ELEMENTARY TEACHERS' PERCEPTIONS TOWARDS ICT INTEGRATION IN TEACHING AND LEARNING PROCESS: AN EXPLANATORY MIXED METHOD

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ABSTRACT

ELEMENTARY TEACHERS' PERCEPTIONS TOWARDS ICT INTEGRATION IN TEACHING AND LEARNING PROCESS: AN EXPLANATORY MIXED METHOD

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An explanatory mixed method research design was utilized to examine the elementary teachers' (classroom teachers) perceptions towards ICT integration in education and its effect on their teaching. In the first phase instruments were translated into Turkish and pilot tested with 282 classroom teachers. For the main study, the survey was distributed to classroom teachers in 90 schools in Ankara. With a 45% percent return rate, 1055 surveys from elementary teachers were used in the quantitative data analysis part. Two simultaneous multiple regression analysis were conducted and the results showed that teachers' perceptions towards ICT integration in education and its effect on their teaching can be explained by different sets of variables where the most important one is teachers' pedagogical beliefs. In the third phase, teachers were clustered under constructivist and behaviorist groups and ten teachers from each group were interviewed to reveal the differences on teachers' ICT integration perception in relation to education and their teaching. The research result presented that elementary teacher pedagogical beliefs affect their perceptions towards ICT integration in teaching and learning process. Qualitative data analysis presented differences between constructivist and behaviorist group participants in relation to ICT integration in teaching and learning process.

Keywords: ICT integration, pedagogical belief, classroom teacher

ÖZ

SINIF ÖĞRETMENLERİNİN EĞİTİM VE ÖĞRETİM SÜRECİNDE BİT ENTEGRASYONU ALGISI: BİR KARMA YÖNTEM

BAĞER GÜLSOY, Vesile Gül

Doktora, Bilgisayar ve Öğretim Teknolojileri Eğitimi Bölümü
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Sınıf öğretmenlerinin eğitim ve öğretimde bilişim teknolojileri entegrasyonuna yönelik algılarını ve etkisini inceleme amacı ile karma yöntem araştırma tasarımı kullanılmıştır. Çalışmanın ilk aşamasında anketler Türkçeye tercüme edildi ve 282 sınıf öğretmeni ile pilot çalışması yapıldı. Ana çalışma için, anket, Ankara da 90 ilköğretim okulunda görev yapan sınıf öğretmenlerine dağıtıldı. % 45 oranında geri dönüş oranı ile 1055 sınıf öğretmeninden gelen veriler nicel analiz kısmında kullanıldı. Çalışmada, iki eşzamanlı çoklu regresyon analizi yapıldı ve analiz sonucu öğretmenlerin pedagojik görüşlerinin eğitim ve öğretim sürecinde BİT entegrasyonuna yönelik algılarını saptamada önemli bir değişken olduğunu gösterdi. Üçüncü aşamada ise, öğretmenleri yapılandırmacı ve davranışçı grup altında gruplandırıldı. Her iki gruptan 10 öğretmen ile eğitim ve öğretim de BİT entegrasyonu algılarını ortaya koymak için görüşme yapıldı. Araştırma sonucu, ilkokul öğretmelerinin pedagojik inançlarının öğretme ve öğrenme sürecinde BİT entegrasyonuna yönelik algılarını önemli bir şekilde etkilediğini ortaya koydu. Nitel veri analizi, öğretme ve öğrenme sürecinde BİT entegrasyonu ile ilgili yapılandırmacı ve davranışçı grup katılımcıları arasında farkların olduğu göstermiştir..

Anahtar Kelimeler: BIT entegrasyonu, pedagojik inançları, sınıf öğretmenleri

To My Family

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CHAPTER 1

INTRODUCTION

Global competition and speedy developments in science and technology lead to dramatic changes on a nation's economy, social life and future expectations. The assembly line of the industry age has become inadequate to meet the needs of the current situation where the "customization, diversity, networking, process orientation" (Reigeluth, 1999, p. 17) features emerged and influenced all parts of the system. Reciprocal relations and ongoing changes among these areas have produced the need for changing the main characteristics of the system. Keeping up with the newly defined and highly sophisticated characteristics of the conceptual age has been seen as important and crucial by nations. Restructuring the National Education Curriculums is the most proper way to prepare future generations to be competitive in today's highly sophisticated scientific and technological world. In the current age, Information and Communication Technology (ICT) is presented as the mediator of a nation's educational goals.

1.1 Background of the Study

Technology integration in K-12 has a history of a century. However, for about two decades, the inclusion of computers and related technologies has sped up this movement (Russell, Bebell, O'Dwyer, & O'Connor, 2003). Huge budgets are allocated and schools have been equipped with computers and computer labs (Cuban, 2001). Educational policies and curriculums have been redesigned to fulfill desired ICT integration. The underlying reason for this highly expensive effort is the belief that technology use in schools will improve teaching and the learning process

(Barton, 2004; Hennessey, 2006; Hew & Brush, 2007; Yildirim, 2007). Indeed, Cuban (2001) proposed three points as the power of ICT: to improve student achievement, to prepare a future workforce, and increase the quality of instruction Roblyer and Edwards (2010) emphasized five reasons behind the in and out of class use of ICT. These are the effects of ICT on (a) students' motivation, (b) unique instructional capabilities, (c) support for new instructional approaches (d) increase teacher productivity, and (e) required skills for an information age.

Several countries proposed many innovative movements to reach the desired educational outcomes in many subject areas (Ford, Yore & Anthony, 1997). The common point among these is the ICT integration process in K-12. The transformative feature of ICTs in education (Yildirim, 2007), and its capability of meeting the needs of the information age learners (Roblyer & Edwards, 2010) are highly valued.

Along with the emphasis on ICT integration, a radical change has occurred on the understanding of teaching and the learning process. During the last two decades the traditional view of education has been replaced with the constructivist one. The former view has been built mainly on the objectivist point of view where reality exists and can be learned independently by each person while only being detected by the changes in behavior (Reiser, 2007). On the contrary, in the latter view, learners construct their own reality by their active engagement with the real world. Constructivist epistemology advocates building one's own knowledge to solve problems, being critical thinker, being self determinant, and having multiple perspectives for any issue (Driscoll, 2005). In this knowledge construction process, teachers and students have active and participatory roles where students "develop their abilities to question, reason, and think critically about scientific phenomena" NSES, 1996, p. 120). This epistemological shift is also apparent in the new science and technology course curriculum. This change from positivist to interpretist science brought questionability to scientific knowledge and emphasis on raising scientifically literate students.

Scientific literacy was first spelt out in the USA after the launch of Sputnik by Russia (DeBoer, 1991; 2000), and the undesirable results of the international assessments such as PISA and TIMMS, increased the efforts of accomplishing this goal. Scientific literacy was defined as an "understanding of science and its applications to our social experience" by Hurd in 1958 (DeBoer, 1991, p. 176). Although the importance of science and its relation to society was pointed out decades ago, in science curriculums and its applications the importance was given to the content and whether the students grasped it or not without any daily life inclusion. School science was thought of as a body of knowledge (Gardner, 1999) and the information was unquestioned.

Teachers generally teach the way they were taught. This notion worked for the industry age where the aim of the education was to prepare a future workforce for the system (DeBoer, 1991). However, the general characteristics of today's needs propose very different perspectives in science teaching and learning. Educators and policy makers have come to realize the problems of science and technology education today in that the understanding of science and technology extended from only mounted up information and instrumentation to reciprocal relations among the science, technology, and society triangle as calling societal enterprise (Gardner, 1999). This change has formed scientific literacy to "the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity" (NSES, 1996, p. 22). The aim of school science has begun to include personal development components, such as critical thinking skills, scientific ways of thinking, problem solving skills, decision making, and an understanding of how to be a part of the society (DeBoer, 2000).

The change in the epistemological approach on the reality and truth affected the generation of scientific knowledge. This epistemological change from positivist to interpretivist brought the questionability of scientific knowledge. The Kuhnian perspective presents the relation of sociology and psychology in his remarkable work. This reflected the change on science education. The interpretivist view of science emphasizes the importance of the nature of science (NOS) which is defined

as “the epistemology of science, science as a way of knowing, or the values and beliefs inherent to the development of scientific knowledge” (Abd-El-Khalick, Bell & Lederman, 1998, p. 418). Driver, Leach, Miller and Scott (1996) argued that NOS helps people to understand scientific and technological developments, participate in the scientific argument and decision making process, while giving them appreciation for science, scientific endowers, and moral issues involved along with better understanding of the content.

Developing such competency with a traditional view of education is not likely to be accomplished (DeBoer, 2000). Traditional science education generally centered on the scientific facts (Huang, Tsai & Chang, 2005), not on the process and nature of its development. In traditional instruction, the teacher teaches what he already knows, rather than giving the students opportunity to understand on their own terms, by not only experiencing science themselves, but also to view science from a historical, philosophical, and sociological perspective. With the constructivist applications in a science and technology course, students can gain some aspects of NOS, such as the scientific process (Bell, Blair, Crawford & Lederman, 2003), data interpretation, social interactions, personal beliefs, and scientific knowledge that affect their understanding of NOS (Sadler & Zeidler, 2004).

Applying the constructivist teaching and learning approach to develop scientific literacy is seen important among educators. Preparing a suitable learning environment and selecting the proper strategy is the duty of the teachers, and this role is very crucial to supporting scientific literacy (Eshach, 2006). During this period, the teacher has to fulfill ICT integration to present “a variety of information resources as well as the tools (technological and conceptual) necessary to mediate learning,” (Windschitl & Sahl, 2002, p. 137), since school, media and technology can influence and shape the students views of science (Chittleborough, Treagust, Mamiala & Mocerino, 2005).

1.2 The Need for the Study

Turkey, as a developing country, wants to elevate the prosperity and education level of its citizens. Along with the developments and changes in other countries' educational systems, the Turkish national education curriculum was restructured and introduced to K-8 grades in 2004 (MoNE, 2004). This change affected the way of presenting the information as well as how and what to teach by focusing on the personal knowledge construction. As the implementer of the curriculum, the teachers encountered new pedagogical orientations, objectives, goals, instructional methods, and materials where active student participation and teacher guidance is emphasized (MoNE, 2004). Additionally, science is not seen as a set of mature and stabilized knowledge chunks, instead, it is a growing tentative body of knowledge, considering the nature of science, impact of technology on society (MoNE, 2004). Beginning with the early grades of education, it is suggested that elementary teachers integrate ICT to facilitate their teaching and to develop students' scientific literacy.

It is widely believed that ICT integration has positive effect on students' personal developments, however, studies indicate low level ICT use by teachers (Becker, 2000; Cuban, 2001; ETI, 2005). In the literature, there are many issues identified as obstacles for teachers who wish to participate in ICT integration. These ranged from the presence and availability of technological devices, to the teachers' personal beliefs on technology. This presents a wide range spectrum and these varied examples were grouped under two categories: extrinsic and intrinsic barriers (Ertmer, 1999). The former one includes the deficiency of hardware and software, insufficient time for planning, and inadequate support to integrate technology. On the other hand, the latter barrier is related with one's worldview including his/her understanding of learning, teaching, and adopting new strategies, as well as resources. Overcoming extrinsic barriers can be solved by providing the necessary technologic infrastructure and related support and training. However, it is not as easy to overcome intrinsic barriers as finding solutions to external ones.

In spite of technological availabilities in schools, research results revealed that the technology integration in education is not at the desired level (Cuban, 2001; Ertmer,

1999; Ertmer, Addison, Lane, Ross & Woods, 1999). Due to the problems that are still faced with, researchers are focusing on the teacher's belief and personal views on many kinds of factors (Bai & Ertmer, 2008; Becker, 2000; Ertmer, 2005; Hew & Brush, 2007; Niederhauser & Stoddart, 2001).

Teachers play an important role in educational change (Fullan, 1991; Duffee & Aikenhead, 1992) and they decide what, how, and why to learn by translating the curriculum into practice (McComas, Clough & Almazroa, 2000). Lewin and Wadmany (2006) argue that "personal belief systems have a powerful effect on what teachers learn from educational reform schemes and professional development programs, as well as on the teachers' curricular decision-making and teaching practices"(p :159). With relation to this, teachers are likely to adopt new practices when their underlying assumptions are parallel with their own epistemological beliefs (Windschitl & Sahl, 2002). Pajares (1992) argues that teaching practice is shaped by teachers' beliefs on teaching and learning. Specifically their beliefs on science influence how they value science and technology, and therefore, how they conduct their course on the subject (McComas, Clough & Almazroa, 2000). Moreover, teachers decide the instructional strategies they are going to use.

Teachers are the ones who are going to raise scientifically literate students as proposed by MoNE in the National science and technology course curriculum. They are informed to use a constructivist teaching perspective while helping to develop students' scientific literacy by using ICT (MoNE, 2004). It is known that teachers' ICT integration is related to their perceptions towards it. Most of the Turkish studies on the teachers' ICT use and the barriers related to ICT availability (Cagiltay, Cakiroglu, Cagiltay, & Cakiroglu, 2001; Gulbahar & Guven, 2008; Yildirim, 2007), lack of time (Gulbahar & Guven, 2008; Gur, Ozoglu, & Baser, 2010), overload curriculum (Cagiltay, et al. 2001), teacher training, technological support (Adiguzel; 2010; Yildirim, 2007), colleague support (Askar & Usluel, 2005; Karaca, 2011) , years of experience (Gur, Ozoglu, & Baser, 2010; Kuskaya-Mumcu & Kocak-Usluel, 2004), demographic characteristics (Adiguzel, 2010; Celik & Bindak, 2005; Pala, 2006) and teachers' ICT integration beliefs, discarded the teacher related factors.

As presented above, many studies have been designed to explore and differentiate obstacles that affect the ICT integration in Turkey. Although teachers play an important role in the ICT integration process, there were limited studies that pointed out the second order barriers which are related with the teachers beliefs. . This study is aimed to use teacher related factors that derived from the redesigned science and technology course curriculum in order to fill this gap. Based on the course curriculum, teachers supposed to promote their students learning by helping to construct their own knowledge construction in order to reach the desired scientific literacy level by the help of ICT integration. Due to the fact that, classroom teachers' ICT integration perception, pedagogical beliefs, scientific literacy, and ICT use frequencies should be investigated both to draw a picture of today's teachers' portrait and how teachers' views on these things can shape their perceptions of technology integration.

The result of this study may contribute to the literature on elementary teachers' ICT integration process by identifying Turkish elementary teachers' pedagogical beliefs (behaviorist or constructivist), scientific literacy, and their perceptions of ICT use. The result of the study will be valuable information for both MoNE and the faculty of education while revising their strategies for teacher training, in-service training and guidance on related issues.

1.3 Purpose of the Study

This study aimed to reveal current status of Turkish elementary teachers' ICT integration perceptions, pedagogical beliefs, and scientific literacy. The main purpose of the study is to investigate the current status of technology integration perceptions of elementary teachers in relation to their pedagogical beliefs (constructivist, behaviorist) use (frequency) of ICT and scientific literacy and their years of experience. The main question for this part becomes how elementary teachers beliefs on teaching (constructivist or traditional), their scientific literacy, use of ICT and teachers years of experiences affect their ICT integration perceptions in

teaching and learning The secondary focus is to identify whether the study factors make differences on teachers' ICT integration.

1.4 Research Questions of the Study

There are many factors affecting the ICT integration in education. One of the main elements of this process, teachers' perceptions towards ICT integration and teacher related factors needed to be revealed. With this respect, following research questions were investigated:

1) What are the elementary teachers' perceptions toward ICT integration?
2) What are the elementary teachers' beliefs on teaching?
3) What is the level of elementary teachers' scientific literacy?
4) What kinds of technological tools and software applications do the teachers use for educational purposes?
5) How well the elementary teachers pedagogical beliefs, scientific literacy, use of ICT and years of experience do predict teachers' perceptions toward ICT integration in education?
6) How well the elementary teachers' pedagogical beliefs, scientific literacy, use of ICT and years of experience do predict teachers' perceptions' towards the impact of ICT to their teaching?
7) What are the teachers' opinions regarding to the impact of their pedagogical beliefs (Constructivist vs. Behaviorist) on ICT integration?

1.5 Definition of Terms

ICT: ICT is an acronym that stands for Information and Communication Technologies which helps to handle information. It encompasses the technologies that have been introduced into education system from the beginning of the formal education, including radio, television, computers and communication technologies. ICT definition encloses "computer hardware and software, the networks ..., and a host of devices that convert information (text, images, sounds, motion) into common digital formats" (ISTE, 1999, p. 10).

ICT integration: In this study ICT integration is defined as elementary teachers and students use of information and communication technologies for educational purposes. This includes use of technologies such as computers, software, internet, TV, DVD … during course preparation (e.g. internet search, handout - exam preparation, record keeping) and in classroom use (e.g. internet search, presentation, educational CD use) to support teaching and learning process.

Belief: In this study, belief is mentioned with a parallel view of following statement. Pajares (1992) viewed the belief as speaking "to an individual's judgment of the truth or falsity of a proposition, a judgment that can only be inferred from a collective understanding of what human beings say, intend, and do" (p.316).

Pedagogical beliefs: Pedagogical beliefs refer to teachers' educational beliefs about teaching and learning. Constructivist and Behaviorist educational approaches are used to define teachers' pedagogical beliefs.

Scientific literacy: Scientific literacy is defined as "the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity" (NSES, 1996, p. 22). The term encompasses three main dimensions, subject matter, nature of science and impact of technology on society. In this study, SL refers to the nature of science and impact of technology on society. Subject matter knowledge is discarded because the remaining factors are related with personal view points.

1.6 Abbreviations

APDoNE : Ankara Provincial Directory of National Education

ICT:Information and Communication Technology

MoNE: Ministry of National Education

SL: Scientific Literacy

SPO: State Planning Organization

CHAPTER 2

LITERATURE REVIEW

This chapter presents the selected research studies on the topic. In the first section, information and communication technologies and education are briefly introduced. The second section illustrates the various technology uses in education. The third section examines the factors affecting technology integration in teaching and learning.

2.1 ICT in Education

Information and communication technologies (ICT) have a considerable place in the education system. After the introduction of computers to the public, computers got attention from educators and educational policymakers. With gradual developments, computer technology became to offer information storage and retrieval features. Shortly after the availability of World Wide Web to everyone, these technologies were named information and communication technologies. In its basic form, ICT tools helps to manage information. It encompasses the technologies that have been introduced into the education system from the beginning of formal education, including technologies like radio, television, computers and communication technologies. Now, all of these are interwoven to form a "networked world" (UNDP, 2001). Through these developments, the ICT definition encloses "computer hardware and software, the networks ..., and a host of devices that convert information (text, images, sounds, motion) into common digital formats" (ISTE, 1999, p. 10).

These developments offer networking opportunities for individuals and organizations. The potential of ICT lies under these features in the globalized and highly networked information society. Along with this reciprocal relationship, all

parts of the society have been influenced by the developments in ICT, and today, ICT integration is regarded as essential in education system. Hepp, Hinostroza, Laval, and Rehbein (2004) noted the following motives for the integration of ICTs in education to develop new skills: to enhance the productivity of the education system, and to improve the quality of learning to cope with the enhancements in the information society. Likewise, Kozma (2005) argues that ICT integration in education can support a nation's economic and social features as can be seen in following:

- ICT integration supports the delivery and access to resources and information.
- Developing the ICT skills of students makes them to be prepared for the future workforce.
- ICT integration can be used to support students' understanding so that the quality of the education can be enhanced.
- ICT integration can be used with educational reforms to support knowledge creation where teachers and students build their own learning environment so as to prepare for lifelong learning.

In this information society, nations are focusing on how to benefit from technological developments. Huge budgets have been allocated to support lifelong learning, personal development including learning, and using ICT to refurnish schools. A decade ago Cuban (2001) pointed out the underling aims of these attempts as (a) preparing a future workforce (b) increasing the quality of instruction and (c) improving student achievement. There has been a gradually developing force to furnish the schools and classrooms with new technologies in Turkey. The report by the Turkish State Planning Organization (SPO) (2006-2010) emphasizes that ICT will be one of the main tools of the educational process and both students' and teachers' effective use of these technologies will be supported.

The last five-year National plan has been supported with a flow of building ICT laboratories in schools. By the end of 2009, 27.999 information technology (IT) laboratories were set up in schools. Additionally, those 17.261 schools that did not have the capacity required for the establishment of IT infrastructure were given at

least a projection machine, scanner, and printer. The student computer ratio was down to 15:1 (SPO, 2010). With the new 5 year term strategies proposed by the SPO and the newly introduced FATİH project, the technological infrastructure of the schools will be established by placing computers, projectors, and smart boards in each classroom, rather than placing this technological equipment in a lab environment.

