teaching the concepts and usages of tablet and functions of the tablets rather than the proper application which accomplishes the aims of the use of technology. One other disadvantage of use of technology in the classroom of mathematics is that, students and teachers use technology for every task and avoid using their own personal skills.

The main findings of the research regarding the positive impacts of the technology integration in mathematics classroom is that, technology is the source which motivates and satisfy the needs and wants of the students, as well as the teachers (Zhao et al., 2002). The successful use of one technology for teaching a particular content area with a group of students can be different from its use for another content-specific domain with a different group of students (Ferdig, 2006; Mishra & Koehler, 2008). Consequently, what can be considered a meaningful use of educational technology varies from case to

case. Given the multiple advantages the FATIH project possesses, it would allow students to understand mathematics in an effective and efficient manner.

4.3. Advantages and disadvantages of integrating technology in Mathematics' classroom for the Teachers

Technology is also playing a significant role in the life of the teachers. Teacher can use technologies in order to teach their students in most effective and efficient way. It is also revealed that technology is not broadly utilized in the math classroom (Norton, McRobbie and Cooper, 2000). It is observed that many problems and challenges must be resolved with the intention to encourage the suitable and proper technology integration in the mathematics classroom. The findings of the research also revealed that technology has the powerful influence on learning and teaching if use in effectively. The researches of Yücel et al., (2010), Ayas (2006) and Beer et al., (2000) revealed that technology is the most significant part of the classroom teaching and teachers are motivated to use different types of technologies in their classes. Technology has the probability for enhancing the learning and teaching in education. However, many teachers simply use technology to enhance their existing practice rather than to support collaboration and reform-based practice, although they often claim to have transformed their teaching styles and strategies. Clearly, using technology does not automatically produce learning gains or changes in teaching styles. It is a matter of how technology is used (Mishra & Koehler, 2006). Hanna (2000) and Jones (2002) argue that the use of dynamic geometry software might not be effective (or might even make things worse) if integrated inappropriately with curriculum and pedagogy (e.g., with carelessly designed tasks, no professional

teacher input, and no opportunities for students to explore the tasks). For teachers to overcome the most fundamental challenge in technology integration, which is to teach with technological tools in a meaningful and productive way, researchers have called for better understanding of teachers' perceptions on how they use the tools in their practice as well as how teachers define successful technology integration in the classroom.

As Pierson (2001) indicates, teachers have different definitions of technology integration, and these definitions vary depending on the ways that teachers use technology in the classroom. For example, research indicates that teachers value both the didactic-inspired uses of technology (e.g., providing rote drill and practice) and the uses based on constructive discovery processes (e.g., facilitating creative, analytic, and independent thinking). On the other hand, some teachers view technology integration as the use of technological tools that result mainly in more collaborative student-centered teaching and learning. This disparity among teachers' conceptions of technology integration can lead to a misunderstanding of appropriate and effective technology use. The disparity also raises questions about how different facilitators and barriers to teachers' technology use influence the development of teachers' conceptions of technology integration.

Many indicate that teachers have the most significant impact on the quality of technology integration, and therefore factors directly relating to teachers are most frequently cited as influencing technology practices in the classroom (Hew & Brush, 2007). These factors include teachers' pedagogical beliefs about student learning and their role in classrooms (VanFossen & Waterson, 2008), their self-efficacy and confidence (Yuen & Ma, 2008), their technological comfort levels and freedom to shape

instruction (Gorder, 2008), their access to properly functioning technology, and their knowledge of and experience with technology integration.

Indeed, Becker (2000) suggests four factors affecting technology uses in schools that are directly associated with teachers. He argues that technology is a “valuable and well-functioning instructional tool” (p. 29) when it is implemented by teachers who have

- comfort and experience in using technology;
- freedom in the curriculum; and
- access to technology, and (4) pedagogical beliefs aligned with a constructivist pedagogy.