2.2 ICT and Students Outcomes

In the information society, specialization is important and in most vocations technological qualification is needed along with the core knowledge. In the SPO (2010) report, it has been shown that besides the direct employment opportunities created by ICT, it also increases the demand for people who have the ability to use technology. Thus, as mentioned above, the national development plans are focusing on to preparing future generations by integrating technology into the learning process. The attempt at raising literate civilians for the future workforce is mostly associated with the quality of instruction. The underlying understanding of integrating ICT in education is the belief that ICT integration has positive effect on teaching and the learning process (Barton, 2004; Hennessey, 2006; Hew & Brush, 2007; Linn, 2004). Although it is not universally accepted, there are research results showing the positive affect of technology integration in schools on students' academic achievement.

In their study, Taylor, Casto, and Walls (2007) investigated elementary and high schools students' academic achievements when technology was integrated. Technology integration poses a significant gain in elementary classes and better student learning. However, class dynamics, mainly the ones incorporated with the constructivist educational approach should be included for affective teaching and learning.

The relationship between the technology integration and K-12 students' outcomes were investigated by Lei (2010). The use of technology for social-communication

purposes affected student developmental outcomes significantly and influences the participants' academic achievements.

Papanastasiou, Zembylas and Vrasidas (2005) examined the relationship between students' science achievement and their computer use. The study data was the results of the PISA 2000 study on 15- year-old students. The Multiple Regression Analysis result showed that frequency of computer use had effect on the students' science achievement. Mann, Shakeshaft, Becker and Kottkamp (1999) examined a statewide instructional technology program called the West Virginia Basic skills/Computer education on the increase in student achievement. The study revealed a significant gain in students' achievement. The findings supported the positive affect of computer use in the classroom instead the lab environment.

In the literature there are many studies that examined the effect of technology integration on students' achievement (Lei, 2010; Mann, et al., 1999; Papanastasiou, Zembylas & Vrasidas, 2005; Taylor, Casto &Walls, 2007). Although the abovementioned literature focuses directly on students' academic developments, there are also studies pointing out the positive affect of ICT on students learning by means of motivating students and fostering a positive attitude towards subjects (Burgess, 2009; O'Neill, 2007; Ringstaff & Kelly, 2002; Varank, 2003; de Winter, Winterbottom & Wilson, 2010), engaging the students in the subject related task (Espinoza & Quarless, 2010), and fostering critical thinking problem solving (Jonassen, 1996; Lim & Hernadez, 2007; Loveless & Dore 2002; Yang & Tzuo, 2011). Supporting these aspects of learning is also important for the learners' construction of knowledge.

A study result on the international online exchange project showed that the use of ICT can make a difference other then students' academic achievement (O'Neill, 2007). Students' intercultural competencies, social interactions (O'Neill, 2007) and motivations to do school work (Varank, 2003) can be enhanced by using ICT applications. The De Winter, Winterbottom, and Wilson (2010) study result proposed similar findings where the students' motivation and attitude toward learning is increased when the ICT applications are used, such as visuals like PowerPoint

presentations and animations. Sivin-Kachala and Bialo (2000), argued this increase in students' motivation has a positive effect on students learning. From this dynamic relationship, ICT utilization also develops students' problem solving, higher order and critical thinking skills. Yang and Tzuo (2011) argued that the students who engaged with ICT applications showed higher order thinking and problem solving skills. Espinoza and Quarless (2010) proposed that using the technology based lab environment will be useful while developing critical thinking skills of students, would also affect the students' scientific literacy developments.

The aforementioned literature shows the effect of ICT integration on the students' learning. Mostly, the educational aspect of ICT integration is seen as progress on students' personal development, focusing on students' academic achievement, motivation, critical thinking, and problem solving skills. However, in studying the integration process's effect on students learning, teachers' use of ICT and their perceptions towards its integration should also be investigated.

2.3 ICT and Teachers

Technology integration in education has been valued as the research results showed its positive effect on students' personal development. Roblyer and Edwards (2010) argued that by planning to incorporate ICT in their teaching, teachers can make differences on students' understanding of concepts, content, skills, and processes. The authors propose four points that drive teachers to integrate technology into their courses. Motivation is the first reason, that teachers can gain students' attention using such different information presentation ways. Additionally, allowing the teachers to produce their own works and giving them the opportunity to control applications by using ICT, drives teachers in the motivating students. The second one is ICT's diverse instructional capabilities in enhancing instruction by connecting real-life applications and skills, visualizing abstract and unfamiliar subjects, linking learners to various information sources, allowing unique study opportunities for students, and providing cooperative study opportunities. The third one is increasing student and teacher productivity by tracking learner progress, providing faster and various

information sources, saving time on production tasks and money on materials used. The last one is developing students' skills for the information age. These skills are technology literacy, information literacy, and visual literacy.

In the integration process teachers' perceptions of ICT integration in teaching and learning is important since the teachers' beliefs and attitudes are important factors that affect the utilization of any materials for their teaching practice. Inan and Lowther (2010) presented this relationship with an empirical study. They argued that the teachers beliefs and attitudes are more important than the technological availability in schools.

Teachers have a key role in the teaching-learning process where they plan, select the suitable learning situation, and put those concepts in action in their classroom. Therefore, for any curricular changes that affect the teaching and learning process, the teachers' beliefs systems get a significant point. Fishbein and Ajzen (1975) defined belief as one's judgment in his world, how they value knowledge and truth shows their own epistemological structure. In the case of teaching and learning, the teacher's own epistemological views shape his/her preferences of teaching practice and decision making process (e.g, Borko & Putnam, 1996; Kagan, 1992; Pajares, 1992; Vartuli, 1999). Those teachers that have different pedagogical beliefs demonstrate those differences in their understanding of the role of teachers and students, instructional organization (Johnston, Woodside-Jiron & Day, 2001) and also on the knowledge generation.

2.3.1 Teachers Beliefs about Technology

Rokeach (1968) explains how attitudes and values are derived from one's personal belief system. Researchers are pointing out that the teachers' beliefs are the predictors of their behavior (e.g. Ertmer, 2005; Kane, Sandretto & Heath, 2002; Mishra & Koehler, 2006; Pajares, 1992).

Teachers' beliefs about technology (Ertmer, 2005; McGrail, 2005; Niederhauser & Stoddart, 2001), teachers beliefs on teaching and learning (i.e. how they value

teaching and learning) (Windschitl & Sahl, 2002) and their beliefs on specific subjects like their understanding of science and technology (i.e. how they value science and technology) (McComas, Clough & Almazroa, 2000) shape their professional practice.

More specifically teachers' beliefs about technology can be shaped by their past experiences, belief and attitudes about learning and teaching (Ertmer, 2005; McGrail, 2005; Niederhauser & Stoddart, 2001; Windschitl & Sahl, 2002). Goktas (2006) argued that a teacher's positive perception is an important factor for successful ICT integration. Ropp (1999) supported this argument that although those teachers who have the necessary skills to integrate ICT in classroom, but don't believe its effectiveness, are likely to not integrate ICT into their proficiency.

Pala (2006) examined the elementary teachers' attitudes towards technology in a study with a total 155 elementary teachers from ten different schools as its participants. The analysis demonstrated that the study participants held positive attitudes towards technology. The statistical analysis on the demographic characteristics of teachers –gender, age, schooling, and years of experience and their technology attitudes were analyzed. The result revealed no significant differences among teachers based on these characteristics.

Primary school teachers' attitudes towards computers were studied by Celik and Bindak (2005). A survey design was used to gather data from 261 teachers. The results proposed positive teacher attitudes towards technology. Like Pala (2006), they conducted statistical analysis to present any difference on teachers attitudes based on demographic characteristics. No difference was found based on participants' gender, branch and schools. Whereas possessing computers and frequency of computer use had significant differences on teachers' attitudes towards technology.

Goktas, Yildirim and Yildirim (2008) investigated K-12 teachers' ICT perceptions and ICT usage. Both quantitative and qualitative research approaches were used to collect study data and analysis. The study data was collected from 1429 K-12 teachers in 92 K-12 schools at 35 provinces of 12 different regions in Turkey. Along

with open-ended items in the questionnaire, interviews were conducted with six K-12 teachers. The result of the study presented K-12 teachers' positive perception towards ICT integration in education.

2.3.2 Teachers' ICT Use

There are many researchers pointing out the supportive feature of ICT to the process of teaching and learning in K-8 (Cox, Abbott, Webb, Blakcley, Beauchamp, & Rhodes, 2004; Hepp, et al., 2004; Loveless & Dore, 2002; Roschelle, Pea, Hoadley, Gordin, & Means, 2000), along with its affect on students' academic achievement. Teachers' use of ICT has been studied and classified. Tondeur, van Braak and Valcke (2007) and van Braak, Tondeur and Valcke (2004) identified teachers' technology use under two dimensions: (a) supportive ICT use, and (b) classroom ICT use. The supportive use of ICT is defined as record keeping, preparing worksites, and handouts for students, along with searching for information and material via internet for lesson preparation. Using computers and related technologies for presenting the subject, which is "encouraging [for] pupils to train skills, instructing pupils in the possibilities of computers" (Tondeur, van Braak & Valcke, 2007, p.197) are categorized under classroom use of ICT.

In another classification for K-12 teacher's use of ICT in education, seven dimensions were determined (Bebell, Russell & O'Dwyer, 2004). These are (a) classroom preparation, (b) professional e-mail use, (c) delivering instructions, (d) accommodation, (e) student use, (f) student product, and (g) grading. Hennessy's extensive literature review on the use of ICT in science education, Hennessy (2006) reported the main technology use purposes as the following; (a) to capture and analyze data, (b) to support hypothesizing, investigating and knowledge building, (c) to support communication and research and (d) to enhance presentation (p.4-5). The integration of ICT and teachers' use as identified by the researchers have similar characteristics whether in the larger scale or subject specific issues. The following paragraphs present some research on the ICT integration and technology use by K-12 teachers.

Ruthven, Hennessy, and Brindley (2004) studied teachers' views on technology integration on teaching and learning. The starting point in this study was the obligatory use of information and communication technology to support pupils both in the use of ICT itself and use of it while developing their understanding of subject matter. For this purpose, core subject teachers were selected as the participants of the study. This qualitative research study was mainly developed on group interviews to obtain information about the successful computer and related technology use in six secondary schools in England. The analysis result revealed seven wide themes on the pedagogical aspects of technology integration in education which were (a) affecting working processes and improving production, (b) supporting processes of checking, trialing, and refinement, (c) enhancing the variety and appeal of classroom activity, (d) fostering pupil independence and peer support, (e) overcoming pupil difficulties and building assurance, (f) broadening reference and increasing currency of activity, and (g) focusing on overarching issues and accentuating important features (p. 271). The authors stated that the study findings supported the major themes derived from the literature on the effects of technology for motivating pupils for schoolwork, and developing their "scholastic process and outcomes" (271).

Yildirim (2007) examined teachers' ICT use in K-8 grades. The study revealed that teachers use ICT for classroom preparation. The teachers mostly used computers to prepare handouts and tests and parallel to that, those participants presented themselves as competent in using word processers. On the other hand, their use of ICT for instruction and record keeping is very low. Teachers reported very low use of instructional software in their classrooms and use of ICT for grading and administrative tasks.

In a nationwide study, Goktas, Yildirim, and Yildirim (2008) investigated the ICT usage of K-12 teachers. For this survey study data from 1429 teachers presented the overall ICT use in schools in Turkey. From the demographic data the following points were identified: more than 1/3 of the teachers do not use ICT laboratories for their courses, but only a quarter of those stated their use of ICT labs. The remaining either uses labs rarely or not has such facility in their schools. When their ICT integration into classroom was asked about only 25% of those presented positive

answer. Overall teachers mostly use computers, printers, word processers and the internet. The teachers' drive for internet use was indicated high for lecture preparation.

Cure and Ozdener (2008) conducted a survey study with 163 K-12 teachers to determine teachers' ICT use achievement and examine their attitudes towards ICT. From the result of the data analysis, it was shown that the teachers were more competitive in using word processers, PowerPoint presentations and less in the use of scanners, projectors, and preparation and evaluation educational software. The result of the attitude survey concluded that the participant teachers hold positive attitudes towards ICT use in education. Moreover, among teachers it is widely believed that ICT facilitates the learning process by getting students' attention and that ICT integration is essential for effective teaching and learning.

In his study, Adiguzel (2010) investigated the status of instructional technology in primary school and the level of elementary teachers' use of these technologies, revealing the problems that the teachers encountered during technology use. The findings of the study presented that the schools do not have adequate instructional technology facilities. The use of written and printed materials among the participants was found to be abundant whereas teachers' use of ICT was found to be very limited. Among those technological devices, computers and projectors were much preferred, however, occasional use of such devices were reported. The overall results were compared based on the participants' gender, graduation school type, grade taught, classroom size, and years of experience. The results of mean comparison analysis showed were not significant. The interview result presented following barriers: lack of knowledge and skill, inadequate in-service-training, inadequate technical and technological support, unavailable technological devices for classroom use, and lack of technologic devices in schools.

A decade ago, K-12 teachers' computer perceptions and its use in education in Turkey were depicted by Cagiltay, et al, (2001). The study covered the teachers' needs and the obstacles during technology integration process. A survey study with 202 teachers revealed that the teachers had positive perceptions towards the

integration of computers in the teaching and learning process. The result proposed that the quality of education could be enhanced by computer integration and this integration period was not seen as a burden by teachers. Although the computer availability in schools was not abundant, still, the use of computers by teachers did not go beyond exam preparation, grade calculation and for administrative purposes. The result showed the following problems related to computer integration in turkey: lack of computers, lack of teacher education on computers, inappropriate instructional programs, lack of teachers' knowledge on computer integration in instruction, and overload in curricular activities.

In her descriptive study, Akkoyunlu (2002) presented the internet use among K-12 teachers with a survey study. The result indicated that the internet was barely used by teachers. From the various teaching subjects, computer and science teachers are the two subject teachers use internet mostly where elementary teachers were not among the internet users. The teachers preferred to utilize internet for communication and personal issues. The teachers did not use the internet as an information source. However, 84% of the participants stated that internet use contributes to the teaching process. Only 7% of those mentioned the use of the internet to reach information and search for classroom activities and materials. Akkoyunlu related this low usage of the internet among K-12 teachers to the lack of technological infrastructure in schools, barriers to connect internet from schools and homes, and lack of teachers' understanding on the potential use in teaching process.

Gur, Ozoglu, and Baser (2010) examined K-12 teachers' ICT use level and purpose and the barriers that they faced with during such use period. For the aim of the study, 381 teachers were surveyed and the result revealed that computer, projectors and educational software uses were not popular among the teachers. Teachers mostly used word processors for typing, report preparation, and personal internet use. Time, curricular loading, lack of technical support, and national tests were presented as the barriers that prevent teachers to use ICT in education.

The abovementioned studies expressed that although teachers hold positive views towards ICT integration, it is underused. Barriers that obscured the ICT integrations

were mentioned by researchers. Time, professional development programs, in-service trainings, and technical support were the problematic issues that affect the ICT integration process. However, as presented above, these variables are only related with first order barriers. Researchers' could not present any variable related with teachers' beliefs. There are many other factors that have affect on teachers ICT use and their views on ICT.

2.4 Factors Affecting Technology Integration

Although the abovementioned studies showed that the technology integration is seen important, the results did not demonstrate improvement on the teachers' ICT integration (Cuban, 2001; ETI, 2005). This problem has been identified as the presence of many different types of obstacles. Ertmer (1999) defined these as barriers affecting the ICT integration process.

Lack of necessary equipment, time administrative and technical support, inadequate technology training, low confidence and personal beliefs are some of the factors that have impact on teachers' technology integration. Ertmer (1999) categorized such factors as extrinsic and intrinsic ones. The former one is composed of the lack of equipment, lack of time and support problems, whereas the latter barrier is related with people's worldview on learning, teaching and adopting new strategies and resources. Based on the related literature, factors affecting ICT integration will be described in detail.

2.4.1 Technology Proficiency

Teachers' technology proficiency, especially on computers, is seen as an important factor for their classroom technology use. Many study results depicted the direct relationship between computer proficiency and technology use in practice (e.g. Hernandez-Ramos, 2005; Mann, et al., 1999). Ertmer (2005) also noted that the teachers' proficiency is related to their computer use confidence. On the other hand, in their path analysis model, Inan and Lowther (2010) proposed that teachers'

computer proficiency has an indirect affect on their classroom integration. Rather, teachers' readiness and teachers' beliefs on the technology mediated this indirect effect to teachers' classroom technology integration.

2.4.2 Technology Availability

The main obstacle for technology integration is the availability of technological devices (O'Dwyer, Russell & Bebell, 2005; Lemke & Coughlin, 1998; Tondeur, Valcke & van Braak, 2008). Without any technological infrastructure namely, hardware, software, and communicational tools, such integration opportunity is limited (Hew & Brush, 2007). On the other hand, the scarcity, limited access to technology or unavailability of up-to-date technologies is seen as a big challenge for teachers (Adiguzel, 2010; Akkoyunlu, 2002; Barron, Ivers, Lilavois, & Wells, 2006; Cagiltay et al., 2001).

2.4.3 Lack of Time

Time is an important factor for technology integration in education (Gulbahar, & Guven, 2008; Gur, Ozoglu, & Baser, 2010; Hew & Brush, 2007). Teachers need to allocate extra time other than their instructional period for searching for the necessary material from web sites, selecting proper educational software and-or films, preparing handouts, and even keeping records. This brings an extensive burden onto a teacher's time (Hew & Brush, 2007).

2.4.4 Support

This factor encompasses the following dimensions: administrative, peer, and technical support. O'Dwyer, Russell, and Bebel, (2004) noted that teachers' technology integration and their students' use of computers is affected by administrative support. Along with this, peer and colleague support are important factors for teachers to share the problems that they face (Karaca, 2011). This collaborative college environment enables teachers to find solutions for their

problems (Sandholtz, Ringstaff & Dwyer, 1997). Another important form of support that affects the teachers' technology integration is technical support. Adequate technical support should be given to teachers for different technologies (Hew & Brush, 2007; Yildirim, 2007).

2.4.5 Beliefs and Attitudes

Studies indicated that the availability of technological devices, support, and training variables, which are defined as first order barriers, are crucial for teachers to use technology for educational purposes. Ertmer (1999; 2005), however, stated that in the case of surmounting the first order barriers do not make significant changes on the teachers' technology integration. In their study, Bebell and O'Dwyer (2010) presented the results of a longitudinal research after implementing 1:1 computing models. This large scale project enabled students and teachers access to technology along with proper in-service training for teachers. Overall in their main findings, furnishing the schools with technological devices and making those available for each student and teacher brought an increase in teachers and students' use. Like some other researchers' findings, technology availability and access to technology cause positive effect on students' academic achievement.

The result showed an increase on both student and teachers' ICT use frequency. However, differences among teachers were found. This discrepancy was explained as the variability on teachers' belief and related preferences for technology use. The result of a similar study (Bebell & Kay, 2010) pointed out the importance of the teacher's role in the ICT integration process. Even though the technological infrastructure, technology training and support are similar, teachers are the important element in the ICT integration process, (Drayton, Falk, Stroud, Hobbs, & Hammerman, 2010; Shapley, Sheehan, Maloney & Caranikas-Walker, 2010). The results of such researchers validated that overcoming the first order barriers, such as technological infrastructure and technological devices, support and training, do not guarantee teachers' utilization of technology in education. On the other hand," if we truly hope to increase teachers' uses of technology, especially uses that increase

student learning, we must consider how teachers' current classroom practices are rooted in, and mediated by, existing pedagogical beliefs" (Ertmer, 2005,p.36)

2.4.5.1 Pedagogical Beliefs

The two epistemological approaches, objectivist and constructivist, differ on how knowledge is generated and how learning occurs. Driscoll (2005) explained the discrepancies as the following: in the objectivist view, knowledge is not related with personal views; instead it exists independently from learner. Relying on this view, learning occurs via transferring the knowledge to the learner where teacher has the main role. The knowledge is seen as absolute where it is taught to be memorized by heart to use for their future life. The teacher is the knowledge source and learning occurs when the desired outcomes are observed in students' behaviors. On the contrary, in constructivist epistemology, knowledge is viewed as constructed by experienced. Teachers have the role of designing the learning environment, in which they guide learners to construct their own knowledge. The characteristics of constructivist learning and teaching have been stated by many educators (e.g., Driscoll, 2005; Ernest, 1995; Jonassen, 1994). Students are active knowledge constructers, where teachers facilitate their knowledge construction process by multiple perspectives and representations of authentic activities and real-world presentations that leading them to be critical thinkers, knowledge seekers, by developing students skills on problem-solving, higher-order thinking and in-depth understanding of the subject.

In their study Aksu, Demir, Daloglu, Yildirim, & Kiraz (2010) presented the entering student teachers pedagogical beliefs with a quantitative study. Their findings presented that teachers hold some aspect of both progressive and traditional pedagogical beliefs. Although the mean scores of items presented a range, over all the participants rated constructivist items slightly higher than the traditional ones.

Teo, Chai, Hung, and Lee (2008) revealed the relationship between teachers' beliefs about constructivist and traditional teaching and their use of technology in classroom. It was found that constructivist teaching was significantly correlated with technology use where traditional teaching belief was only negatively correlated. The

study illustrated that teachers' pedagogical beliefs affected the way that technology was used, where age and gender has no significant prediction power.

Tondeur, Valcke and van Braak (2008) in their study focused on the teachers' pedagogical beliefs and computer use in Flemish primary education. The results of the analysis showed that the availability of the computers in classrooms was positively related to the ICT adoption as a learning tool. Among those teachers having constructivist educational view presented positive opinions and those holding behaviorist educational view presented negative opinions in addition to all ICT integration processes.

In their study Niederhauser and Stoddart (2001) focused on the elementary teachers' instructional views and the use of technology as a part of their instruction. Their use of educational software was categorized as skill-based that related with behaviorist orientation and open ended consistent with constructivist educational view. The authors concluded that the teachers' pedagogical views of instructions were related with their preferences of software use.

Primary teachers' technology use as supportive and in the classroom was studied by van Braak, Tondeur and Valcke (2004). The focus was given to the relation with the technology use and teacher characteristics. The path analysis result showed that different variable sets were mainly the predictors of supportive and class use of computers. Primary teachers' previous computer experience and general computer attitudes were presented as the strongest addition to predict the supportive use of computers, whereas participants' attitude towards technological innovativeness and gender were the strongest predictors for the class use of computers. The authors of the study also stated that the teachers who hold positive attitudes to computers and their presence in teaching and learning were more likely to present technological innovativeness that affected the use of computers in class.

Primary teachers' perceptions of ICT and its relation with their pedagogical views have been studied by Loveless (2003). This case study depicts the "interactions between Subject Knowledge, Pedagogic Knowledge, Didaktik, Identity and Community which are held in tension by the teachers' experiences of, and reflections

upon, change in their practice" (p.317). With his model, mutual and dynamic interaction between the different professional knowledge dimensions has been identified. The analysis of the study presented teachers positive perceptions of ICT integration in the teaching and learning process.

Uibu and Kikas (2008) designed a case study to find out the primary teachers perceptions on computers in teaching, and their impact on instructional process. Five extensive computer user primary teachers' interview results indicated that ICT integration enables teachers to motivate students, which eases the teachers' efforts to get their attention on the subject. Additionally, teachers mentioned that this integration has changed the activities and their role as teacher. By using ICT, better information distribution and various materials use is enabled. However, over all, ICT integration does not change the primary school teacher's role, but it offers new options for teaching practice.

2.4.5.2 Scientific Literacy

It is argued that teaching and learning are related to teachers' pedagogical beliefs (Brownlee, 2003; Pajares, 1992). The relation between teachers' beliefs and their instructional preferences is apparent from this perspective. As teachers' beliefs are seen as a predictor of their further preferences, from the view of Baxter Magolda (1993), those teachers holding the independent and contextual epistemological knowledge should demonstrate more of a facilitator role in the class than those holding absolute and transitional ones. In this respect, when it is observed how teachers value knowledge, those from the last two categories internalize the personal development of science and technology, viewing the aim to be raising scientifically literate persons. On the other hand, those believing the presence of absolute knowledge can only transfer factual knowledge. Constructivist teachers and those aiming to raise scientifically literate persons have parallel epistemological characteristics in that they lead students to develop their own knowledge construction in science and technology.

Personal development is seen as essential to take a part in the highly personalized digital age. The participants in the information age need to be critical and inventive

thinkers. In this respect, great importance has been given to cultivate the literacy levels of citizens all over the world in many areas, such as information, science, technology, and media. The common view became to enlighten their peoples' understanding in those subjects in order that they may live better lives (DeBoer, 2000; 2004; Lederman, 2004). A science and technology course is the properly fits to imbue the necessary competences that the individual needs in the information society.

The current wave in science and technology education is to raise scientifically literate citizens. "The life-enhancing potential of science and technology cannot be realized unless the public in general comes to understand science, mathematics, and technology and to acquire scientific habits of mind; without a science-literate population, the outlook for a better world is not promising" (Science for all American, 1990).

It is argued that the science literacy emphasizes the "utilization of scientific knowledge for the benefit of individuals, the common good or social progress" (Hurd, 1998, p. 409). Scientifically literate persons can differentiate and understand dogma, pseudoscience, knowledge from opinion, temporal nature of knowledge, limitations of science procedure; the scientifically literate person should be a critical thinker in recognizing the pros and cons and hold this habit in their actual lives while considering ethical and moral issues.

Coverdale (1996) conducted a case study which utilizes qualitative methodology to investigate how elementary teachers think about scientific literacy and how they use instructional technology to elevate the pupils' scientific literacy. Based on the researcher's classroom observation and interview with the teacher, the researcher found out that the teacher used instructional technology to develop students' global perspective and engaged her students in activity-based science lessons. The teacher used instructional technology to access and share information through collaborative problem solving activities. The subject teacher pointed out the importance of relating the learning with the real world and integrated instructional technology into her teaching.

McNall (2004) investigated how the first graduates of the revised secondary science teacher education program at the University of Virginia integrated educational technology during their induction year of science teaching. The researcher used interpretive research strategies with analysis of the data and five assertions were found: (a) the beginning science teachers in the study were confident in their abilities to use educational technology (ET) in their instruction; (b) they used ET to help students to visualize science concepts, to create authentic science experiences for students, and to make science concepts more meaningful to students; (c) They used ET to help transfer their philosophy into practice; (d) realities of classroom affected the participants' instructional use of ET during the induction year. (e) Although realities of classroom affected the participants' instructional use of ET, they continue to view it as an important facilitator of school science.

Mackinnon (2006) designed an action research study with teacher interns (n=68) in a science education course. The researcher's purpose was to guide teacher interns to be critically reflective teachers and eventually to become scientifically literate citizens in their professions. With this overall purpose, Mackinnon designed a technologically empowered science education course where the students were introduced to an electronic concept maps program. The students presented a positive view on using electronic concept maps during their education and the teacher supported the students' learning. The authors argued that by labeling the discussions and hyper linking with the concept map, students realized the value of its support for their conceptual understanding. Teacher interns stated positive views on technology integration into the teaching and learning process. They stated that by the use of technological tools they could possibly express their understanding in a rational way and the use of such devices in their profession would help their students to be more reflective learners.

Thoe, Rani, and Fook (2005) in their work "Developing Scientific and Technological Literacy (STL) Towards Lifelong Learning," presented the importance of scientific and technological literate people for a country. Their study was primarily centered to increase the STL understanding of twenty three in-service science teachers by focusing on the nature of science and meaning of STL, values and attitudes in

science, and strategies to promote lifelong learning. This in-service course flourished with the ICT inclusion with active learning strategies. The participants were given pre and post tests on the first and last day of course on six different issues: (a) the nature of science and meaning of STL, (b) values and attitudes in science, (c) strategies to promote lifelong learning, (d) the use of alternative assessments, (e) Web Quest and the use of multimedia resources for the planning of science lessons, and (f) multimedia resources for teaching and assessing STL. Observation on the participants' use of ICT in science and open ended data collected along with the post test were analyzed as the evaluation of learning outcomes. The results of pre and post test showed an increase on the participant's average scores on the six issues as presented above. Moreover, the results also revealed an increase in participants' knowledge and skills concerning the issues.

2.4.6 Years of Experience

There is an understanding that while teachers' years of experience are increasing, their adoption of new things becomes lower. Newly graduated teachers are more likely to use technology in their daily life (Hernandez-Ramos, 2005). Two factors should be considered in this perspective. The first one is about the training that they receive during their undergraduate studies. The second one is about the widespread use of ICT for academic achievement and personal purposes. The availability of technological devices helps those pre-service teachers to be competitive in ICT while preparing course research, papers, and presentations. Moreover, today, ICT is the most powerful communication and entertainment facilitator that is very popular among the younger groups.

Becker (2007) focused on the teachers' experiential differences in terms of technology and how teachers integrate technology into their curriculum. The results indicated that teachers having taught 1-10 years took technology classes more than veteran teachers and that novice teachers rate themselves higher than veteran teachers on operational skills (Word processing, email, spreadsheet, internet navigation, graphic organizer, video and sound applications and classroom

management systems), whereas all the teachers' ratings on pedagogical skills did not show significant differences. Interestingly veteran teachers rated themselves high on using dedicated instructional programs. Based on the teachers' use of technology, both operational and pedagogical novice teachers rated themselves higher then veteran teachers on the use of technology.

There are research results showing the negative correlation between teaching experience and the use of ICT (Gur, Ozoglu, & Baser, 2010; Kuskaya-Mumcu & Kocak-Usluel, 2004). Also, Bebell, Russell, and O'Dwyer (2004) stated this negative link in their study. The result of the study depicted that the teachers having experience in teaching for more than 15 years, reported the use of ICT for course preparation. Also those teachers are less likely to adopt the materials that prepared by others then the less experienced teachers.

2.5 Summary

ICT integration in teaching and learning process has been widely accepted. Many studies showed its positive effect on students' personal development via elevating their academic achievement (Lei, 2010; Mann et al., 1999; Papanastasiou, Zembylas & Vrasidas, 2005; Taylor, Casto & Walls, 2007), enhancing their motivation and positive attitudes towards learning (Burgess, 2009; O'Neill, 2007; Ringstaff & Kelly, 2002; Varank, 2003; de Winter, Winterbottom & Wilson, 2010).

In the literature, there are many studies, some of which are presented above, that focus on ICT integration and student learning. It is believed that this integration process has an effect on students' development and governments are supporting higher budget programs to make the technological devices accessible in schools and classrooms in order to facilitate the learning process. Despite the increase in technological devices in educational settings, researchers point to teachers' low use of ICT (Becker, 2000; Cuban, 2001). In the integration process teachers play the most important role (Fullan, 1991). Many studies proposed issues as barriers for teachers to accomplish ICT integration. Two broad categories are formed, first and

second order barriers. The former one presents the factors related with external issues such as technical availability, technical and administrative support, lack of time, whereas the latter one is composed of teacher related factors. The research results on integration of ICT among teachers presented that although the technical infrastructure of schools, technical and administrative supports are improved, teachers ICT integration pattern did not changed (Bebell & O'Dwyer, 2010; Cuban, 2001; ETI, 2005). For successful ICT integration teachers perceptions about ICT are an important factor (Gulbahar & Guven, 2008). From teacher aspect, teachers beliefs on teaching and learning (i.e. how they value teaching and learning) (Windschitl & Sahl, 2002) beliefs about technology and their beliefs on specific subjects like their understanding of science and technology (i.e. how they value science and technology) shape their professional practice.

In the literature, although teachers' perceptions towards ICT integration in education have been widely studied, there is not much study on teachers' perceptions towards its impact on their teaching. This study will present whether the classroom teachers perceptions towards ICT integration differs on its affect on education and their teaching. There are also few studies on classroom teachers' pedagogical beliefs in Turkey. The current study will identify the classroom teachers' pedagogical beliefs and profile them based on their pedagogical beliefs (constructivist and behaviorist) and its affect on teachers perceptions towards ICT integration. In addition, presenting scientific literacy of classroom teachers' and its relation with their perceptions of ICT integration is a new variable that studied with this study. Along with these, both teachers ICT use frequency and years of experience are studied in relation to teachers' perceptions of ICT integration in education and on their teaching. The result of the study will fill the abovementioned gap in the literature.

CHAPTER 3

METHODOLOGY OF THE STUDY

This chapter lays out the main tenets of the research methodology employed in the present study. An explanatory mixed method research design is selected and both quantitative and qualitative research methods are used to answer the research questions. By means of using the descriptive statistics, participants overall views on both dependent and independent variables are presented. To answer whether those predictor variables have any effect on the criterion variables multiple regression statistical analysis technique was used. With follow up interviews, teachers' views on those issues are presented.

Before the main study, a pilot study was conducted to examine the reliability of the instruments. In this chapter, design of the study, quantitative phase, qualitative phase, ethical issues, limitation and results of the pilot study are presented.

3.1 Design of the Study

The main purpose of the study is to investigate the current status of technology perceptions and its integration among the elementary teachers according to their pedagogical beliefs (constructivist, behaviorist), scientific literacy, frequency of ICT use for educational purposes and their years of experience.

In social science, there are many research methods that can be utilized ranging from pure quantitative to pure qualitative (Creswell & Plano-Clark, 2007). The edges of this range, offer a single research paradigm use with its epistemological beliefs on what values as true and how knowledge is generated. Most of the researchers agree that the research methodology employed totally depends on the research questions.

Bogdan and Biklen (1998) suggest choosing the either quantitative or qualitative one based on what the researcher is aimed to propose at the end of the research. Although this view has advocates, some others highlight using different research methodologies together (Fraenkel & Wallen 2005). Mixed methods research design use has gain a positive acceleration among the researchers. The rational is grounded to the insufficiency of using one methodology to answer the research question (Ivankova, Creswell & Stick, 2006). This allows covering their own deficiency not only collecting and analyzing different types of data but also answering the research problem from different perspectives.

As it has been discussed over decades, the definition of the term has been evolved by the time. Creswell, Plano-Clark, Gutman and Hanson (2003) the authors draw a detailed picture of this movement as following:

> "A mixed methods study involves the collection or analysis of both quantitative and qualitative data in a single study in which the data are collected concurrently or sequential, are given a priority and involve the data at one or more stages in the process of research. (p.212)"

This definition proposes to build the research not only on collecting different types of data and analysis, but it highlights the importance of choosing to meet the best fit model of mixed methods designs. Based on the studies in the literature, Creswell and Plano-Clark (2007) proposed four major mixed method types. These are categorized based on their data collection procedure, data priority and integration stage of those data. The first one is triangulation design aiming to collect different types of data to form a meaningful end result on one topic. The second one is embedded design where one research methodology has primary importance and the remaining has the supportive role. The third one is called exploratory design with domination on qualitative design. The last design type, two step mixed methods design, quantitative data directs the research where the qualitative part has a supportive role, and called as the explanatory design.

In sequential explanatory mixed methods research designs both quantitative and qualitative methods are used so that understanding of the study topic can be

enhanced (Ivankova, Creswell & Stick, 2006). The main aim for using explanatory design is to collect qualitative data on the research topic to explain the quantitative data results (Creswell, et al., 2003). The use of this design type is suitable to get deep information about outliers, unexpected or significant results, and also to make groups for qualitative part of the study (Creswell & Plano-Clark, 2007). Explanatory mixed methods is more straightforward than other types and this makes to conduct each phase at a time and present the results separately (Creswell et al., 2003; Ivankova, Creswell & Stick, 2006). The length of time to collect both quantitative and qualitative data sequentially is the limitation of the study (Ivankova, Creswell & Stick, 2006; Creswell & Plano-Clark, 2007).

This explanatory mixed methods research design is employed based on Creswell, et al., (2003), and Creswell and Plano-Clark (2007) descriptions to answer the research questions. Demographic and descriptive items, five-point Likert-type scale questionnaires and semi-structured interviews were used to collect the study data. Figure 3.1 shows a detailed picture of the research design. The rational for selecting this research methodology as the design of the study is presented below.

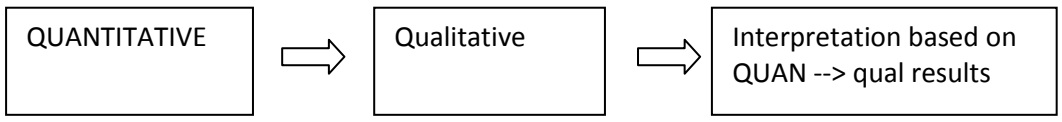


Figure 3.1 Sequential explanatory mixed method design

In this research, first of all quantitative part of the study then following qualitative phase was conducted. The quantitative research approach is used in order to find out general characteristic of the elementary teachers on the topic and the relationship between dependent and independent variables (Creswell, 2003). A survey instrument, consisting of demographic and descriptive items, and five-point Likert-type scale with three different surveys, is used to collect data from a large number of individuals to address the research questions (Fraenkel & Wallen, 2005; Creswell, 2003) that can be generalized to the population. Teaching Belief Survey (TBS), Technology Attitude Survey (TAS) and The Basic Scientific Literacy Survey (TBLS) are the instruments that were adapted for the study.

Main study was conducted in the city of Ankara in Turkey. The population is the elementary teachers who are currently employed at the state elementary schools. Random cluster sampling strategy was used to assign the schools. The quantitative data were calculated by using SPSS 15 statistics program. Based on the results of the analysis, the researcher collected further information in the qualitative phase. The result of the quantitative phase is used to make participant selection of the following phase (Creswell, 2003). In the qualitative part of the study it was aimed to identify the both group participants' common and different perceptions on the significant variable that identified in the quantitative phase (Bernard & Ryan, 2010). The design procedure was presented with a visual diagram to make the research procedure more apprehensible for the reader (see Figure 3.2).

Research Design

PHASE	PROCEDURE	PRODUCT
QUANTITATIVE data collection	Survey instrument N: 2350	Numeric data
	Random cluster sampling	
	Permission from MEM	
	Instrument application	
	Data collection	Transforming data into statistic program
QUANTITATIVE data analysis	Data screening (univariate-multivariate)	Descriptive statistics
	Frequencies	Descriptive statistics
	Multiple regression	Regression equation
	Interview question preparation	Interview protocol
Connecting Quantitative and Qualitative study	Cluster analysis	Grouping teachers based on their teaching belief
	Convenience sample selection based on cluster analysis	20 individuals selected 10 from constructivist 10 from behaviorist clusters
Qualitative data collection	Semi-structured face-to-face in-depth interviews	Audiotape interviews transformed to text
	Coding and thematic analysis	Codes, themes
Qualitative data analysis		
Presenting QuaN and Qual results		Quan and Qual part results
Integrations of the quantitative and qualitative results	Interpretation and explanation of the quantitative and qualitative results	Discussion Implications Future research

Figure 3.2 Visual model of research design

3.2 Quantitative Phase of the Study

In this quantitative part, participant selection, instrumentation, data collection, and data analysis of quantitative part of the research are presented.

3.2.1 Selection of Participants

Sampling procedure is an important step as obtained information is used to find out the characteristics of the population base on the selected variables (Johnson & Christensen, 2004).The random sampling strategies enable researchers to draw representative participants of the population so that the generalizability can be meaningful. Cluster sampling strategy is the one that used, where it is hard to reach each individuals form a population (Fraenkel & Wallen, 2005). The population of this study is the elementary school teachers and it is too difficult and inefficient to reach each elementary teacher that is employed in Ankara.

Ankara, the capital of Turkey was selected for the research site because of its cosmopolite structure and representative picture of the whole country. The population of the current study becomes elementary teachers (classroom teachers) currently employed in the city of Ankara. As presented by Ankara Provincial Directory of National Education (APDoNE), the number of elementary schools in Ankara is 530 with approximately 9880 elementary school teachers by the year 2008. Eight Ankara city counties are selected and from each county 25% of the schools are randomly identified by using SPSS 15 statistic program. A total of 140 schools are selected as the target schools. Although the sampling strategy is essential for a study, reaching the desired population is the most important point for collecting the data. For the study, permission from the related institution for the selected schools was requested. The researcher was asked to eliminate some of the schools which were recently selected by other researchers. After the elimination of those schools, the permission was obtained for 17 % of the schools. The data were gathered from 90 schools' elementary teachers for this study.

The researcher visited each school with the permission from the APDoNE and the surveys were distributed to the elementary teachers. As it is presented in the APDoNE's permission, volunteer teachers participate to the study and those volunteers handed in the survey with their responses. 2350 surveys were distributed with a return rate of 45%, and 1055 data were collected for the study. Table 3.1 shows the general characteristics of study participants.