Other studies have shifted the focus from teachers alone to their holistic teaching environments (Drenoyianni, 2006; Windschitl & Sahl, 2002). In particular, factors identified in these studies include the time required for planning technology-based instruction and for teaching with technology, opportunities for professional development (Mueller, Wood, Willoughby, Ross, & Specht, 2008), support from mentors and school administration, peer support (Hew & Brush, 2007), and infrastructures for social networks and interactions (Groff & Haas, 2008; Haydn & Barton, 2008; Hew & Brush, 2007). Regardless of the particular focus of a type of factors, all of the factors affecting the use of technology in the classroom are interrelated. As an example of the interdependent relationships among these factors, Windschitl and Sahl (2002) note that the teachers’ use of technology itself cannot transform their teaching practice toward more student-centered pedagogy. Rather, the transformation of practice is also mediated by teachers’ beliefs about students, the features of teaching in the school context, and the role of technology in students’ lives. It is the interrelationships among the factors that

determine how teachers use technology in their classrooms, not a long list of individual, independent factors.

From the past literature, it is also identified that teachers utilized technology austere, and many are not prepared for the integration of technology into the class of mathematics. The easiest path in order to prepare teachers for the technology integration in the mathematics classroom is for the educators of the teachers to work with these teachers to enhance their concepts and ideas of, and capability to use, technology in a significant way (Norton, McRobbie and Cooper, 2000).

The findings of the research also mentioned certain advantages of technology integration in mathematics classroom for the teachers. The integration of technology can enhance the teaching of mathematics. Teachers can utilize effective form of technologies in order to establish improved mathematics (Roschelle et al., 2000). With the help of technology integration, teachers can easily introduce more advanced topics related to mathematics earlier. Both the possibilities to learn better math and to teach better math should be well-thought out in the technology plan of school and professional development plan of teacher. The technologies of the tablet have been integrated into the mathematics classroom in order to improve the learning skills of students and teaching capabilities of teachers. Additionally, numerous applications have been effectively designed in order to further improve the education system in the mathematics classroom.

There are some of the issues which are also associated with the use of technology in the classroom. The use of tablet technology and some other form of technology may limit the background and basis of the teacher, limit access to the technology, and lack of professional personal development. Some teachers have the skills and competencies to

properly integrate technologies in their mathematics classroom; nevertheless, others teachers may be lacking either the confidence or training in their skills related to the technology, therefore, not able to use advanced technologies to its complete prospective (Bennison and Goos, 2010). Administrators are also facing challenges in order to train teachers. Sometimes teachers are not able to learn the proper use of technology because of lack of competencies and sometime the implementation of the whole technological program needs more effort from the administrators.

4.4. Essential steps to train mathematics teachers for technology integration in mathematics classroom

It was identified during research that the educators of the mathematics teacher should take an enhanced role in assisting the mathematics teachers in order to integrate technology as part of the mathematics classroom. The findings also revealed that the adaptation of the innovative technologies and methodologies in the education and in the classroom ensures effective, interactive and efficient learning, and it is also lends an assisting hand to students to build their understanding in a profound and practical manner. In today's era, teachers act as the guide for the students so that they can learn the basic and main concepts of mathematics at all stages of education. For this, technology is used as a mind tool. This type of technology can be utilized as a support for the deep reflective thinking which is the essence of the meaningful learning (Jonanssen and Carr, 2000). According to The National Council of Teachers of Mathematics for teaching and learning math technology is an imperative tool. Technology should be integrated in the classroom in a wise way by well-informed teachers to make the provision of support to

students in making them understand mathematical concepts (National Council of Teachers of Mathematics, 2000).

The Ministry of National Education created six different training programs for teachers and administrators, which are Basic Computer Education (75 Hours), Using Educational Technology (30 Hours), Technology and Leadership (especially for administrators) (24 Hours), Smart Board (8 Hours), Pardus(Linux based software which is created for tablet), and Promotional and Informational seminars about FATİH project (MNE Activity Report, 2012).

The integration of the latest technology in mathematics class and to utilize the benefits of technology has begun to get significant therefore, it is imperative to take essential steps to train mathematics teachers for technology integration in mathematics classroom. Numerous evidences highlighted that teachers do not have the adequate training on the technology based teaching, in general, and on the proper use of the technology in mathematics teaching, in particular. Many teachers feel unprepared to integrate technological tools into their instruction, and many who do integrate them fall short in their capability to meaningfully utilize the technology in the classroom or to transform their mathematical skills of teaching (Larreamendy-Joerns, J., & Leinhardt, 2006). Therefore, the outcomes raise a call for the professional development to deepen and strengthen the subject matter of teachers with respect to the tablet and other technologies.

The findings of the research mentioned that there is a need of the teachers' courses thorough which they will be able to effectively implement the technological integration in the mathematics classroom. With the help of these courses, they are able to

learn about the shortcuts and how to find the paths around the technology of tablet. These courses are also effective for teachers in order to make them able to demonstrate different apps of the technology in an efficient manner. The integration of the technology is the source of professional development for teachers. I also believe that, teacher need to know how to do with the technology is figure out ways to utilize it that will assist students learn mathematics in an efficient manner. As with other studies providing support for extensive and content-focused professional development, the findings in this study suggest that more extensive, content-focused professional development with technology would have beneficial effects. Professional development that affects teachers' knowledge appears to reinforce their teaching practice (Sowder, 2007).

The findings of the research mentioned the most appropriate and effective way to deepen the concept of the teachers related to the use of the technology for the mathematics classroom may be to engage teachers in explicit discussions and practices about the proper and accurate use of the technology especially tablet and some other in the mathematics classroom. On the other hand, there are numerous factors which are inhibiting the participation of the teachers in the technology based professional development. Some of these factors are the accessibility and availability of the resources of technology, support from the educational institution, teaching domain, curricular materials that are utilized by teachers, duration of teachers, time and social pressure. These all factors vary from teacher to the teacher and school to school. The findings of the research also mentioned that the professional development is complex and involves multitudinous and complicated factors related to changing knowledge and beliefs, context, critical issues, and strategies that support and influence professional

development, which is dynamic in nature (Leavy, 2006). It is also mentioned that by failing to address or to take into account these important factors relevant to professional development with technology, such programs may not be effective. The results from this study thus reinforce what other researchers have suggested about the coherence of professional development with other influences on teachers' practice, and at the same time point to the need for more complex analyses of additional factors affecting professional development and practice. The findings suggest that technology-based professional development projects should take these factors into account when planning, implementing, and evaluating professional development and other interventions. Specifically, it is important for professional developers to understand what works for which groups of teachers and stakeholders under what circumstances. In addition, closer investigation reveals other issues about teaching conditions that can inhibit the use of technology for creating and facilitating student-centered learning (Leavy, 2006).

The aforementioned findings indicate the issues of limited access to technology in schools and large class sizes that hinder teachers' efforts to use technology in classrooms or force them to use it in a way that does not require students to have much technology access (e.g., only using technology for demonstration in front of the classroom). School or district support, although promoting the use of technology in schools, does not seem to substantially enhance technology use for facilitating student-centered environments.

4.5. Meanings of Successful Technology Integration in Mathematics Teaching

The literature review provides a helpful discussion of some specific constructs for the successful use of technology in mathematics education that are related to the key features of technological tools used in mathematics education and the TPACK framework. These

include several ideas. For example, teachers need to allow students to explore technologies (e.g., calculators, dynamic geometry software programs, the Internet, and IWBs) in relationship to mathematics in authentic contexts. They also need to understand not only the use of technology to enhance the instruction of meaningful mathematics (e.g., mathematical thinking, problem solving, communication, reasoning), but also the affordances that different technological tools offer for facilitating student learning and ways to transform knowledge acquired through these tools into mathematical concepts. Concisely, the above review suggests that the features of successful technology integration in mathematics teaching are the practices of introducing, illustrating, and taking advantage of technology to:

- incorporate multiple linked representations of mathematical concepts and interpret the relationship(s) among these representations;
- facilitate the development of formal mathematics through the nature of intuitive, reflective thinking and learning the meaningful aspects of mathematics;
- provide opportunities for constructive learning, social collaboration, and conceptual communication;
- interconnect and transfer the acquired knowledge via technology to mathematical concepts; and
- Link the acquired concepts to real-world situations.

These key characteristics compose the conceptual framework for considering teachers' perspectives on the appropriate and effective use of technology in mathematics teaching.

However, in spite of numerous guidelines for and reported examples of successful technology integration available in the literature, research on the incorporation of educational technology into mathematics education still “struggles to tackle the complexity of the integration of the evolving technologies”. Hence, clarification of how teachers should teach mathematics with technology is needed. As Mumtaz (2000) argues, the transformation of teaching practices is unlikely to occur without clear guidance and consideration of teachers’ views about teaching and learning with technology. The review of the literature also highlights teachers’ perspectives on technology integration as an important area to be considered for more sophisticated use of technology in mathematics teaching. As the focus of recent research has moved from technological skills to knowledge and skills required for the meaningful teaching of mathematics with technology, it has become clear that merely knowing how to use technology is not the same as knowing how to integrate it into mathematics teaching. But since teachers do not necessarily know how to incorporate technology effectively in their teaching, then in order to translate skills into practice, teachers need to have clear ideas about how to use educational technology in a meaningful way.