Table 3.1 Demographic characteristics of participants

		Frequency (N)	Percentage (%)
Gender	Female	654	62.0
	Male	401	38.0
	Total	1055	100.0
Years of Experience	1-10	298	28.2
	11-20	500	47.4
	21-30	216	20.5
	31- high	41	3.9
Grade Level	1th grade	159	15,1
	2 nd grade	177	16,8
	3 rd grade	192	18,2
	4 th grade	213	20,2
	5 th grade	172	16,3
	Missing	142	13,5
Schools Graduated	High school-college	314	29.8
	Faculty of education	492	46.6
	4 year faculty	249	23.6

3.2.2 Data Collection and Instrumentation

For the purpose of the study, three different instruments were administrated to answer the research questions. To assess elementary teachers views on ICT and its effects on teaching and learning Technology Attitude Survey (TAS), to identify teachers pedagogical beliefs the Teacher Beliefs Survey (TBS) and to present their scientific literacy, The Basic Scientific Literacy Survey (TBSL) were used. In this section, first of all, all instruments were introduced in detail, than the translation procedure was given. Afterward, validity and reliability issues of the instruments were presented.

3.2.2.1 Technology Attitude Survey

Elementary teachers' perceptions of ICT integration in education was measured by a modified version of the Technology Attitude Survey which was developed by Francis-Pelton and Pelton (1996). Original instrument was composed of 42-item 5-point Likert scale responds (1: strongly disagree to 5: strongly agree). After statistical analysis, the authors presented 39 items solution with eight factors where half of the factors only contain three items in each. Bai (2006) used the instrument with 42 items and after pilot study he came up with four factor solution with 33 items. He named the factors as; educational benefits, confidence, impact on teaching and concerns effects on students. Based on the literature review and the constructs of this instrument, it was decided to modify and use the instrument for the aim of the study.

3.2.2.2 Teaching Belief Survey

In the literature, there are instruments developed to measure some aspects of the teachers' ways of teaching but most of them are not focus on the pedagogical beliefs. McCombs and Whisler (1997) developed 35-item Likert type Teacher Beliefs Survey. This instrument focuses on three factors related to pedagogical views of the teachers. First one is learner centered beliefs about learners, learning and teaching, second one is about non-learner-centered beliefs about learners and last one is non learning-centered beliefs about learning and teaching.

Another survey, The Teacher Beliefs Survey, was first developed by Sandy Woolley (1999) to find out elementary teachers' beliefs on the learning theories; constructivist and behaviorist then the instrument was revised. The instrument used in this study was adopted from Benjamin (2003) from 48 item- teaching beliefs survey. The validation study presented four factors structure, behaviorist management, behaviorist teaching constructivist teaching and constructivist parents, with 0.72, 0.74, 0.68 and 0.54 cronbach's alphas.

Benjamin (2003) presented both behaviorist and constructivist views of teaching and learning so that the participants' views on both aspects can be assessed by using a single instrument. Based on the purpose of this study, a modified version of the TBS was used. For this adopted version of TBS 19 items were selected from behaviorist and constructivist items.

3.2.2.3 Scientific Literacy Survey

An extended literature review on the instruments assessing scientific literacy reveal three important points; nature of science, science subject, and technology dimensions. Many researchers used Nature of Science perspective to assess scientific literacy (e.g. Test on Understanding Science (TOUS), Nature of Scientific Knowledge Scale (NSKS), and Views of Nature of Science Questionnaire (VNOS). The second dimension of scientific literacy has been frequently used in the educational settings in order for to assess the key concepts of science. For the technology dimension the most prominent example is Views on Science-Technology-Society (VOSTS). These instruments are developed to assess only one dimension of scientific literacy. However the Basic Scientific Literacy Survey developed by Laugksch and Spargo (1996) assess all three components of scientific literacy; Nature of Science Subtest (NSST, 22-item), Science Content Knowledge Subtest and (SCKST, 72-item) and the Impact of Technology on Society Subtest (ISTSST, 16-item). This instrument is the most appropriate one in the literature to assess the target populations understanding of science and technology. As the aim of this study is not on the content knowledge of the participants, two dimensions of TBLS nature of science and impact of technology on society are included.

3.2.2.4 Technology Use Frequency

The elementary teachers' technology use frequency was assessed by using 14-item technology use items. This scale was developed based on literature. Teachers hardware and related software use frequency was gathered with the instrument. Factor analysis was conducted with these fourteen items and based on eigenvalues greater than1 presented two factor solutions where as the scree plot one factor solution was clear. The one solution factor result presented a reliability score .86.

3.2.3 Translation and Validation of the Instruments

For this study, Technology Attitude Survey (TAS) developed by Francis-Pelton and Pelton (1996), The Teaching Beliefs Survey (TBS) developed by Benjamin (2003) were translated from English to Turkish. Van de Vijver and Poortinga (2005) presented the importance of the need of adaptation process rather than translating the instrument linguistically one language to another. Since the original instruments are developed other than Turkish, literally translation rather than wording of item is needed. This also helps not to make construct bias since "behaviors, attitudes or norms are not identical across groups" (Van de Vijver & Poortinga, 2005, p. 43). Sireci, Patsula and Hambleton (2005) pointed out the importance of using content experts who are literate in different languages in order for to overcome the construct issue.

For this reason, five, different area experts are included in the adaptation phase of two instruments and an elementary teacher is involved in the checking the appropriateness of the items for the target population. Two English language instructors at a university, both have master degree in educational science translated the instruments separately. They were informed to modify the items based on their meanings in Turkish. Both translations were compared and the discrepancies were handled. After comparing the translations, another English language instructor was asked to back translate Turkish version to English. Two research assistant from CEIT and one from science education department who are all fluent in both languages checked the translated version and necessary changes were done. In addition, a

faculty member both educational science and educational technology expert checked last version of the instruments and compared the adopted items with the original ones. The Turkish version was given to an elementary teacher and asked to read and think loudly on the sentences. After all these, proper changes were completed and the Turkish version of The Teaching Beliefs Survey (TBS) and the Technology Attitude Survey were used to collect data on the research topic.

3.2.3.1 Validation of TBS

Validation is about accuracy of the construct. For the translation of an instrument to another language, it is important to be aware of the biases that can be faced with. Construct, method and item biases are the most prevalent ones that are to be considered by the researcher (Van de Vijver & Poortinga, 2005, p. 43). Construct bias is about the variation on the construct among the culture where method is about the different responses or use of the instrument itself and item bias is about the poor translation of the items. The instrument adapted has a 5-point Likert type response, and these types of instruments are very popular in Turkey, since this method bias did not taken into consideration whereas other two proposed to make an extended work on the instrument. Because of the nature of the issue, the construct itself has a very huge description, it is hard to select items from a very largely defined pedagogical views. By considering these, Benjamin's (2003) the Teaching Belief Survey was used as a guide to select the pedagogical items. An expert in educational science was asked to select the most appropriate items from the original instrument that can present the two different pedagogical views for the elementary teachers.

Nineteen items out of forty eight were selected for the study. Eleven of the items represented the constructivist view of teaching and remaining eight items represented the behaviorist views of teaching. The selected items were adapted into Turkish. The translation was conducted by area experts, faculty and target population participants. This procedure was presented under the translation of instrument section above. Data collected from pilot study were analyzed and factor analysis was performed. Scree plot presented two factor solutions while Eigen value greater than 1 showed more than 2 factors. Since the items were selected from two different teaching aspects, it was determined to stick with two factor solution. The principle axis factoring method

with oblique rotation was conducted to find out whether the construct items fall under the stated factors. In the literature, item loadings around .7 is accepted as excellent where loadings below .3 seen as poor (Comrey & Lee, 1992). Although this categorization is mostly preferred one, identifying the cutoff point for factor loadings is depend on the researcher's interpretations (Tabachnick & Fidell, 2001).

The factor loadings were presented in the pilot study section and the loadings are ranged from .72 to .24. Three items (1, 3, and 4) were loaded with a value below .3, when the items were checked it was decided to strict with first and third items since those items represented key characteristics of the constructs. On the other hand, item number 4, which was also with low loading and item number two with .3 loading, were seen as unclear. The first factor composed of ten-item constructivist teaching beliefs and behaviorist view is assessed by 7 items (see table 3.2). The first factor presented an alpha of .78, and the second factor revealed .58.

Table 3.2 Factor and item loads for TBS

Factors	Item number	Cronbach's alpha
Constructivist items	1, 5, 7, 8,12, 13, 14, 16, 18, 19	.78
Behaviorist items	3, 6, 9, 10, 11, 15, 17	.58

The reliability analysis results presented acceptable reliability for the both factors. When looked at the development process and the expert opinion section, the best was done to form an effective and efficient instrument in order to use for the research purpose, but the construct itself is an ill and widely defined one. Teachers' belief on teaching is a blur construct to measure by using multiple paper pencil tests as stated

by Richardson (1996). This explanation makes sense to explain the low reliability of the sub factor.

3.2.3.2 Validation of TAS

The instrument items were seen as the most proper one in order to reveal the elementary teachers technology perceptions, so two of the sub dimensions of the instrument were used, educational benefit and impact on teaching.

As mentioned previously construct and item biases were taken into consideration while adopting the TAS instrument too. Educational benefit and impact on teaching dimensions were translated to Turkish by experts in the area and population member checking was done to make the translated items much proper for the target population. Along with an area expert faculty, two research assistants in CEIT and one from educational science checked the items. The items get low loadings in Bai's dissertation was discussed by the experts and as because of their low loadings and fairly blur translations those items were discarded from the item pool.

Elementary teachers' technology integration perceptions were assessed by using two-factor 20 items five-point Likert type scale (1: strongly disagree, where 5 strongly agree). Pilot study data were used to present the latent constructs of the instrument. With the pilot study data explanatory factor analysis was run and scree plot and Eigen values were checked to find the number of factors. Scree plot presented a very clear cut of point with two factor solution, where eigenvalues presented more. The researcher decided to go with two construct. Explanatory factor analysis was run by principal axis factoring method with oblique rotation. The result of the analysis presented a good picture of 2 factor loading, ranging .67 to .38. Item examination with loadings were done by an area faculty and a faculty from educational statistic and it was decided to continue with two factor solution but experts gave consultant towards to drop the last two items since the translated form of the items presented an understanding of confidence on technology use and the item number 12 because of its pre-service teacher focus. The final version of the instrument composed of 17 items, 12 items under educational benefit and 5 items under impact on teaching. To find out the cronbach's alpha values for each factor, reliability analysis was

conducted and educational benefit factor presented .87 and impact on education factor showed .69 cronbach's alpha values.

3.2.3.3 Validation of SL

Fraenkel and Wallen (2005) propose that the construct related validity can be obtained by first, with clear definitions of variables. The original test development process and expert opinion are the appropriate validity indices for the survey.

TBLS items were developed based on literacy goals in science, math and technology in AAAS's report naming Science for all Americans (SFAA) document. Selected 240 key sentences from the report was examined by 41 randomly chosen Fellows from the Royal Society of South Africa, then the sentences were converted to true-false-don't know items. Having the items checked by 21 university lecturer, language of the items was examined by experts. With a total 472 item, pilot test was conducted to 966 university students enrolled to chosen lessons. The participants were divided into two groups based on the science courses that they took. Item discrimination was used to determine the final 110 item test; 22 items for Nature of Science, 72 items for subject test, and 16 items for nature of technology. They proposed that the content validity of the TBSL can be considered as high since the items were all developed based on a national report leading the science, math and technology education. The criteria were set to identify scientifically literate pupils from others by pilot testing with two different groups. The results presented positive test discrimination between instructed and uninstructed students.

For item validity, item-objective congruence and technical quality of items were reported. "Item-objective congruence was evaluated by a judgmental review procedure" (Laugksch & Spargo, 1996, p.342) that the researchers were confident about this validity. Technical quality was also provided by 21 expert opinions. Construct validity of the instrument was presented by comparing the test items with benchmarks for science literacy published by AAAS. Since the development of TBSL was ahead before the benchmarks and as stated by researchers both documents had more then 60 % statements, and the TBSL's construct validity was provided. To assess the reliability of the test, the researchers used internal consistency. Kuder-

Richardson 20 coefficient for subtest was given α20: .73 for NSST, α20: .94 for SCKST, and α20:.78 for ISTSST and the whole tests α20: .95.

The Turkish translation was done by Turgut (2005) and cronbach's coefficients alphas for two subscales, nature of science and the Impact of Technology on Society Subtest were presented as 0.83 and 0.73.

For this study, target participant check was conducted to make the instrument more appropriate for the participants and cognitive interviews were conducted with two elementary teachers. In addition to the participants' views, two academics were asked to check the items on their content appropriateness. After necessary changes, 38-item TBSL survey was administrated in the pilot study. The reliability coefficient for the total instrument was found .71. In the main study, the instrument was used by eliminating some items of it to use the instrument in an efficient way with other instruments. This elimination was done by an expert. After elimination of the items, elementary teachers' scientific literacy was identified by using 23 items, 15 for science and 8 for technology part. In this survey 10 items were reversed coded so that all the items became true statements as declared by the survey developers (Laugksch & Spargo, 1996). The internal consistency reliability analysis was conducted and cronbach's coefficient alpha of the whole test present .64

3.2.4 Data Analysis

Quantitative data from main study and pilot study were analyzed by using descriptive statistics, explanatory factor analysis cluster analysis, and multiple regression analysis by using SPSS 15 program.

Descriptive data from main study was calculated in terms of means, minimum, maximum and sum values. Continuous data for teachers' years of experience were grouped with 10 years of intervals. One to ten years, "1"; eleven to twenty years "2"; twenty-one to thirty "3"; and more than thirty one years "4". This categorization enables to classify the teachers years of experience with a decade interval.

The elementary teachers were asked to check how often they use technology (hardware and software) where non use presented "1", once a week "2" more than one "3", and everyday "4". Their use of technology was calculated by adding the scores. Three surveys were used to reveal teachers understanding of science and technology, teaching belief, and perceptions of technology. At the beginning of the analysis the negative items were reverse coded to make the item positive so that all the items become coded within the same direction. Data screening were conducted both using Z score and residuals so that to identify any scores that can make significant affect on the results of the study. Explanatory Factor analysis, cluster analysis and multiple regression analysis were conducted and presented below.

3.2.4.1 Elementary Teachers' Beliefs on Teaching

The Teaching Belief Survey was consisted of two subscales one represent constructivist views of teaching where the second one present behaviorist oriented view. The scores from 5-point Likert type scale presented a continuum for constructivist dimension scores range 10 to 50 point and for behaviorist dimension this score range 7 to 35. No criteria were set for labeling the participants as constructivist or behaviorist. In order to find out the number of teachers who had constructivist and behaviorist views cluster analysis is used. This analysis is appropriate to categorize meaningful and homogeneous subgroups (Fraley & Raftery, 1998) on the selected variables. The cluster analysis is used to create groups with maximum similarity among group members, and maximum variation among between group members. There are many different cluster analysis types. The most prominent ones are two step cluster analysis, hierarchical cluster analysis and K-means cluster analysis. Two step cluster analysis can be used for large data sets (>200) with log-likely hood method, and in the selected method, Euclidean distance measure is used this is robust for violation of analysis assumptions (Garson, 2010). In addition, in the analysis any outliers can be detected and discarded while creating the sub groups. These criteria led the researcher to use K-means cluster analysis this approach to make subgroups within the data set. Before conducting the analysis, the variable scores were converted to standardize score to make the impact of variables equal while computing the distances.

3.2.4.2 Elementary Teachers' Technology Perceptions

Teachers' technology perceptions were assessed by using Pelton's technology attitude survey (1996). The survey composed of 17 items, 12 items for educational benefit and 5 items for impact on teaching. From educational benefit dimension scores range 12 to 60, where on impact on teaching dimension this range is 5 to 25.

3.2.4.3 Elementary Teachers' Scientific Literacy

Participants' mean scores on Test of Basic Scientific Literacy (TBSL) with two subscales were calculated. The test scores were on five-point Likert type continuum 1: strongly disagree to 5: strongly agree. Participants mean score presents a range of 23 to 115. Participants total mean scores for each part was calculated through dividing the scores for the number of items. The scores which were under 3 represented a naïve understanding of science and technology (Turgut, 2005) where above scores represented a realistic understanding.

3.2.4.4 Relation with Criterion and Predictor Variables

The study is build on to learn more about the relationship between elementary teachers' ICT integration perception and pedagogical beliefs, scientific literacy, their ICT use frequency and years of teaching experiences. To present such relationship, the most proper statistic analysis is multiple regression analysis. Before the analysis, normality, homoscedasticity, and independence of errors assumptions were checked. Below, multiple regression analysis assumptions for both educational benefit and impact on teaching were presented.

3.2.4.5 Assumption Check for Educational Benefit

Correlation is often used to explore the relationship among a group of variables (Pallant, 2001). Tabachnick and Fidell (2001; p.84) suggest that bivariate correlations between two variables should be less than .7. Two predictor variables individual correlations between independent variables were analyzed and the correlation coefficients were not found above .7.

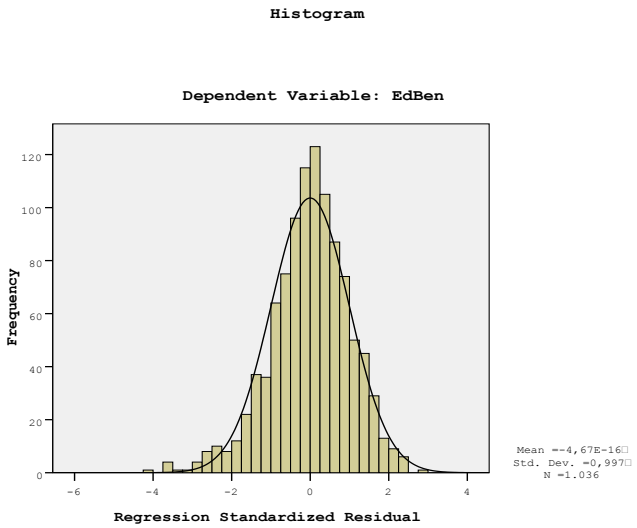


Figure 3.3 Histogram of educational benefit

For normality assumption, histogram, P-P Plots and scatterplots were considered. When the shape of the histogram is considered, as shown in Figure 3.3, it is normally distributed. Therefore the assumption is not violated. There is no apparent pattern that the normality assumption is not violated. In addition values of skewness and kurtosis are between [-3, +3] (Tabachnick & Fidell, 2001; p.72) that the normality assumption is not violated.

The assumption of homoscedasticity examines whether the standard deviations of errors of prediction are approximately equal for all predicted dependent scores. Homoscedasticity means that the band enclosing the residuals is approximately equal in width at all values of the predicted dependent variables (Tabachnick & Fidell, 2001: p.121). Thus, for Educational benefit the assumption is NOT violated.

To check the assumption of independence of errors, the Durbin-Watson coefficient test was used which can get a value between 0 to 4, with a value closer to 2 indicates no correlations among residuals (Field, 2005). Durbin-Watson analysis for the

criterion variable, Educational benefit revealed the score d=1.94 presents no violation of the independence of errors assumption.

At the beginning of the analysis missing values were checked. It was seen that for only the frequency of technology use contains missing values of 0.8% percent of data. Since the proportion is under 5% nothing has done to deal with the missing values (Tabachnick & Fidell, 2001). Standardized scores were used to check the outliers. Influential observations were checked by scatter plots, residuals plots, Cook's distance, and leverage test. Although a few outliers were detected their influence on the regression results were checked by their Cook's distance and Leverage values. It was seen that the Values of Cook's distance are less than 1, centered leverage values are less than 0.5. (Stevens, 2009)

To identify multicollinearity, bivariate correlations, tolerance and VIF (variance inflation factor) values were checked. As it mentioned before bivariate correlation is less than .7, so all variables can be retained (Tabachnick, & Fidell, 2001). Most of the variables presented collinearity statistics values of tolerance larger than .2 and values of VIF less than 4.

3.2.4.6 Assumption Check for Impact on Teaching

To assess the normality assumption histogram, P-P Plots and scatter plots were checked for any violation. As shown in figure 3.4 criterion variable's frequency distribution was nearly normally distributed. Also, skewness and kurtosis values are range between [-3, +3] (Tabachnick, & Fidell, 2001) that the normality assumption is not violated.