To date, however, very little research has focused on what successful technology integration means to mathematics teachers. In addition, the existing literature has a major gap that needs to be addressed. Much of this literature is based on scholarly discourse about successful technology integration which tells us about how existing theoretical frameworks like the TPCK framework can be used for guiding what teachers need to know and be able to do for their meaningful technology practice. In other words, researchers seem to view these frameworks as a foundation of what it means to teach

mathematics with technology in a fruitful way. Yet, the literature does not clearly tell us about the nature and appropriateness of technology integration from the teacher's point of view. Although some work has been conducted in this area, very little is known about how features of successful technology integration from teachers' perspectives are similar to or different from the features presented in scholarly discourse. Based on the teachers' standpoint, it is not clear whether the meaning of successful technology use in teaching mathematics refers to an overarching conception as assumed in the research paradigm.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1. Summary

Taking into consideration the above mentioned research regarding “Technology integration in the mathematics classroom”, it can be concluded that technologies have the significant impact on the mathematics classroom and FATİH project of Turkey is also the most effective initiative by the authorities. In order to provide more recent data regarding this research, empirical studies and literature reviews as well as discussion of the research findings over the investigated topic were used as well. This approach also contributed in looking at the topic from all perspectives and enabled the researcher to critically analyze the topic. Hence, the topic which had been investigated in this research paper was based on providing the intense and comprehensive information on the technology integration in the mathematics classroom and the role of FATİH project in this area. The first chapter of this research explored that aim and objective of this research and also mentioned the scope and background of the research. The main aims of this research are to examine the advantages and disadvantages of integrating technology in Mathematics’ classroom for teachers, students and administration of an educational institute; essential steps that are to be taken to train mathematics teachers so that they can integrate technology in their teaching; different ways through which technology can be integrated in mathematics’ classroom through FATİH Project in Turkey; and this research is also analysing the concept of how various projects in United States and other countries have been successful in integrating technology in mathematics. Researcher also mentioned the significance and ethical concern of this study and how this study will be beneficial. The ethical consideration for this study is based on constituting the true knowledge and accurate

information regardless of any kind of biasness. Hence, it is the ethical responsibility of the researcher to reflect the truthful information in presenting the research work on the proposed topic.

The literature review was the second chapter of this research in which different studies and theories were presented related to the research topic “Technology integration in the mathematics classroom” and the role of FATİH project of TURKEY. On the other hand, chapter 3 explored the research methodology. For this study, researcher used the secondary research or past reviews of literatures for methodology. Furthermore, the purpose of using empirical studies or literature review is to provide the most recent account as well as discussion of the research findings over the investigated topic. This approach also contributes in looking at the topic from all perspectives and enables the researcher to critically analyze the topic. Literature reviews are systematic syntheses of previous work around a particular topic. Nearly all scholars have written literature reviews at some point; such reviews are common requirements for class projects or as part of theses, are often the first section of empirical papers, and are sometimes written to summarize a field of study. Given the increasing amount of literature in many fields, reviews are critical in synthesizing scientific knowledge. Although common and important to science, literature reviews are rarely considered to be held to the same scientific rigor as other aspects of the research process. The chapter four of this research highlighted the outcomes and findings of this research. The in-depth analysis of the collected secondary information was reviewed throughout this chapter related to the aims and objectives of the research. On the other hand, chapter five of the research summarized the findings of research and also provided the suggestions related to the

research findings and further future research recommendations are also given in this chapter.

5.2. Conclusion

Education and learning is an important part of an individual's life. These factors play immensely valuable role in the development of an individual and play their part in shaping the life of an individual. Learning and development are the two processes that are attached with the human beings and would continue to be part of human nature as long as human beings are present on earth and burgeoning. In order to grow and develop oneself there is a need to embrace latest techniques and technologies. Adaptation of innovative technologies and methodologies in education and in classrooms ensures interactive, effective and efficient learning, and it also lends a helping hand to students to develop an understanding in a practical and profound way. The purpose of this research was to explore integrating technology in teaching mathematics.