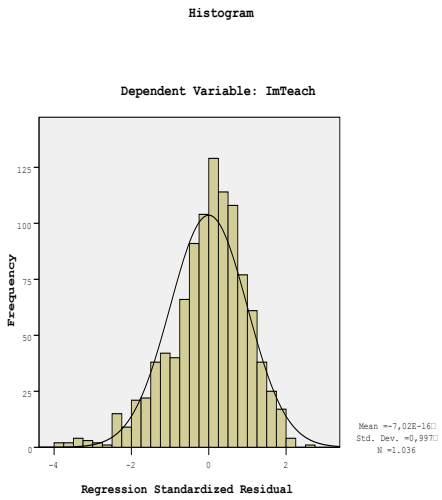


Figure 3.4 Histogram of impact on teaching

The homoscedasticity assumption for impact on teaching criterion variable with all predictors, the assumption was met. Independence of errors assumption was checked by Durbin-Watson coefficient. For impact on teaching criterion variable D-W analysis reviled a score of d=1.73 presenting no violation of the assumption.

Missing values in the data presented a small amount of value (0,8%) so nothing has done because of the percentage of the missing were well below the suggested value of 5% to make treatment for the values that were not presented (Tabachnick & Fidell, 2001). Outliers check was done by using z scores of the variables. Scatter plots, residuals plots, Cook's distance, and leverage test were checked and no influential one was detached. Bivariate correlations, tolerance and VIF values were checked to assess multicollinearity. Bivariate correlation showed less than .7, so all variables can be retained. The predictors showed values of tolerance larger than .2 values of VIF less than 4 by presenting collinearity assumption met.

3.3 Qualitative Part

In this part, participant selection, instrumentation, data collection, and data analysis of qualitative part of the research are presented. The qualitative part of the study was conducted after completion of the quantitative part. For the interviews, 20 elementary teachers were purposefully selected, and the interviews were conducted during the spring and fall semester of 2009 academic year.

3.3.1 Selection of Participants

The main aim of using purposeful sampling is to select information rich elements to make an in depth understanding (Patton, 2002) on the topic. Focusing on information rich cases allow researchers to minimize the number of the participants. As its nature, explanatory mixed methods research design is very straightforward with sequential use of both quantitative and qualitative methods. Implementation of quantitative part and the results of the data mostly identify the focal points for the qualitative part. While selecting the participants of qualitative part, one can use different individuals from the previous part or select from the quantitative sample. This is totally depends on the research purpose and the selection strategy. In this explanatory research design, the sampling for qualitative part of the study was done after Quantitative data analysis as shown in Figure 3.2, by purposefully selection of the participants who were accessible participated to the quantitative part of the study.

The result of quantitative data analysis was used to form qualitative sampling. The statistical analysis presented a high effect of elementary teachers' pedagogical beliefs on their technology perceptions, and this point was determined as the focal point while determining the samples of qualitative part of the study. Although the developers of the Teaching Belief Survey did not presented any criteria to label the participants either constructivist or behaviorist, it was decided to conduct a cluster analysis to form groups based on similar views of pedagogical beliefs. The result of the cluster analysis presented a four group solution, first group presented behaviorist orientation, second group presented constructivist orientation and remaining two

groups presented neither constructivist nor behaviorist orientation. It was determined to conduct face-to-face semi structured interviews with elementary teachers who hold different pedagogical views to reveal an in-depth understanding on the issue. Since the multiple regression analysis result presented very high impact of teaching belief, qualitative part participants those who were accessible were purposefully selected from behaviorist and constructivist group.

3.3.2 Data Collection and Instruments

The interviewees were asked whether they might be a participant of the interview study. They were asked the proper time and location in their school for interview. With those accepted a face to face semi structured interviews were conducted in their schools. The interviews were scheduled and mostly they were done in the teachers' room, in participants' free time. Semi structured face-to-face interviews were conducted with a number of twenty teachers. The interviews were lasted 20 to 50 minutes. The interviews began by informing the participants that the interview will be audiotaped and one out of twenty participants accepted. The researcher used an interview guide to collect data on the research topic

3.3.2.1 Interviews

Interviews are valuable instruments that help to collect first hand data from by one-to-one interaction. The main aims for interview studies are to reveal individuals thoughts or feelings on the issue (Fraenkel & Wallen, 2005). For the qualitative part of the study semi structured interviews were conducted. Semi-structured interviews are composed of series of questions with probing questions. Because this type of interview technique does not have a strict nature, the probes and their sequence are varying based on the participants' responses. This flexibility of the semi-structured interviews allow researcher to shape the session based on participant's answers. The interview protocol was developed by the researcher for elementary school teachers on the topic of the study.

First of all, the interview questions related with the issues addressed in the quantitative part were listed. The instruments, analysis and the result of the quantitative part were explained to three research assistants from faculty of education. They were asked to check the interview protocol and make suggestions on the questions and probes. Then, proper revision was done and a faculty was checked the appropriateness of the items on the topic. Lastly, with an elementary school teacher, interview protocol questions were discussed and again changes were made. Table 3.3 presents the last version of the interview questions.

Table 3.3 Interview schedule

What kind of technological tools you can use in your classroom and school?
How you evaluate the ICT integration during course preparation and classroom use?
Could you please briefly describe the process of your preparation for your classes?

3.3.2.2 Data Analysis

The most challenging part of the qualitative study is data analysis. In the qualitative data analysis it was aimed to present common themes, and categories that present similarities and differences between two group participants (Bernard & Ryan, 2010). Data analysis part of the study involved transcribing, organizing, examining, arranging, categorizing, dividing, synthesizing, and discovering understanding of the study data and presenting the findings.

The qualitative data analysis in this research is conducted based on the way that described by Marshall and Rossman (1999). The data analysis process was begun with the organization the data including data transcribing from audiotaped to written format. MS word was used to present and arrange the written version of the data. All

interviews were arranged in the same flow in order to make the data coding process effective and efficient. The researcher read the transcribed data for each interviewee. Having done this process, all interviews are read through for each question and their answers. This procedure enable researcher to identify common elements and prepare for the data coding phase. During the qualitative analysis open coding, and axial coding were used as described by Strauss and Corbin (1998). "The analytic process through which concepts are identified and their properties and dimensions are discovered in data" is defined as open coding (p.101). Line by line analysis procedure was used in the data coding part. Same codes were given for similar expression. Axial coding was conducted to "to begin the process of reassembling data that were fractured during open coding" (p. 124).

Many codes were identified through the open coding process. These codes were arranged under patterns and similarities and sub categories were emerged. patterns, themes, and categories are formed. Those codes themes and categories are presented in an analysis table (see, appendix, D). The final report is presented based on final themes, and categories.

3.3.2.3 Quality and verification of the qualitative part of the study

In quantitative researches quality an verification of the study is important (Cresweell, 2007). In quantitative inquiry, this procedure is called validity and reliability, however in the qualitative research different terms are used. Guba and Lincoln (1985) use trustworthiness and credibility, conformability, dependability, and transferability strategies are focused to ensure it. Many other strategies are presented in the literature (Creswell, 2007; Merriam, 1998) and following points were considered for this study.

Prolonged engagement: It is important for researcher to spent proper time with the target population. The qualitative phase of the study was conducted after the quantitative part in which the researcher communicates almost each quantitative participant of the study. During this period, and based on the results of the quantitative part, the researcher had the opportunity to learn the culture and communicate with the interviews before the data collection.

Data record: the most important treat for the quality and verification of the study is data record. The data was audio recorded in order not to make inferences from researcher's field notes.

Peer review: this procedure provides and external check of the process. Creswell (2007) stated that the reviewer may be a peer or another researcher. In this study, two researches assistant and an instructor from the same department participated to the peer review process

Member checking: Lincoln and Guba (1985) presented this procedure is the most important part of the qualitative study. For this study, data transcribe and data analysis, two interviews were asked to check whether the raw interview data and the codes and themes which were derived from were accurate.

External audit: This process "allow an external consultant to examine both the process and the product of the account, assessing their accuracy" (Creswell, 2007, p. 203)". A different area expert participated to this phase of the study.

Rich description: data collection, analysis and data presentation processes were described in detail to make the study more comprehensible. Using such detailed information presentation way increase the probability of replicating the study in other contexts (Creswell, 2007).

3.4 Ethical Issues

In research the ethical issue is a matter that the researcher must be deal with. Three important issues are to be considered by the researcher; protection participants from harm, confidentiality of participants, and informant of participants on the study (Frankel & Wallen, 2005). In addition to protect the participant's rights, data collection and the result presentation are other important phases that the researcher should consider. For this research study, ethical community approvals were obtained. First of all, with proper documents including the research purpose, procedure, sample and the instruments that that are going to be implement, researcher apply to get an

approval from the university ethics commission., the commission gave permission to conduct the study. Secondly, after getting the university commission approval, researcher apply to APDoNE with necessary documents and university ethics report and both commissions stated positive report for the study. In addition to ethical reports, during the implementation phase, participants were not merged to fill the research instrument. As it is stated in the APDoNE reports, teachers do not have to be a part of the study unless they voluntarily participate. For the quantitative and qualitative part of the study, the researcher asked the elementary school teachers whether they want to be a participant of the study or not, and they were also informed before the study that they can quit any time they want. Their permission on audio taping the interview session was also asked.

3.5 Limitations

- This study is limited by elementary school teachers in ANKARA.
- This study is limited to 1055 elementary school teachers with a return rate 45 % to the survey study.
- In the study, cluster random sampling strategy was used to determine the schools in the city of Ankara. To be able to conduct the study in elementary schools, APDoNE approval is needed. When the researcher apply for permission for randomly selected school, the APDoNE staff asked to eliminate some schools as they were had just selected for other researchers. This may cause a problem for randomization of sampling.
- The Qualitative part sampling was done based on the results of the Quanitative results. Statistical analysis may cause a limitation.
- As for the qualitative part, convenience sampling strategy based on the statistical analysis is another limitation.
- Study has a limitation based on the reliability of participants' responses to the instrument.
- In the science content part of the TBSL survey was discarded. This may cause a limitation to identify the teachers' scientific literacy levels.

3.6 Pilot Study

For pilot study, 24 schools from a small city in the southern west part of Turkey were randomly selected. The elementary school teachers from these schools became the sample of the pilot study. Data were gathered from 282 elementary teachers (201 male and 81 female).

The teaching belief survey consisted of 19 items on a continuum of five-point Likert scale where 1- "strongly disagrees" and 5- "strongly agree". Items were representing both behaviorist and constructivist statements. Technology attitude survey consisted of 20 items. TBLS was consisted of 38 items.

Factor analysis a statistical technique applied to a set of data to discover which items can load to latent constructs (Tabachnick, & Fidell, 2001), was conducted whether the items clustered under the specific factors. Exploratory factor analysis (EFA) with principle axis factoring extraction method by direct oblimin rotation was conducted to determine the latent factors for the Teaching Belief Survey and Technology Attitude Survey since the principle axis factoring extraction method was conducted as it is not consider the normality assumptions.

Before conducting the factor analysis the appropriateness of the sample size, normality, and multi-collinearity (Tabachnick, & Fidell, 2001 p. 628) were checked to see whether the FA can be applied to the data set. After meeting the assumptions, initial FA was conducted to identify the numbers of factors using principal axis factoring based on Eigenvalue and scree plot. Eigenvalues more than 1 and in scree plot the point at which the curve begins to straighten shows how many factors must retain for further investigation (Tabachnick, & Fidell). Second factor analysis was conducted with oblique rotation which is mostly used in social science indicating that the factors "might be correlated with each other" (Andy Field , 2005,p. 645) that the factors are related with each other so that the axis that used to . With the result of the rotated factor analysis items which were load to the factors were used to calculate the sub dimension's reliability value. In this study, SPSS 15 statistical program was used to analyze the data with alpha level of .05.

3.6.1 Assumptions for Factor Analysis

Missing values and any values other then the defined ones were checked prior to analysis. If there is only a few data points about 5% are missing in a data set, handling of these missing points yields similar results (Tabachnick & Fidel, 2001, p. 59). In pilot data set, no missing value was identified.

In order to check the multivariate normality, univariate and bivariate normality must be checked. Histograms, skewness and kurtosis, were examined for multivariate normality. Having checked the histograms, it was observed that the distributions were all skewed to both sides depending on the question. Also the values of skewness and kurtosis between [-3, +3] (Tabachnick, & Fidell, 2001) is an indicator of the normality, and the values of this analysis presented a result between indicated interval.

3.6.2 Factor Analysis for Teaching Belief Survey

Initial factor analysis was conducted to identify the teaching belief surveys' latent construct. Scree plot and eigenvalues were checked to decide the number of factors for Teaching Belief Survey. Scree plot (figure 3.5.) revealed a significant cut point with two to three factors which can be studied for this analysis. Eigenvalues, surpassing the value 1, revealed more factors.

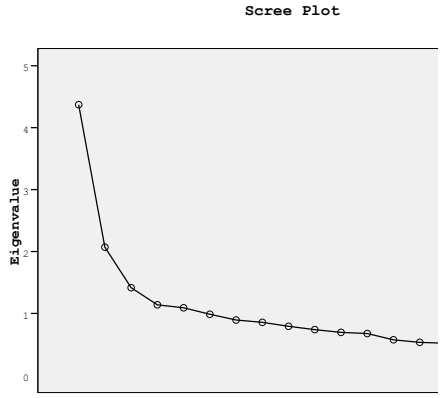


Figure 3.5 Scree plot for TBS

Since the items were selected based on two categories, constructivist and behaviorist, and as seen in the scree plot two factorability can be studied. A second factor analysis was conducted by limiting the number of factors two. The factor analysis with principle axis factoring analysis was conducted on 19 items, using direct oblimin rotations, by limiting the number of factors 2. Table 3.4 shows the factor loadings

Table 3.4 Pattern matrix of teaching belief survey

	Factors	
	Constructivist	Behaviorist
1. I believe that expanding on students' ideas is an effective way to build my curriculum.	**.236**	.014
2. I prefer to cluster students' desks or use tables so they can work together.	**.307**	-.139
3. To be sure that I teach students all necessary content and skills, I follow a textbook or workbook.	.084	**.267**
4. I wait for students to approach me before offering extra help.	**.258**	.092
5. I invite students to create many of my bulletin boards.	**.717**	-.065
6. I believe that encouraging competition among students motivates them to learn more.	**.341**	.302
7. Rewarding students for being good citizens is a good way to teach students to care about one another.	**.601**	.128
8. I encourage students to solve internal problems independently when doing group work.	**.594**	-.050
9. I like to make curriculum choices for students because they can't know what they need to learn.	-.132	**.464**
10. I base student grades primarily on homework, quizzes, and tests.	.031	**.338**
11. I immediately tell students the correct answers when they cannot figure them out by themselves.	-.115	**.469**
12. I invite parents to volunteer in or visit my classroom almost any time.	**.377**	-.048
13. I function in my classroom as a learner and partner in learning with my students.	**.463**	-.055
14. I guide students in finding their own answers to academic problems.	**.702**	-.097
15. I find that textbooks and other published materials are the best sources for creating my curriculum.	.112	**.438**
16. I believe in developing my classroom as a community of learners.	**.617**	.037
17. It is more important for students to learn to obey rules than to make their own decisions.	-.133	.573
18. I operate a democratic classroom because I believe it promotes social learning.	**.731**	-.013
19. I encourage students to resolve conflicts independently.	**.606**	.068

Three items (1, 3, and 4) were loaded below .3, but the first and third items were seen as important for the study. The adaptation of second and forth items were seen as not clear for the participants since the second item were seen as behaviorist as in the original instrument and translated one by the experts and these 2 items were identified to expel from the survey.

Based on the factor loadings, two factors were identified as the latent elements for the TBS. the first factor allocated ten-item constructivist teaching beliefs with following items 1, 5, 7, 8,12, 13, 14, 16, 18 and 19, with a cronbach's alpha .78. The items of 3, 6, 9, 10, 11, 15, and 17 were loaded under second factor, behaviorist items, with a cronbach's alpha .58.

3.6.3 Factor Analysis for Technology Attitude Survey

In order to find out the latent constructs of technology attitude survey, explanatory factor analysis is conducted. Before conducting the factor analysis, negative items (4, 5, 6, 11, and 13) were re-coded (1 to 5 and 5 to 1) to make the items in the same direction.

Scree plot and eigenvalues were checked to decide the number of factors under technology attitude survey and Scree plot (figure 3.6.) reveal a significant cut point with two factors where eigenvalue presented more factor solutions.

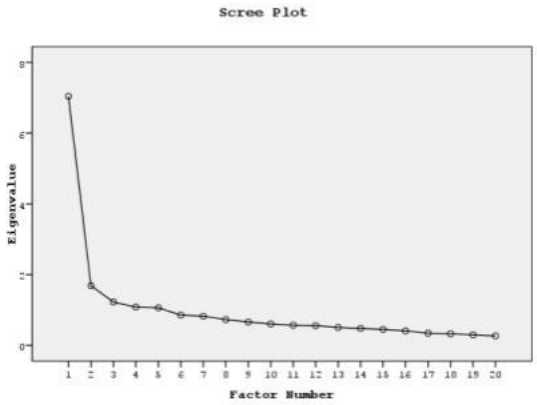


Figure. 3.6. Scree Plot for TAS

Since the items are selected based on two different categories and as seen in the scree plot two factorability can be studied, the second factor analysis is conducted by limiting the number of factors two. A principle axis factoring analysis is conducted on 20 items, using oblimin rotations, with 2 factors. Table 3.5 presents factor loadings.

Table 3.5 Pattern matrix of technology attitude survey

	Factors	
	Educational Benefit	Impact on teaching
1. Computer will make better thinkers out of our students	**.436**	-.045
2. Computers and related technologies are as important as to students as textbook in the classroom	**.585**	.159
3. I look forward to using the microcomputer to teach processes related to my subject.	**.563**	.206
4. Using computer technologies in my job will only mean more work for me.	.071	**.612**
5. I don't have any use for computer technologies on a day-today basis.	.077	**.546**
6. I do not think that computer technologies will be useful to me as a teacher.	-.064	**.530**
7. Computer based instruction will improve students attitudes toward learning.	**.577**	.145
8. I feel that the computer should be used to teach activities that involve the student in problem-solving.	**.608**	-.045
9. We should rethink how our educational curricular are organized so they make maximum use of	**.517**	.045
10. Supplying every students with easy access to microcomputer is a worthy educational objective.	**.560**	-.140
11. I don't see how computer technologies can help me learn new skills	.125	**.380**
12. All prospective teachers should be required to take course on the application of computer technologies.	.**426**	.131
13. Knowing how to use computer technologies will not be helpful in my future teaching.	.064	.**594**
14. If we use computers and related technologies in classroom instruction, students will have a better	.**617**	.193
15. Computers and related technologies will allow students to become active learners.	**.671**	.119
16. I would be interested in using computer and related technologies for instruction in the classroom.	**.758**	.056
17. If I can use word processing software, I will be a more productive teacher.	**.575**	-.182
18. All teachers should be familiar with internet resources such as e-mail.	**.660**	.005
19. With the use of computer technologies, I can create instructional materials to enhance my teaching.	**.464**	.149
20. I could use computer technologies to access many types of information source for my work.	**.648**	.122

All 20 items were loaded to two factors with above .3 loadings. The following items were loaded under educational benefit factor, where as they were originally loaded under impact on teaching factor. Based on expert views 19 and 20th items were discarded since the translation and adaptation of 19th and 20th items presented like confidence items. Secondly, 12th item was about pre-service teachers; also this item was not included to the survey.

Based on the factor loadings following items were loaded under educational benefit 1,2,3,7,8,9,10,14,15,16,17, and 18 (item 18 was originally loaded under impact on teaching) and item number 4, 5, 6, 11, and 13 were loaded under impact on teaching. In order for to find out the cronbach's alpha values for each factor reliability analysis was conducted. With twelve item loading, educational benefit factor presented .87 and with five item impact on education factor showed .69 cronbach's alpha values.

CHAPTER 4

RESULTS

In this chapter the findings of the quantitative and qualitative parts are presented. In quantitative part, descriptive of elementary teachers' teaching beliefs, scientific literacy, and their use of ICT frequency are presented. Two different simultaneous multiple regression analysis were conducted whether the teachers' pedagogical beliefs scientific literacy, frequency of ICT use, years of experience jointly predict teachers' perceptions of ICT use on education and teaching. In the quantitative part, the interview results of both constructivist and behaviorist group were presented.

4.1 Results of Quantitative Phase

In the quantitative part, first demographic characteristics of the participants then, participants' overall scores on each scale were presented. After that, multiple regression analysis results were given. In the qualitative part, the data analysis result, educational benefits of ICT integration, and impact of ICT integration on teaching are presented.

This section presents demographics of the participants. The demographics include participants' ICT uses frequency, scientific literacy levels, their teaching beliefs and ICT integration perceptions. Data were collected from 1055 elementary school teachers currently working at public schools in the province of Ankara.

The elementary school teachers ICT integration perceptions, teaching beliefs and scientific literacy's were obtained with a five point rating scale where "1" indicating strongly disagree and "5" indicating strongly agree. Teachers use of ICT were obtained with a frequency indicator scale where 5 pointing out every day use and 2

presents non use and 1 presents no opinion. Table 4.1 shows descriptive data with means and standard deviations of criterion and predictor variables.

Table 4.1The mean scores and standard deviations of study instruments

	N(item)	M	SD	Min.	Max.
Educational benefit	12	47.90	6.03	26	60
Impact on teaching	5	20.64	3,18	9	25
Constructivist belief	10	40.56	4.23	26	50
Behaviorist belief	7	21.38	3.98	10	33
Scientific literacy	23	74.26	5.27	59	91
Technology use	14	38.41	8.61	16	70
Years of experience		15.82	8.16	1	40

4.1.1 Elementary Teachers ICT Use

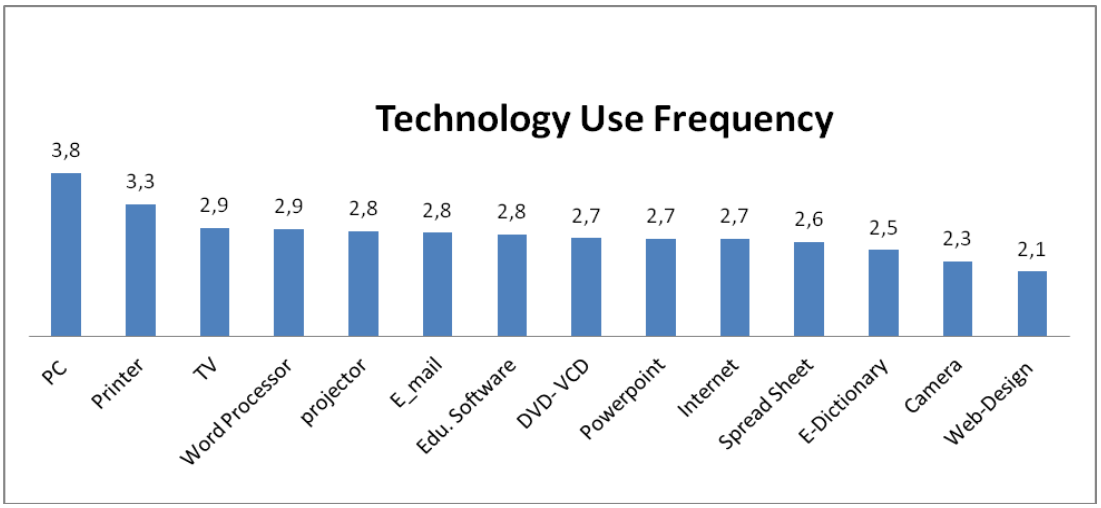
Teachers were asked in which places they use ICT and Internet. Additionally the frequency of teachers' use of ICT was also obtained. As shown in the Table 4.2, most of the teachers presented a high proportion of ICT (76.2%) and Internet use (81.3 %) at home. Half of the teachers use ICT (48.3%) and Internet (52.4%) at teachers room. Classroom use of ICT (42.2 %) and Internet (14.7%) is fairly small than teachers room. Almost one third of the teachers stated that they use ICT (37. 1%) and internet (20.7 %) at computer lab.

Table 4.2 The usage of ICT and Internet

	ICT Use				Internet Use			
	N		%		N		%	
	Yes	No	yes	No	yes	no	yes	no
Classroom	445	610	42.2	47.8	155	900	14.7	85.3
Teachers room	510	545	48.3	41.7	553	502	52.4	47.6
Computer lab	391	664	37.1	62.9	218	837	20.7	79.3
Home	804	251	76.2	24.8	858	197	81.3	18.7

Elementary teachers' ICT use frequencies were displayed in table 4.3. From the table, it is seen that most frequently used hardware were PC and printer whereas camera was the less used one. Among the software, word processor and e-mail were stated as the mostly used ones. On the other hand, web design tools were least used software applications by the teachers.

Table 4.3 Technological tools and software applications



Among the teachers, computer was the most frequently used element for educational purposes (M=3.8). Figure 4.1 shows that 27% of the teachers use PC on daily bases and very small number of teachers presented themselves as none user.

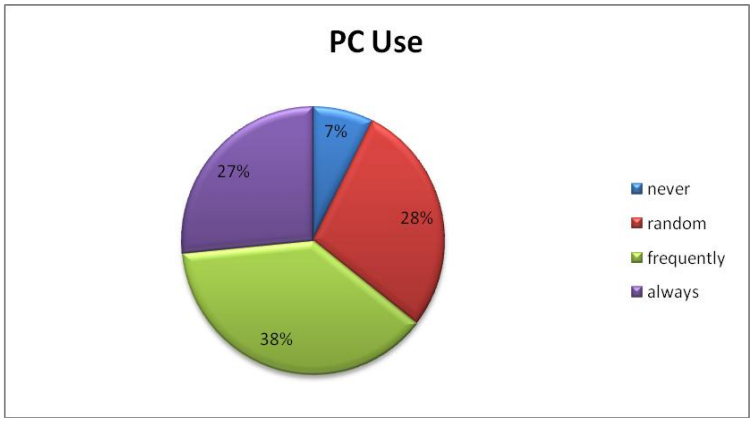


Figure 4.1 Percentage of PC use for educational purpose.

Printer is the secondly frequent used technological devices by the elementary teachers. However, when looked at the percentages, 24 % of the teachers use printer frequently where half of the participants not (see Figure 4.2.).

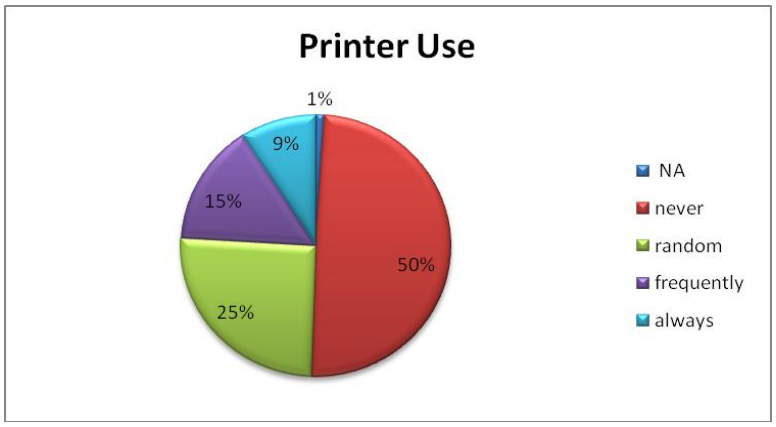


Figure 4.2 Percentage of printer use for educational purpose.

Teachers stated their mostly use of software as word processor and e-mail. Almost 30 % of the teachers use word processer frequently. However, 50% of teachers never not use word processor (see Figure 4.3). Like as the word processor, e-mail use has similar characteristics (see Figure 4.4).

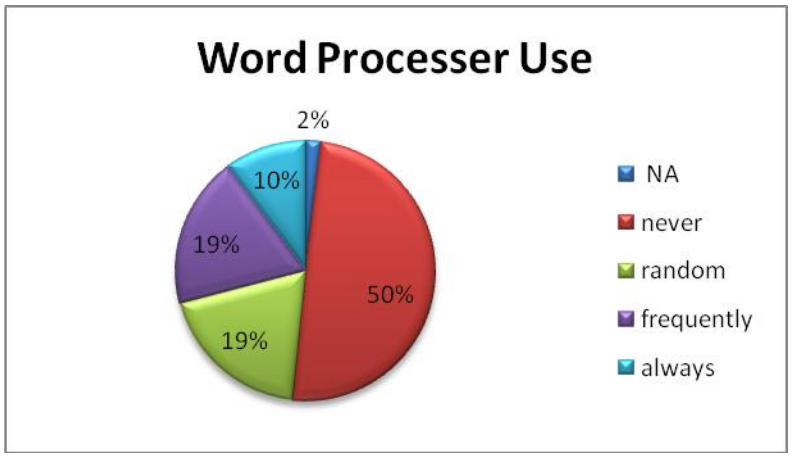


Figure 4.3 Percentage of word processor use for educational purpose.

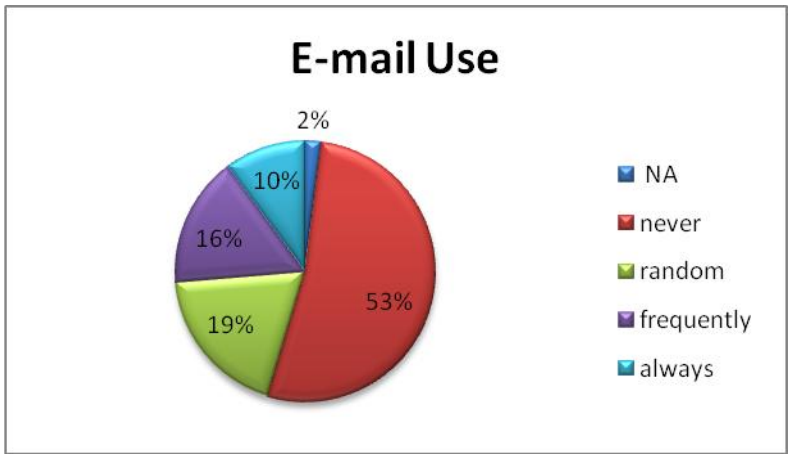


Figure 4.4 Percentage of e-mail use for educational purpose.

4.1.2 The Elementary Teachers' Beliefs on Teaching

The teaching belief survey was consisted of two subscales; one represents constructivist views of teaching where the second one presents behaviorist oriented view. The analysis results showed that all participants had higher scores on both constructivist and behaviorist subscales (M= 40.55, SD= 4.27) and (M= 21.38, SD= 3.98) respectively. Since, the survey developer did not presented any cut point in order to group the participants, total scores of the instrument cannot be an indicator of naming any participant as constructivist or behaviorist. To overcome this issue, Cluster analysis was used to form distinct groups. The analysis result showed appropriateness of 4 -cluster solution for the data set with 1055 participants. The result of this analysis was presented in Table 4.4.

Table 4.4 Between-groups differences for constructivist and behaviorist measures

	Cluster 1 High score n=271		Cluster 2 Behaviorists n=268		Cluster 3 Constructivists n=277		Cluster 4 Low score n=239	
Measures	M	SD	M	SD	M	SD	M	SD
Constructivist	44.34	2.46	37.99	2.04	43.27	2.77	36.00	2.66
Behaviorist	25.31	2.84	23.59	1.76	17.88	2.42	18.52	2.30

*p<.001

Figure 4.5 shows the group distribution of the participants. For each groups the cluster mean scores and standard deviations were also presented (see Table 4.4). Clusters 1 and 4 showed neither constructivist nor behaviorist orientation with a number of members respectively N: 271 (25.7%) and N: 239 (22.7%). The cluster number two present a group of people N: 268 (25,4%) with behaviorist orientation where the group member get high scores on behaviorist items (M=23. 59, SD=1.76) and low scores on constructivist part (M= 37.99, SD= 2.04). The cluster number three show constructivist oriented teachers (N= 277) 26, 3% with high scores on constructivist items (M=43.27, SD=2.77) and low scores on behaviorist part (M= 17.88, SD=2.42). Based on the results among clusters, constructivist group is larger than the high scored, behaviorist, and low scored groups.

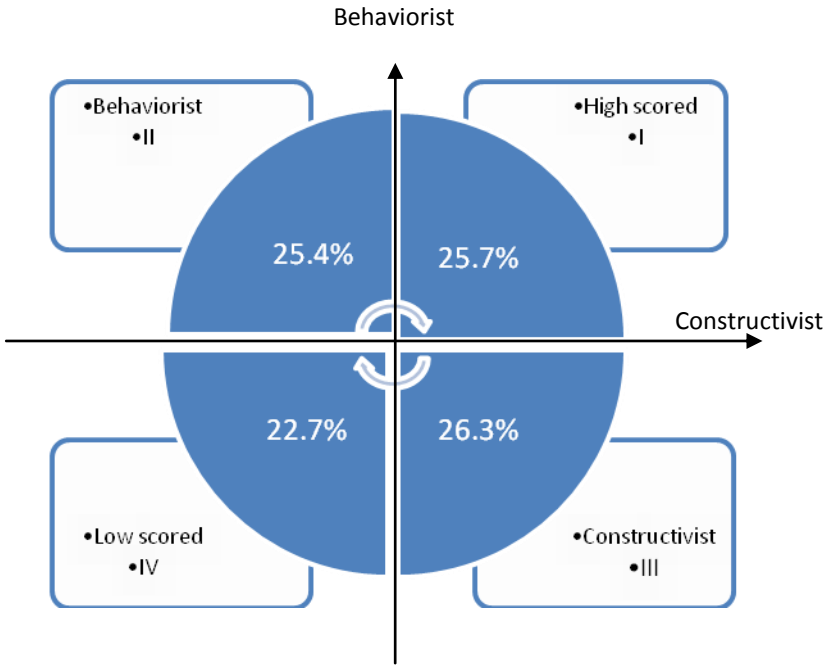


Figure 4.5 Elementary teachers' pedagogical profiles

4.1.3 The Elementary Teachers' Perceptions towards ICT Integration

The result of teachers' technology perception towards ICT integration presented that the participants have positive views on its benefit of education and impact on teaching. For educational benefit the total score was calculated as M= 47.90 where the lowest score was 26 and the highest one was 60 (M= 47.9, SD= 6.03). Teachers perceptions towards the effect of ICT on their teaching also showed high mean score M= 20.64 where the lowest score was 9 and the highest 25 (M= 20.64, SD= 3.18).

4.1.4 Scientific Literacy Levels

As displayed in Table 4.5, in-service elementary teachers had average levels of scientific literacy. The calculated average score of the test presented (M= 74.27, SD= 5.27). The max score can be 115 and minimum can be 23 for the total score. The mean score of Scientific Literacy scale is (M= 3.23, SD= .23). The high score on SL and sub dimensions presents that the teachers had positive scientific literacy. To identify participants general characteristics, participants total mean scores for each part was calculated through dividing the scores for the number of items. The scores which were under 3 represented a naïve understanding of science and technology (Turgut, 2005) where above scores represented a realistic understanding. The analysis result showed that 18 % (N: 185) of the elementary teachers presented naïve SL understanding where remaining 82 % (N: 870) realistic view.

4.1.5 Factors Affecting Teachers' ICT Integration Perception

One of the research question was about the relationship of elementary teachers perceptions towards ICT integration with regard to their pedagogical beliefs, scientific literacy, use of ICT and years of experience. Teachers' perceptions towards ICT integration in education was assessed by using two criterion variables. The first one was teachers' perceptions of educational benefit of ICT integration. The second one was about the impact of ICT integration on participants teaching. To answer the question above, two separate multiple regression analysis was conducted.

4.1.6 Educational Benefits of ICT Integration

A simultaneous regression analysis was conducted on educational benefit sub dimensions, by using the four sets of predictors. The predictors were participants' scores on scientific literacy survey, teaching belief survey (constructivist and behaviorist), technology use frequency, and years of experience. The predictor variables were entered together. The analysis showed that the teachers' perceptions on ICT integration in education can be predicted with their constructivist teaching belief, technology use frequency and their years of experiences. In the regression equation, only teachers' years of experiences presented a negative relation whereas the others are positive predictors of criterion variable (Table 4.5).

Table 4.5 Multiple regression of educational benefit

Variables	EdBen	Const	Behave	SL	Techuse	YearoEx	B	β
Const	.39						.52	.37*
Behave	-.03	.11					-.07	-.05
SL	.15	.14	-.08				.05	.44
Techuse	.26	.11	-.08	.13			.15	.20*
YearoEx	-.124	.001	.020	.012	-.178		-.67	-.09*
Mean	47.92		21.38	74.26	38.41			
SD	6.02	4.28	3.99	5.27	7.74			
					Intercept=20.11			
							R^2	.21
						Adjusted	R^2	.22
							R	.46

*P<.001

The results revealed that a significant amount of the variance of teachers' perceptions towards the educational benefit of ICT integration can be explained by the predictor variables. F_{change} (5, 1038) =55.72, p<.05, R^2_{change} =. 21. The predictor variables that used in the study explained 21% amount of the variance in teachers ICT integration perceptions on Educational benefit (Table.4.6). The rank of the predictor variables based on their importance on the criterion variable is; constructivist educational view of teachers, their technology use frequency and their years of experience. The regression equation is found as following.

Educational Benefit = 20.11 + 0.37*Const + 0.20*Techuse - 0.09*YearoEx

Table 4.6 Summary of multiple regression analysis with educational benefit score

Step	Predictor variable	R^2 (adjusted)	ΔR^2	ΔF
1	constructivist teaching belief, technology use frequency, years of experience	.21	.21	55.72*

*p<.001

4.1.7 Impact of ICT Integration on Teaching

Another simultaneous regression analysis was conducted to find out to what extend do the predictor variables can explain the teachers perceptions on the impact of ICT integration on their teaching. The predictors were participants' scores of pedagogical beliefs, scientific literacy, technology use frequency, and years of experience. The

analysis showed that all of the predictor variables are significant predictors of criterion variable. Teachers' constructivist teaching belief, technology use frequency and scientific literacy are significant positive predictors, whereas their behaviorist pedagogical beliefs and years of experiences are significant and negative predictors of the criterion variable (Table 4.7).

Table 4.7 Multiple regression of impact on teaching

Variables	Impact on teaching	Const	Behave	SL	Techuse	Yearo Ex	B	β
Const	.25						.18	.24*
Behave	-.23	.11					-.18	-.23*
SL	.17	.14	-.08				.06	.10*
Techuse	.30	.11	-.08	.13			.09	.22*
YearoEx	-.20	.01	.02	.012	-.18		-.63	-.16*
Mean	20.66	40.56	21.3	74.26	39.21			
SD	3.18	4.28	3.99	5.26	7.74			
					Intercept=10.74			
							R^2	.23
						Adjusted R^2		.22
							R	.48

*P<.001

The results revealed that a significant amount of the variance of impact on teaching can be explained by the predictor variables. F_{change} (5, 1038) =60.63, p<.05, R^2change =. 23.

The predictor variables that were used in the study explained 23% amount of the variance in teachers' perceptions on the on their impact of ICT integration on their teaching (Table 4.8).

The rank of the predictor variables based on their importance on the criterion variable is; constructivist, behaviorist educational view of teachers, their technology use frequency, their years of experience and scientific literacy. The regression equation is found as following.

Impact on teaching = 10.74 + 0.24*Const – Behave*0.23 + 0.22*Techuse – 0.16*YearoEx + 0.10*SL

Table 4.8 Summary of multiple regression analysis with impact on teaching

Step	Predictor variable	R^2(adjusted)	ΔR^2	ΔF
1	Pedagogical belief (constructivist, Behaviorist), scientific literacy, use of ICT, years of experience	.23	.23	60.63*

*p<.001.

4.2 Results of Qualitative Phase

The main purpose of the study is to investigate the elementary teachers' current status of technology perceptions and its integration according to their pedagogical beliefs (constructivist, behaviorist), scientific literacy, ICT use frequency, and the participants'

years of experience. The pedagogical belief is the most powerful variable for predicting the elementary teachers' ICT integration perception. In this explanatory mixed method design, the follow-up interviews were conducted based on these quantitative results to present an in-depth understanding on how constructivist and behaviorist teachers' perceptions of ICT integration differ. The participants for the qualitative part were selected by clustering the participants based on their pedagogical beliefs. Ten participants from both constructivist and behaviorist group participated in the interviews. The same interview protocol was applied to each participant from both groups.

In the following section, the findings of the interviews with elementary teachers' concerning their perceptions of the ICT integration in education are presented. First of all, participants' ICT availabilities are displayed. Then the major themes emerged from the analysis of the qualitative data are presented. These include the educational benefit of technology integration and its impact on participants teaching. The results of both constructivist and behaviorist groups are presented separately. The themes and related subcategories are presented in Appendix B.