It is concluded from the findings of the research that, a number of researchers have revealed through thorough research over the past few years that the effective use of technology always has a positive impact on the process of teaching and learning. It is very important for teachers to understand and comprehend that the teaching programs that they develop for students should involve the use of technology within the classrooms. The study that has been presented in this research work aims to identify the role of technology integration in the mathematics classroom and impact of involving teachers and students in the training sessions that were designed for the implementation of technology into mathematics instruction. It has been further observed that the

awareness, confidence and appreciation of the preservice teachers were enhanced for the analysis, selection and crafting of the lesson of technology based mathematics. This research could be considered as a very important foundation for future research. The training methods used for teachers have been combined with the investigation of the impact of training on the process of teaching and learning for the empowerment of the environments based on technology. The model used in this study proved to be very successful and could be used by the educators of teachers in the courses of mathematics methods and technology.

As per our research, the research methods that have been presented in this study also show the way in which higher education can serve as a catalyst towards the best use of instructional technology. With the passage of time and advancements in technology, the use of tablets in a mathematics class has become a reality, and this tool should be used to provide opportunities for students allowing them to learn about the subject in a meaningful and effective manner. With the help of the previous researches in this context, the aim of this paper has been to provide a way forward in which the use of tablets can be more effective in a mathematic class. It is very important to understand that the study of the real life experiences of the students who have already learned mathematics with the help of tablets is essential for developing an everlasting relationship between mathematics and the tablets. The main aim of doing this would be to prove that the tablets is not only a fashionable tool, but could also be used for some really important works.

It can also be concluded that technology in the field of education has become a part of the modern world and is continuously becoming ubiquitous in the lives of the

students and teachers with the passage of time. The incorporation of technology in the teaching and learning methods is also a proven method for improvement in learning. The major emphasis of the use of technology in teaching should not be directed towards noting the improvement in the test scores, but the benefits that students receive by this innovative method of learning. The use of technology in education also motivates students to develop a positive mindset towards the attainment of education. It is also very important to analyze that how well the young people of the current society are prepared and educated with interpersonal, technical, creative and communicative skills. A very important question that should be highlighted in the field of education is that what steps could be taken in order to remove the barriers so that the integration of technology in the majority of schools could be spread in an effective and efficient manner. It is very significant that more research is required in the area of education to overcome the technological barriers in education and effectively move technology based learning towards more and more students. Another important area in which research is required includes the provision of technology based learning to students with special needs and students who are at risk with access to technology.

5.3. Recommendations

In accordance to the findings of the research during the qualitative secondary research, it was recommended by the research to integrate technology into the development of the teachers and also reduce the time constraints for the teachers. Results indicate that the lists of requirements suggested by researchers for teaching mathematics effectively with technology may need further thought and development. As indicated

from both the quantitative and qualitative analyses, teachers uniquely use different hardware and software tools in the mathematics classrooms based on their views regarding effective and appropriate technology integration, which are reshaped based on their practices. Hence, features of meaningful technology-based instruction from the teachers' standpoint are interrelated with the nature of their technology use. Given that the majority of teachers incorporate technology into their mathematics lessons to enhance their existing direct instruction, it is not surprising that teachers' accounts of technology-based teaching are different than those posited in the scholarly literature. To turn technology into a medium for engaging with mathematics differently from how students traditionally engage, the following discussion suggests some elements that deserve closer scrutiny while researchers develop theoretical constructs for accounts of technology integration (Hou et al, 2008).

Clearly, having competent teachers who use a technology regularly to teach mathematics does not warrant that they know how to implement it appropriately and effectively for instruction. The aforementioned findings illustrate how teachers with high proficiency and frequency levels in using technology fall short in their ability to meaningfully provide students with more access to mathematical concepts taught in the classroom. Indeed, teachers use technology in a fashion that they believe to be appropriate based on their current teaching practices. The results from this study also indicate that technology is an alternative tool for teaching and learning, and part of the successful use of technology in mathematics education is teachers' ability to select (or not select) and use (or not use) different technological tools depending on the concepts that they are teaching.

Integrating technology is not about technology - it is primarily about content and effective instructional practices. Technology involves the tools with which we deliver content and implement practices in better ways. Hence, to effectively incorporate technologies into teaching, technological use needs to be integrated with the teaching activities of mathematics in a thoughtful way if the end goal is to truly enhance students' experiences with and understanding of mathematics.