4.2.1 Qualitative Results for Constructivist Group

In this part, constructivist group participants' ICT availabilities in classroom and school and the result of the data analysis were presented.

Ten teachers from constructivist cluster formed based on statistical analysis, participated to the interview study were become the sample of constructivist teachers. Nine of the participants were female and one was male. All teachers were working as an elementary teacher; however their graduated schools were different. Six participants had four-year undergraduate degree where as only four of them were graduated from education faculty. Three of the participants were graduated from vocational teaching training program, and one was a teacher school graduate. The participants' years of experiences were ranged seven to twenty-five years.

Each teacher has at least one technological device in their classrooms. Eight of the participants have available working TV and DVD-VCD in their classrooms. PCs were also available in four of the teachers' classrooms, and three of those have projectors. In addition, printers, overhead projectors, cameras, and tape recorders were other devices available for teachers classroom use. Besides, teachers have the opportunity to use the available technologic devices in their schools. In the teachers' room, teachers can use available computers, printers and internet. Another place that technological devices were presented in school is IT labs. Each teacher mentioned the presence of IT labs in their schools but most of the teachers could not have the opportunity to use the labs due to the computer course schedules. The participants' demographic information and technological availabilities were presented in table 4.9

Table 4.9 Constructivist participants' demographic information and technological availabilities

	Participants									
	1	2	3	4	5	6	7	8	9	10
Years of experience	23	10	8	8	25	21	23	7	13	14
Grade taught	2	5	1	5	4	2	1	4	5	1
TV	x	x	x	x	x	x		x	x	
DVD	x	x	x	x	x			x	x	
PC	x				x		x			x
Projector	x						x			x
Printer	x						x			
Overhead		x	x		x					
Camera							x			

4.2.1.1 Educational Benefit of ICT integration

There was a common view among the constructivist group that the ICT integration had a positive effect on students learning and their active participation to the learning process. The participants agreed that the ICT integration enables the use of different information presentation methods besides lecturing. Use of PC, TV and related devices and educational software make it possible to present information in different forms. This helps to visualize the information and motivate the students to support student learning.

The first subcategory to enhance students learning was about the visualization of information. Seven out of 10 participants stated 16 times that the students learn better when information was presented via different media. Each group participant stated their use of available technological devices, PC or TV and other peripheral devices. Specifically, educational software and educational films were the ones that most frequently used ICTs. Teachers use those technologies to make the abstract and unfamiliar information more concrete. One of the participant mentioned her use of documentary CD on ocean life which help her to explain ocean and ocean life to the students (T:4). Another participant stated her use of lab experiment CDs. An eight-year experienced teacher pointed out that "*Although, only watching experiments from CDs is not a good way for students learning, I think it is a great opportunity when the experiments can cause hazardous results or when the necessary equipment are not available*" (T:3). Along with CDs, teachers' also use small flash activities. Two participants who were teaching same grade level from different schools mentioned a flash activity on water-cycle, and expressed that presenting such information by using visuals, sounds and animations helps their students to understand natural dynamics. Whether for lab activities or different subjects, almost all of the group members (N: 8) emphasized the visualization capability of ICT. From their views, this feature of ICT helped students to create meaning from abstract and unfamiliar issues. A fifth grade teacher stated the importance of this as following statement "*Having taught abstract information means nothing for students, however, when I have the opportunity to visualize it, I can see the difference on students understanding"* (T:9).

Moreover, using such different information presentation methods support ease and permanency of learning. This was supported by six participants (8 times) in the data (T:1,3,4,6,8, &10). "*The visuals are easier to remember than the words read or heard. I try to use different channels together to help my students to build their own understanding on the subject*"(T:4) and "*this make the students learning process much easier* "(T: 10). Additionally, to make the learning easy, the permanency of learning was another issue that teachers were concerned with when they were planning and implementing the class activities. Half of the participants (N= 5) pointed out with a very highly frequent (f= 22) manner that the visualization of the information supports permanent learning (T: 1, 3, 4, 6, & 9). Three of the participants stated the role of motivation on permanent learning (T: 1, 3, & 4).

The second subcategory was about the motivation power of ICT use in the lesson. The majority of the teachers (N: 9 out of 10) presented that ICT integration in education supports learning by increasing students motivation (T:1, 2, 4, 7, & 10) and engagement (T:1, & 6), capturing students' interest (T:1, 6, 7, 8, & 9) and creating an enjoyable learning environment (T: 2, 5, 6, 7, 8, &10). The constructivist teachers directly stated that the use of such applications motivate the students to the subject and enhance their attention time. For example, one of the teachers with 23 years of experience who was teaching second grade stated "*When students are confronted with things getting their attention, they can learn easily. Especially projector use captures students' attention and they are more willing to participate to the lesson. They generally raise questions about the content or they try to connect the subject with their previous knowledge*" (T: 1). In addition to benefits of ICT to capture the students' motivation, and attract the students' interest, presenting information via different channels helps to enhance their imaginations which also makes them engage and participate in the subject. An experienced teacher with 21 years of teaching mentioned that "*When information was presented in ways other than lecturing such as via video or through visuals, students can focus on different aspects of the subjects, and ask questions and raise their ideas on the issue"* (T:6). It was obvious that integration of ICT enabled teachers to present information via different channels which helps to visualize the abstract information.

Additionally, they believed that visualization of the information and experiencing different strategies motivate and engage students to the subjects.

The second category under educational benefit of ICT integration was fostering active student learning. The participants of the constructivist group all agreed that ICT was an excellent platform for their students to reach information without time and place restrictions. This important role of computer and internet technology was emphasized by all group members (14 times). Not like searching from press materials, students can easily access information or materials that they need or are curious about (T: 7). This feature of ICT and its use facilitates students' personal developments (T: 1). Half of the participants assert the positive role of internet to reach information, and specifically pointed out their desire to establish the habit of how the information will be reached (T.2, 4, 5, 8, & 10).

> "I try to attract my students' attention to show how and where to reach knowledge. I also try to be a role model for them. My main goal is to teach where they can access information. They are likely to forget the subject that they have searched but the main goal is to internalize how to reach information and ICT has a great importance and potential in this process" (T: 2).

Those participants emphasizing how to lead students to obtain information also agreed on informing their students to compare and evaluate the information they found. The reason for this concern was explained by Teacher: 6 as "*we should warn the students in order to be critical thinkers so as not to get lost and make false inferences from information".*

Although it was important to learn how to reach and search for information, there was also another sub dimension for fostering active learning preparing and presenting their findings via ICT. Five teachers (T:1, 2, 4, 5, & 7) stated their students' ICT use for searching information, preparing and presenting their reports. One of the teacher with 10-year experience and teaching fifth grade mentioned about teacher and student ICT use as "*In our course books, we do not have very information. Both teachers and students are asked to investigate and find the information"* (T:2). Another fifth grade

teacher with eight years of experience stated that "*we ask students to do research assignments on both academic and general content. They use computers and the internet to find related information and visuals. By using those documents, they type their assignments and create a portfolio. After completing the assignments they are supposed to make presentations on the research topic*" (T: 4). Teachers pointed out the importance of guiding their students to criticize the information they found. With her own words, teacher: 4 also mentioned the importance of false information along with true information.

> "I usually warn my students to be aware of that resource such as books, internet, and magazines, can give missing or wrong information. Because of this reason, I want them to check the information from different sources before relying on it. During our lesson, we talk about such problems to develop their awareness on the issue" (T:4).

The constructivist participants directly presented that ICT integration has a positive effect on students' learning by visualizing information, and motivating and engaging them into the learning process. They also added that learning how to reach information through the internet or other means are very important in order to survive in the information society (T:1, 2, 3, 4, & 10) and to raise information age participants. Besides leading students to search for information via the internet, participants stressed their efforts to orient their students to critique the information that they encounter. The following statement is an appropriate summary of this section:

> "For me, ICT integration in education is beneficial. Giving information through different channels motivates students and helps to develop permanent learning. When I use ICT in my classroom context, educational software, interesting points even that I have not noticed are raised by students. Additionally, ICT integration enhances students' imagination. I can see their interpretations on the subject. Moreover, different student learn from different ways, ICT use in education facilitates this" (T:6)

Constructivist group participants agreed on the positive effect of ICT integration on students learning and their personal development. The most sparkling result was the role

of ICT in enabling information presentations via different channels. Today, the information resource is no longer books and teachers. Instead, with the help of technological developments, information can be presented in different forms, such as educational films- software, presentations, visuals, and sounds. Participants also agree that visualizing the information make changes on students' motivation and engagement. Meanwhile, as presented in the curriculum, students were to make personal and group projects. For these projects, students need to use ICT to search, present and report their findings. This group of participants strictly emphasizes the importance of influencing their students how to reach information. They urged their students to understand the value of reaching information by criticizing and comparing with different sources. This was indicated to be a part of personal development. Almost half of the participants presented it as a need to be a part of information society.

4.2.1.2 Impact of ICT Integration on Teaching

Along with its affect on students and their personal development, the participants mentioned the impact of ICT on their teaching. They pointed out why they prefer to use ICT and how this makes differences in their teaching. The data analysis results presented two categories; appeals to teacher and facilitate teaching.

ICT use appeals to teachers because it enhances students learning. With ICT integration, teachers were not information sources or presenters anymore, instead they facilitated their students' learning (T: 2, 3, 4, 7, &10). The teachers stressed why they preferred to use ICT as its affect on their teaching and the students learning. Additionally, those technological devices enable them to present information in different forms.

This aspect enabled the facilitation of their teaching as well. For the first category, two subcategories emerged were: enhance students learning and supports teachers' works. The former concerns the teachers' perceptions of ICT integrations' effects on students learning. Teachers mentioned that ICT use enables them to capture students' attention (T: 1, 3, 4, 7, 8, & 10). They all stated the importance of motivating and engaging the students into the learning process. Meanwhile, teachers presented that using such applications ameliorate students learning and increase its quality (T: 2, 3, 4, 6, 7, 8, &10). The reason behind this was presented as the nature of students learning. The

common view was the understanding of "learning does not occur by just listening" (T: 3). Instead constructivist teachers are mostly aware of individual differences that need different forms of information representations. As their statements directly or indirectly support this reason for using different information presentation methods, the following statement clearly indicates how a constructivist teacher values ICT integration for the sake of the student:

> "When I use ICT in my lessons, it helps me to drown students' attention to the subject. Along with this, students can also use ICT in and out of school. They can do research on their homework, projects and anything they are curious about. Generally, they search for information and visuals from the internet. This enables them to obtain up-to-date information which supports their personal development. Moreover, students use ICT to prepare and present their works in the classroom. They like to search and present it in the classroom. This helps them to be prepared for future. I have been teaching for many years, and before these technological developments, I worked hard to facilitate my students personal development. Today, I can reach information from different sources. Educational sites, teacher portals, and search engines are very helpful to reach many kinds of information. Now I have available technologies which help me to use different teaching strategies in my classroom. Moreover, ICT integration in teaching and learning brought enjoyment both for me and my students" (T:1).

The impact of ICT integration in education was not seen only as enhancements in students learning. Teachers were also aware of its supportive role for themselves. They mentioned that ICT use eases their job. In-class applications, using visuals such as video, games, and presentations help teachers with classroom management (T:4, 6, & 7), attending to students (T:4, & 10) and timing (T:4, 5, 6, 9, & 10). The teachers stated that magnifying the materials via projector helps them to manage the classroom. This includes saving time and effort for writing on the blackboard and they can use such time to observe their students (T: 4 &10). Following statement presents this important feature of the ICT integration from one of the teacher's words:

> "I use projectors to reflect questions on screen so all students can read questions that students understand easily. This helps me to guide the students, which is really important for me. While they are reading I can observe whether they grasp the main idea or not. This allows me to understand we have mentioned the necessary points of the subject. Technology use facilitates me to use my time properly. I can spend much time with my students one to one. This allows me to observe and understand my students learning process and classroom dynamics" (T: 4).

It can be understood from all these expressions that ICT use enabled teachers to focus on each student and their individual development rather than presenting the information. In addition to the in-class applications, the out-of-class applications relate to record keeping, e-school, and communication. Three constructivist teachers presented their use of computers as enabling them to manage coursework and keep students records (T: 3, 7, &10). Although every teacher has to use the e- school system, only one teacher mentioned that "*each teacher can manage the information about themselves and their students by using e-school and this system eases teachers work*"(T:2). It is understood from the statements that the teachers did not think that they use ICT for record keeping both for themselves and as a part of e- school system. Despite the emphasis on using ICT to search and present information by teachers and students, it is obvious that they are not keeping in touch with their students and/or parents via internet. ICT use for communication with students and teachers were very low. Only one teacher mentioned her use of e-mail communication with her students and their parents (T: 5).

Another issue highlighted by the teachers fourteen times was obtaining information via the internet (T: 1, 2, 4, 5, 7, 8, &10). Its role in finding up-to-date information on the subject taught is mentioned. As the nature of the educational approach curriculum was built on, "*the course books do not include all the information on the subject* (T: 2), and "*lead both teacher and student to search for information*" (T: 4). This makes both students and teachers to obtain updated information. Although reaching information from different sources appeals teachers to prefer such applications only two of them (T: 5, & 7) mentioned the instant access to information. The reason for this can be the lack

of hardware and internet connections in schools and especially in classrooms. As stated below, only four teachers have computers without internet connection.

In addition to teachers' use of the internet for finding information, they also search for materials and documents for their classroom applications. Before presenting such results, the group teachers' classroom use of ICT should be presented. The teachers mentioned the impact of ICT owing to its support to their teaching. From the descriptive information, ICT availabilities of the teachers classrooms and schools are seen below. Eight teachers had TV and DVD/VCD in their classrooms. Four of them have computers and from these only one did not have a projector machine. Only one teacher stated that due to not having access to a PC, she brought her own laptop to the classroom. From the interviews it was revealed that the constructivist group teachers use available ICTs in their classrooms. Six teachers (T: 2, 3, 4, 6, 8, & 9) state their use of TV and DVD/VCD in their class. Four teachers who had PC in their classroom use PC and projectors during their class time (T: 1, 5, 7, & 10). TVs and PCs uses were widely accepted, whereas some teachers also use overhead projectors for available materials on their subjects.

Teachers also stated the availabilities of devices in their schools such as PCs for teachers use, PC labs, Projectors in the classroom, and options for printouts. From their responses, they state that there are connections for PCs and the internet in the teachers' room and are available for all the teachers to use for work. None of the teachers specifically presented their use of those available devices for their classroom preparation, instead the teachers stated their use of home computers and their own internet connections to prepare for the classroom. Along with PCs in the teachers' room, schools also had PC labs. However, those labs were mostly used for computer courses. Therefore, due to the time limitations, teachers could not use these labs for their classes. Interestingly, one teacher mentioned a projection class where a projector machine exists. This classroom could be used by appointment and teachers can use their own laptops. Obtaining a print out for classroom applications is another use of ICT. Although all teachers use printers and copy machines to reproduce materials, only three of the teachers stated their use.

Another issue that emerged from the data was the use of technology to search for materials. Nine participants out of ten stated their use of PC and internet was to find materials for classroom use. Participants mostly used the internet to find content and visuals (T:1, 2, 3, 4, 7, 8, & 10), test/ questioners (T:1, 2, 4, & 8), examples (T:1, 2, 4, 8, & 10), presentations (T:1, 4, 8, & 10), and classroom activities (T:2, 3, 5, & 8) to find additional resources (T:1). As mentioned previously, teachers also use the internet to find up-to-date information. One of the teacher stated that she was also a learner with her students and she had to find new and subject related information in order to give different points on the subject. Her concern to search in-depth information on the subject was to answer the students' questions (T: 4). Additionally, teacher: 2 mentioned the need for searching for information on a subject as the nature of the new curriculum. Besides content, teachers searched the internet to find tests, examples, presentations and classroom activities. All of the teachers mentioned that they use a variety of teacher portals, and educational sites to find those materials. Further, in their search and use of pre-prepared materials, six teachers use computers and office applications to prepare their exams, questions and presentations (T: 2, 3, 4, 7, 8, & 10). Although the teachers use such educational sites to obtain materials, none of them stated their documents were shared on those sites.

Teachers have a positive perception of ICT integration on education. They all mentioned its positive effect on students learning and their teaching. These perceptions lead them to use different teaching strategies. Teachers mostly use educational software, movies and documentaries. The use of presentations was mentioned by six teachers (T:1, 3, 4, 5, 6, & 10). Classroom activities were also used by eight participants (T:2, 3, 4, 5, 6, 7, 8, & 10). Concept mapping (T: 2, 4) and brain storming (T:4, & 5) were the other strategies mentioned. Overall, teachers stressed their use of ICT for science and technology and math courses, since the materials used in the classrooms can vary depending on the topic. Teacher:4 mentioned her use of national geography CD's. Her example was about the "Living Things" unit, and specifically about the animals and their habitats. "*The students learned about animals that they were not familiar with through audiovisuals. They watched them rather than reading from books or hearing from me*" (T: 4). Another example was on nature. Teacher-6 used a CD on global

warming to present the effects on the Nature. On the other hand, participant 6 also mentioned that she mostly does not prefer to use educational CDs because of their instruction techniques. She complained that most of the educational CDs were constructed on the questioning technique which was not preferred by her. However, on some subjects she stated her use of sources to obtain benefits surrounding the issue that was not available for them. Additionally, use of educational CDs, animations and simulations in VITAMIN were used to display experiments. The teacher preferred such videos and simulations since they could not conduct the experiments because of material scarcity or safety issues (T: 2, & 4).

Teachers also used presentation method by using computers and TVs. Even in first grade, teacher use audiovisuals while teaching the alphabet. "*I use technology while teaching the alphabet. During my preparation, I found visuals, songs and some other activities from internet. I used a projector to reflect the letter on the screen then play and sing the song related with the subject. Students vocalize the letters then we find words starting with the letter. These all help students to get information from audiovisual channels which help to construct their own understanding"* (T: 10). Animation use was another application that was preferred by teachers to conceptualize the information. Two of the teachers stated that their use of a small animation on water cycle helped their students to understand the concept easily. Moreover, by using those applications, teachers mentioned their use of brain storming strategies (T: 4, 5). On the other hand, only one teacher mentioned her use of concept mapping by using ICT (T: 4).

As presented above, constructivist teachers use ICT to facilitate their teaching. Teachers all stated their desire to develop students understanding on the subject and its relevance to their own life. Those teachers using ICT believed the effects of different teaching strategies to support their students learning. They want to make difference in their students' academic and social life. Their desire was to raise "educated society". Where they are aware of anything around them and apply what they have been already been taught in school. This cannot be facilitated by only lecturing instead using technological availabilities such as visuals, animations, movies or games helps to present various information beyond the course books. While preparing and using such information

presentation ways, teachers are questioning themselves to make differences (T: 1, 3, 4, 7, & 8). "*I'm trying to show that I am not an ordinary teacher. Because I believe that education is a lifelong stage*" (T: 3). The statements of the group teachers address their desire to make difference in teaching and students learning.

4.2.2 Qualitative Results for Behaviorist Group

In this part, the behaviorist group participants' ICT availabilities were presented then interviews analysis were presented under the educational benefit and impact on teaching heading.

Ten teachers from behaviorist cluster, formed based on statistical analysis, were the sample of behaviorist teachers. Eight of the participants were female and two were male. All teachers were working as an elementary teacher, although their graduated schools were different. Six participants have four-year undergraduate degree where as only four were graduated from education faculties. Four of the participants were graduated from Vocational Training Program (High school and College). The participants' years of experiences were ranged four to thirty years.

Each participant had at least one technological device in their classrooms. Seven of the participants had available working TV and DVD-VCD in their classrooms. PCs were also available in four of the teachers' classrooms, and one of those had projectors. Three of the teachers had internet connections in their classrooms. Also, two teachers had overhead projectors in their classes. Participants have the opportunity to use technologic devices in their schools. Teachers can use available computers, printers and internet in teachers' room. Each participant stated ICT lab availability in their schools, but most of the teachers could not have the opportunity to use because of computer course schedules. The participants' demographic information and technological availabilities were presented in the table 4.10.