Although providing a broad conceptualization of successful teaching with technology in mathematics classrooms, the existing guidelines in the field remain ambiguous and not readily usable for guiding classroom practice (Roblyer, 2005). Hence, there is a need to provide teachers with realistic suggestions from which they can draw practical insights. One way to do this is to take into account teachers' technology practice. As illustrated in the findings, changes in technology-based instruction in mathematics classrooms to reform-based, student-centered pedagogy do not simply arise through demonstrating the capacities of technologies and providing them to teachers. Nevertheless, results presented in this study indicate how these changes can possibly be made.

Clearly, teachers' views and practices of technology integration in general, as well as the successful technology use in particular, portray the complexities of their working lives (Hou et al, 2008). Without giving proper attention to these views and practices, research may be underestimating the required transformation of teaching that results in changes in teachers' understanding of and beliefs about technology. Hence, guidelines for technology-based teaching in mathematics classrooms can be realistic,

useful, and well understood by teachers when considering the process of technology use from teachers' perspectives.

Results from both quantitative and qualitative analyses indicate that teachers uniquely teach with different technological tools depending on a multitude of factors that affect their classroom practices. Technology integration in mathematics teaching is context-bound and depends on many factors, including subject matter, pedagogy, technological knowledge, available technologies, and other factors associated with teachers and their teaching environments. In particular, it is not only a long list of individual, independent factors but also the interrelationships between these factors that contribute to how teachers use technology in their classrooms. For example, the aforementioned results from the survey show how relationships between various variables (e.g., duration of teaching experience, hours spent using technology out of class, school technology support, and teaching domain) and teachers' classroom integration of technology can be explained by the teachers' familiarity with technology, school availability of technology resources, available professional development, and the interwoven relationships between these mediators themselves (Jacobbe & Horton, 2010).

The findings from qualitative analysis also support and contextualize these relationships while demonstrating how different factors influence teachers' accounts of technology implementation in their classroom practice. However, a crucial problem with most efforts to examine factors affecting teachers' technology practices is the fact that these efforts "take a very narrow view of what teachers need to use technology ssuch as technical skills and a good attitude, and neglect the complicated relationships of these

factors. This study will consider a wide range of factors that are generally not taken into account in mathematics education research, and the results indicate that these factors and their interrelationships warrant further consideration as researchers develop accounts of technology integration.

Lastly, results illustrate teacher accounts of technology practice that portray the complex interrelationships among different aspects of teachers' knowledge of mathematics, pedagogy, and technology, and their relationships to social and context-bound classroom practice (e.g., equity in education, relationship with colleagues, support from schools and districts, class size, curriculum and social pressure, teachers' personal life, etc.). Indeed, this complexity suggests that it is critical for teachers to come to view technology as a "pedagogic cultural artifact," whose usefulness in mathematics teaching is simultaneously thoughtful and adjustable based on social interaction and pedagogical content knowledge. As Matthew argued, Part of the role of technology in the classroom is deciding when technology is important. You know, you're not just always gonna use technology. And, so as a teacher you have to decide, you know, I need to teach my kids, when is technology important? The act of teaching is situated in social and physical contexts, and distributed across individuals and tools (Jacobs et al, 2007).

Similarly, technology is not neutral. Its affordances, constraints, and biases make some technological tools more appropriate for some circumstances or certain mathematical ideas than others; hence, knowledge about mathematics, pedagogy, and technology is essential but cannot be separated from teaching contexts. Therefore, technology can productively be viewed as a pedagogic cultural artifact, whose use in teaching and learning mathematics is dynamic, changing over time, and dependent on the

distinct contexts of teachers' experiences, social settings, and interactions with others. To be concise, there is a need to view technology as both a cognitive tool "that helps transcend the limitations of the mind . . . in thinking, learning, and problem-solving activities" and a cultural infrastructure developed in response to particular social systems (Kaput et al., 2007). When considering how to appropriately or effectively integrate technology into mathematics education, technology needs to be re-positioned from a catalyst for change to a pedagogic cultural artifact.

Proper teaching of teachers for the integration of mathematics in the classroom is essential and with the help of these training teachers will be able to demonstrate the functioning of the technology effectively to the student. It is mentioned throughout the research that tablet technology integration is the most interesting factor for students, and they want to use this technology during their education. Therefore, it is significant for the teacher to learn more about tablet integration for their mathematics classroom. Simply telling is inadequate to support teachers in building the necessary knowledge and skills for the effective integration of technology into their teaching. Thus, the results raise a call for professional development to deepen teachers' subject matter with respect to technology. Therefore, the outcomes and results of the research findings of this research address the need to revisit the design of support systems, activities, and policies that are provided to teachers. Not only must professional developers be aware of the obstacles that can be created when professional development opportunities are offered to teachers, but the school, district administrators, policy makers, and other stakeholders must also take these issues into account in order to promote appropriate and effective integration of technology in mathematics classrooms (Strudler and Wetzal, 1999).

It is also suggested that for the particular training for the technology, it is significant to designate the campus professional development days in order to reduce the time constraints for the teachers. It is also recommended that management have to provide the some of the management tools with the help of those tools teachers make certain that their students have the opportunity to utilize the technologies and other mobile devices in the mathematics classroom. The number of devices for the technology integration can also be increased with the increasing demands of technology integration in the classroom. Last but not the least, it is suggested that it is significant to offer professional development courses for the teachers through which they will be able to meet the needs of all styles of learning.

5.4. Recommendations to Future Research

This research was based on the concept of technology integration in the mathematics classroom. The findings of the research also revealed the concept of technology integration through FATIH project of Turkey and role of some other successful projects of united states and other countries for the integration of technology in the classroom. The present study may also assist in order to provide an in-depth knowledge about the past theories and researches. It is suggested for the future research that a quantitative research be conducted in order to analyze the barriers encounters by teachers and students because of the technology integration in the classroom, and it is also recommended that topic related to the barriers of administrators is also significant for the future research. On the other hand, it is also recommended for the future research that the investigation would include the research based on the quantitative means of

investigation in order to analyze the significance of technology integration according to the students and their parent and what different advantages students are attaining from the recent integration of technologies in the classroom. With the help of this form of research, the administration and teachers will be able to analyze the importance and significance of the technology integration in the classroom and what different factors they have to consider while implementing technology integration for the education of the students. With the help of quantitative research, the first handed data will be gathered through which the real picture regarding the research reveal.

APPENDIX : Profesional Development for Mathematics Teachers

Technology should be integrated in the classroom in a wise way by well-informed teachers in helping them understand them understand mathematical concepts (NCTM, 2000). Considerable evidence highlights that teachers do not have the adequate training in technology-based teaching, in general, and in the proper use of technology in mathematics teaching, in particular. The findings of the research suggests that there is a need of teachers' courses which will enable them to effectively implement the technological integration in the mathematics classroom. Teachers should be effectively and properly trained about how to utilize the different technologies offered to teachers within the framework and circumstance of the FATIH project in order to acquire technology and any form of helpful and encouraging services. It is important for professional developers to understand what works for which groups of teachers and stakeholders under what circumstances. I believe that the Mnister of National Education should also offer a profesional devolopment program for Mathematics teachers.

I created a traning program for Mathematics teachers who have already completed the other traning programs which were created for the FATIH project.

Training Sessions

The purpose of this teacher training sessions is to help teachers develop and apply the information and skills essential to the integration of technology in math classes. While participating in these sessions, the teachers will have various opportunities to engage in both individual and collaborative project-based activities. Teachers will explore theories of learning and how they inform on the effective uses of technology in math classes. The followings are component of the training session

- **Introductory Section**
 - to explore theories of learning and how the teachers are informed about the effective uses of technology in math classes.
 - to introduce contemporary educational reforms
 - to introduce the teachers to potential advantages and disadvantages of the technology integration.
 - to introduce successful strategies for the integration of technology
 - to inform about the legal and ethical use of digital information
- **Multimedia (Video, Graphics and Animation) Session**
 - the use of multimedia, discussion of the hardware and software necessary for multimedia and the integration of the multimedia into the classroom.
 - The teachers apply a range of methods, tools, media and resources in the planning, design, and development of educational graphics, computer based animation, and videos to help meet classroom needs.
 - the use application software to create mathematics demonstrations.
- **Instructional Design Session**
 - to create effective instructional design, materials and activities for math classes.
 - to inform and provide practice in the planning
 - to evaluate sample lesson plans
 - to develop activities
 - to use application software to build new ideas
- **Educational and Informatics Necwork (EBA) Portal Session**

- to introduce the EBA portal
- to use the software and applications which are provided by EBA portal.
- to use application software to solve mathematical problems.
- to engage in mathematical analysis using software applications

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