Table 4.10 Behaviorist teachers' demographic information and technological availabilities

	Participant									
	11	12	13	14	15	16	17	18	19	20
Years of Experience	15	30	13	4	25	7	12	13	28	28
Grade taught	3	5	5	5	4	5	4	4	5	4
TV	x	x		x		x	x		x	x
DVD	x	x		x		x	x		x	x
PC		x	x		x			x		
Projector		x								
Internet		x	x					x		
Overhead			x		x					

4.2.2.1 Educational Benefits of ICT integration

The teachers from the behaviorist group presented a range of views on technology integration in education. Only four out of ten participants (T: 11, 12, 16 & 20) directly stated that ICT integration had benefits on education. Three teachers (T: 13, 14, & 19) mentioned some beneficial aspects of technology integration where teacher 15 and 17 focused on the importance of prepared students to make use of ICT. On the other hand, one teacher (T: 18) directly proposed that the use of ICT has no effect on students learning. From the data analysis two categories were emerged: benefit of ICT integration on students learning and fostering active student learning

The teachers stated some positive aspects of ICT integration to enhance students learning. The benefit of ICT integration in education was seen as presenting information via different channels which assist to visualize the information. According to the teachers, this helps to visualize the information and make the abstract concepts concrete. Seven teachers emphasized the role of ICT for presenting information through different channels (T: 11, 12, 14, 15, 16, 17, &20). For example teachers 20 and 12 stated that "*students get information via different channels not only depending on my instruction, they hear and see the subject*" (T:20) and "*from my point of view students can learn better when I use different information presentation ways*"(T:12)

The majority of the teachers mentioned the role of visualization of information via hardware (PC, TV, and projection machine), software and other materials (T: 11, 12, 13, 15, 16, 17, &18). This view was supported by four teachers (T: 12, 14, 15, &16) who advocated that visualization of the information makes information more concrete for students. One of the teacher mentioned that using such methods made information more understandable (T: 15). In addition, three teachers thought that the use of ICT enables the permanency of learning (T: 12, 15, &16).

The teachers express the role of capturing students' interest (T: 13, 14, 16, & 20) and a seven-year experienced teacher presented that "*when I use TV and DVD students focused on the subject. As long as it gets their attention, ICT use positively affect students learning*" (T: 16). Moreover, two teachers point out the function of ICT use to create enjoyable learning environment in which students' engagement by focusing on the subject and asking questioned was increased (T: 13, & 14)

Use of ICT in education also enables students to develop different skills such as searching information (T: 11, 14, 16, 17, 18, 19, & 20) and preparing reports and presentations (T: 11, 15, & 18). The behaviorist teachers' state that their students use the internet for their homework and projects. Teachers 11,18and 19 also mentioned that their students use CD's to find information.a third grade teachers having 15 years of experiences stated that *"I have educational CDs on many subjects but I don't prefer to use those in my classroom. Educational software is very superficial and does not have an effect on students learning. Students do not understand by one word, sentence or an*

image. However, my students use those CDs at their homes, and bring them back latter. Still, they might be getting used to the content" (T: 11)

A few numbers of teachers (T: 11, 15 & 18) mentioned that their students prepare reports and presentations by using ICT. Teacher 18 did not believe in the benefit of ICT; however she asked her students to use ICT for report and presentation preparation. The group members propose some positive aspects of educational benefit of ICT integration. Some claim it has power to enhance students' learning by presenting information via different channels and by motivating the students. However, few teachers mention its affect on students' active learning. But more than half of the teachers claim that ICT use in classroom does not make any differences on those who are not prepared for the course.

They indicate the importance of student preparation before the class (T: 11, 15, 17, 18, & 20) to get benefit from the ICT integration. Their focal point was the unwillingness of students towards school and courses. Teachers 20 and 18 pointed out the importance of student preparation so as to learn the subject from the teacher. Whereas teachers 15 and 17 stated that the use of ICT only made differences on the students who are willing to learn and who are prepared for the class.

4.2.2.2 Impact of ICT Integration on Teaching

Like the constructivist group teachers, behaviorist teachers mentioned how ICT impact their teaching in two categories: appeals to teacher and facilitate teaching. Although the teachers generally presented that ICT integration affects their students learning (which was presented under educational benefit session), only three of the teachers presented that the enhancement on students learning may lead teachers to integrate technology in their teaching (T:11, 12, & 20). When looked at those teachers' statements over all of the technology integration views, it was obvious that teacher 11 use of ICT was very limited. Based on her statement, she only uses music CD's during "hands on" activities. Teacher 20 with 28 years of experience gave credit to ICT integration on enhancing students learning and she described herself as "none" in regards to using technology. She neither uses ICT for preparation nor for a part of her teaching. On the other hand, teacher 12 depicted her effort to use and integrate ICT both in her daily life and her

profession and she described the main reason to include ICT in her life and her class as "*my first aim is to raise literate and successful students*" (T: 12).

The most important reason for behaviorist group teachers ICT integration was its help in easing their job rather than its affect on students learning (T: 13, 14, 15, 16, 19, & 20). The group members did not emphasis classroom management as stated by constructivist ones, instead they focus on e-school, timing, and reaching information via internet. Like in the constructivist group only one teacher presented her use of e-school as ICT application (T: 13). She also mentioned that ICT use helps to manage her timing when she is lecturing (T: 13). Another teacher teaching fifth grade with seven years of expereince also noted that his ICT use while lecturing saves time when preparing his students for the national exams (T: 16). Reaching up-to date information via internet was also stated by four teachers (T: 13, 14, 17, & 18) as the benefit of ICT use. One of the teachers (T: 13) quoted an incident when a question was raised about the population and area of Ankara. By using a classroom PC and internet connection they could easily reach the information. She mentioned the ease and time saving features of using ICT to support both learning and her teaching. Two of the teacher also mentioned this feature of the ICT to support to overcome their deficiencies in information or any other skills that they need to perform in their classes. a fifth grade teacher with four years of experience emphasized this very sincerely whether on the information or talent base; in music, paint or content (T: 14).

Additionally, the teachers' use of ICT also facilitates their teaching. Behaviorist group teachers had available technological devices in their classroom and schools. Seven teachers stated presence of TVs and DVDs in their classroom (T: 11, 12, 14, 16, 17, 19, & 20). Four of them had PCs (T: 12, 13, 15, & 18) and only one teacher had a projection machine. Three of the teachers had internet access in their classrooms. Although teachers had available technologies in their class, teachers were not likely to favor using those technologies during their instruction. Teachers-11 only mentioned her use of available technologies for playing music while they were doing hands-on work. Although she had available software and CDs related with the subjects, she did not prefer to use those as classroom activities. She did not believe in their affects on students learning since "students could not learn by watching". Instead she distributed

those to students and asks them to watch them at their homes. The teachers 13 and 15 who had PC in their classroom also did not use PCs. The reason behind this was lack of a projection machine which would enable giving presentations to the whole class.

The teachers can also use the available technologies in their schools. PC, internet connections and printers are available for their use in their teacher rooms. In addition to this, each school had IT labs and only one teacher presented her use.

Behaviorist teachers were not likely to use available technological devices during their instruction. On the other hand they use ICT for supportive purposes. Seven of the behaviorist group teachers stated their use of PC and internet to search for materials that were related with their subject (T: 11, 12, 13, 14, 16, 17, & 18). Teachers mostly use the internet to find content (T: 11, 12, 13,14,16,17, &18), test/ questioners (T: 11, 13,14,16,17, &18), and visuals (T: 11, 12, 14, & 17). Few teachers search for pre-prepared presentations (T: 12), and classroom activities (T: 11, 12, 14, & 16) as supplementary resources. Along with these, some teachers use computers and related materials to prepare their own presentations and questioners (T: 13, 14, & 17).

The behaviorist group members stated their ICT use to find and prepare materials for their courses. By using those materials they were trying to facilitate their teaching. Different teaching strategies such as presentations, educational software use and activities were the ones emerged from the analysis. Among the behaviorist group, teachers educational CDs and Video use was used by seven teachers (T: 12, 13, 14, 15, 17, 18, & 19). Presentation method was the other strategy that was mentioned by the teachers. Three teachers pointed out their use of ICT while they were presenting and explaining subject. T:12 use PC and TV that were available in her classroom. Whereas, two of the teachers stated their use of TV for this purpose (T: 14 & 17). Four of the teachers mentioned using different classroom applications mostly specified by paperwork. Although all of the behaviorist group teachers had technological devices in their classroom and most of them stated their search of different materials, it was revealed that teachers do not use these devices to apply different teaching strategies.

4.3 Summary

In this chapter, both quantitative and qualitative data of elementary teachers were analyzed and the results were presented. The nature of sequential explanatory mixed method design enables researchers not only to select the sample of the qualitative section, but to give explanations on the topic based on the quantitative section results. The quantitative research results revealed that the criterion and predictor variables are significantly related with each other. Elementary teachers' pedagogical beliefs, scientific literacy, their ICT frequency of use and years of experiences are important variables to make prediction on their ICT perceptions (see table 4.6 and table 4.8). Teachers ICT perceptions are positively related with high scientific literacy and high technology frequency of use. Teachers' years of experience is negatively related with the criterion variables. Teachers with a high level of experience have positive ICT perception when compared to teachers that do not have a high level of experience. The most influential variable of the regression analysis is the teachers' pedagogical beliefs; constructivist and behaviorist.

Depending on the result of the quantitative section, teachers were grouped based on their pedagogical beliefs (constructivist and behaviorist) and 10 teachers from each group were interviewed. The interview result presented two main issues related with ICT integration; its educational benefit, and its impact on teaching. Both group teachers were agreed on the positive affect of ICT integration on students learning by enabling different information presentation methods and enhancing students' personal developments. However, these issues are more frequently stated by the constructivist group. There is a discrepancy on their views of students' individual development. The constructivist group participants are valuing the importance of their students own development. Constructivist teachers stressed the needs and importance of guiding their students to obtain and examine the accuracy of the information by encouraging them to use ICT. This aligns with the first regression analysis result and explains that although all teachers hold positive ICT integration perceptions, teachers holding constructivist pedagogical beliefs value and supports this process since ICT help students' personal development.

The interviewees also stated the effect of ICT integration on their teaching. They all pointed out the advantages of ICT integration in easing their jobs. Another advantage that emerged from the analysis is the positive effect on students learning. However, this issue is mostly stressed by the constructivist group teachers. An additional theme is the facilitation of their teaching practice via the inclusion of ICT. Both group members noted similar ICT use patterns for classroom preparation. On the contrary, when classroom use is considered, behaviorist teachers are less willing to use different classroom ICT applications. These findings also explains the second regression analysis result where the constructivist pedagogical beliefs has positive and behaviorist pedagogical beliefs has negative effect on teachers ICT integration perception into their teaching. ICT helps teachers to present information from different channels and different sources. It enables teachers' flexibility for their teaching practice and these features of ICT appeals constructivist teachers since their views on teaching and learning can be achieved by its integration.

CHAPTER 5

DISCUSSION, CONCLUSIONS AND IMPLICATIONS

In the literature, there are many factors identified as affecting the ICT integration process in education. Some of them are the lack of necessary equipment, time, administrative and technical support, inadequate technology training, and personal beliefs. However, among these factors, teachers have a crucial role in the technology integration process (Ertmer, 1999; 2005; van Braak, Tondeur, & Valcke, 2004). This study particularly focuses on elementary teachers ICT integration perceptions in relation to the teaching and learning process. In this chapter, elementary teachers' perceptions towards technology integration, their pedagogical beliefs, scientific literacy levels, and their ICT use are presented. Moreover, their perceptions towards ICT integration in the teaching and learning process along with the main research topic are also discussed.

5.1 Discussion Regarding to Elementary Teachers' Perceptions towards Technology Integration

In this section, findings regarding to elementary teachers' perceptions towards technology integration answering question number one is discussed. Technology integration has long been studied in the literature; however, it was not until the 2000s that the focus was shifted to the teaching and learning process from the technology itself (Lee & Winzenried, 2009). In the current study, the focal point was to present a picture of elementary teachers' perceptions of ICT integration in the teaching and learning process. The result of two dimensional technology integration perception scores illustrated that Turkish elementary teachers have positive views on ICT integration in the teaching and learning process. Along with the result of quantitative data, the

qualitative data analysis showed that teachers hold positive perception on the integration of ICT in education. This finding has parallel characteristics with the literature (Akkoyunlu, 2002; Aral, Butun Ayhan, Unlu, Erdogan, & Unal, 2006; Cure & Ozdener, 2008; Cagiltay et al., 2001; Celik & Bindak, 2005; Goktas, Yildirim & Yildirim, 2008; Seferoglu, Akbıyık & Bulut, 2008).

Positive perception is an important motivation for teachers' ICT implementation process (Sugar, 2002). According to Means (1994), "the primary motive for teachers to use technology in their classrooms is the belief that the technology will support superior forms of learning" (p.4). The result of the current study presented that classroom teachers hold positive perception towards ICT they are more likely to integrate technology into the teaching and learning process. Thus, beliefs are an important element affecting the teachers' decision making regarding to technology use in their teaching.

Although the result is consistent with many studies, the current study finding conflicts with Cakiroglu, Guven, and Akkan's (2008) findings. Their math teacher participants pointed out the negative views on the use of ICT in their courses. The main difference between these two studies is the participants' subject areas. The study result verifies the conclusion of Gur, Ozoglu and Baser (2010) that Turkish elementary teachers hold positive views towards ICT integration. This shows that the elementary teachers are more willing to integrate ICT than subject teachers.

Today, access to technological devices is easier than ever before. The widespread use of technological devices in daily life and the governmental budget allocations for the technological infrastructures of schools enabled teachers to facilitate these availabilities. These developments helped to develop positive perceptions towards technology (Gur, Ozoglu & Baser, 2010) and the aforementioned literature supports this situation.

5.2 Discussion Regarding To Elementary Teachers' Pedagogical Beliefs

In this section, finding regarding to elementary teachers' pedagogical beliefs addressing question two is discussed. Profiling elementary teachers based on their pedagogical

beliefs is one of the important finding of the study. The teacher profiles were formed based on a Teaching Belief Survey with its two sub dimensions.

The result of the study presented that teachers rated constructivist items higher than behaviorist ones. This result aligned with the literature (Aksu, et al. 2010; Bai & Ertmer, 2006). Aksu et al, (2010) revealed the entering student teachers pedagogical beliefs. The result presented that the student teachers hold higher constructivist pedagogical belief than traditional one. The result of the study by Bai and Ertmer (2008) found that learner centered items were rated high and non-learner centered items were rated low by the participants. The results propose that the teachers have a tendency towards the constructivist teaching belief. This conclusion can be acceptable from one dimensional, dual, teaching belief construct where one edge of it shows the behaviorist view and other edge represents constructivist one (Hermans, van Braak & van Keer, 2008).

However, this dual pedagogical view has been criticized by researchers (e.g. Sang, Valcke, van Braak, & Tondeur, 2009; Tondeur, Valcke, & van Braak, 2008; Woolley, Benjamin & Woolley, 2004). The researchers argue that teachers' beliefs are related with "a variety of educational tenets" (Sang et al., 2009, p. 365) and teachers teaching beliefs encompass a multidimensional belief system, (constructivist and behaviorist educational views), where both ends are independent and orthogonal factors (Kerlinger & Kaya, 1959, cited in Hermans, van Braak & van Keer, 2008).

For this study, instead of using a one dimensional pedagogical view, teachers' scores on both constructivist and behaviorist items were used to profile teacher based on their pedagogical orientations. With a cluster analysis, four teacher profiles were identified. The first profile consisted of higher scores on both scales whereas the fourth profile presented low scores and they were not classified either constructivist or behaviorist, (25.7%) and (22.7%) respectively. The second profile represented behaviorist teachers (25.4 %) and the third profile represented constructivist ones (26.3%).

In the literature, there are few studies on profiling teachers' based on their pedagogical views. Sang et al. (2009) and Tondeur, Valcke, and van Braak (2008) identified Chinese and Belgian in-service elementary teachers' profiles respectively. Both studies

presented similar findings with the current one. Four parallel profiles with the current study based on constructivist and behaviorist pedagogical views were identified. Constructivist, behaviorist, and high scored profiles were composed of high percentages in these two studies. Although in those studies, there is not much difference between the percentages of constructivist and behaviorist one, in this study, the constructivist profile was higher than the behaviorist one. Sang et al. (2009) and Tondeur, Valcke, & van Braak (2008) found that the percentage of the teachers holding behaviorist orientation was higher than the constructivist one. When the low scored group was considered, the current study presents a contradiction with the previous ones. In these studies, the lower profile percentage did not exceed 10 %, but the current study result showed that 22.7% of the teachers fall under the low scored profile. This group teachers' hold neither the constructivist nor behaviorist view. Teachers can hold different teaching beliefs in their belief systems (Sang et al., 2009) and this can help them to vary the instructional opportunities and support the teaching and learning process. Parallel to this, Vartuli (1999) argued that the elementary teachers held diverse instructional strategies. Although this point of investigation is out of the research scope, this can explain the teaching profiles with high scores on both constructivist and behaviorist items.

However, the problematic situation is the low scored group where the teachers did not present adequate teaching belief on constructivist and behaviorist beliefs. Teachers should have pedagogical understanding in order to shape a fruitful learning environment because "teaching necessarily begins with a teacher's understanding of what is to be learned and how it is to be taught" (Shulman, 1987, p.7).

In paper pencil tests, teachers are more likely to present their personal thought since their ID is anonymous. However, Pajares (1992) argues that most of the people are either not aware of their personal beliefs or they are more likely be affected by other factors. Teachers may have inadequate pedagogical knowledge to shape their own teaching belief and this may caused by their past experiences and educational background. As presented by Aksu et al, (2010) entering students teachers do present their own pedagogical views and Pajares (1992) argued that teachers pedagogical beliefs shaped during their school years. It is accepted that the teachers are role model for their students and their teaching practice has affect on their students' development.

From this view, both K-12 teachers and faculty of education instructors have the responsibility to guide their students' pedagogical developments. Moreover, the main responsibility of this issue becomes the pedagogy courses given in the faculty of education. Courses given during pre-service teacher training program may not help to shape students' pedagogical views. For the second issue, on the other hand, teachers may have been influenced by the student-centered curriculum they have been teaching for almost four five years at the time the study data were collected. Whether their pedagogical view and practice have parallel characteristics or not their responses to the constructivist and behaviorist items may have been affected.

5.3 Discussion on Elementary Teachers' Scientific Literacy

In this part, discussion on elementary teachers' scientific literacy regarding to the third research question is presented. The result of TBSL survey presented a mean score of (M= 3.23, SD= .23). Turgut (2005) used a cut point to of '3' to classify the teachers as holding realistic or naïve understandings of science and technology. Based on this criterion, 82% of the teachers scored above 3 and the remaining 18% of the teachers scored below 3. This classification shows that a majority of the teachers have realistic scientific literacy. However, the mean score of the survey did not highly exceed the cut point to state that the study teachers are highly scientifically literate.

To promote scientific literacy, teachers hold the most important role (Yore, 2003) and they should be well prepared in science subjects, have an understanding of science and be aware of the relation with the current technological advances and the society (NRC, 1996; Tairab, 2001). It is apparent that the teachers can not present information they do not possess and in order to promote their students scientific literacy, teachers are needed to recognize the scientific literacy element presented above (Lederman, 1992).

The findings of this study presented consistent results with Evans and Rennie (2009) qualitative study with in-service elementary teachers. Their findings revealed that in-service elementary teachers held some level of understanding of scientific literacy, but it was not adequate to demonstrate all aspects of it. Although there are few studies on in-

service elementary teachers' scientific literacy, researchers have identified the SL levels of science teachers (e.g. Chin, 2005) pre-service science teachers (Laugksch, 2000; Turgut, 2005) and high school students (e.g. Dogan & Abd-El-Khalick,2008); Abd-El-Khalick, Bell & Lederman, 1998; Dogan-Bora, Arslan & Cakiroglu, 2006; Tairab, 2001; Tsai, 1999). The findings of the current study corresponds to abovementioned studies where the in-service, pre-service, undergraduate and high school students hold some aspects of scientific literacy, but not at the desired level.

This finding can be interpreted that elementary teachers either do not have or do not value scientific literacy elements. The main reason of this issue could be their educational background.

In Turkey, the concept of scientific literacy has been introduced within the last decade. The introduction of this concept in teaching training programs was also parallel with its inclusion in K-12. Except from the newly graduated teachers, all of the teachers have not been taught with an emphasis on the scientific literacy elements explicitly or implicitly during their K-12 education and their undergraduate studies.

Along with their educational background, teachers are supposed to follow the curriculum and the course books. These references are valuable sources to guide students. Koseoglu, Tumay, Kavak, and Budak (2008) analyzed the Turkish science and technology course books in relation to the scientific literacy elements and pointed out that the content was emphasized more than the process, ways of thinking and science-technology and society relationship. This shows that although the course curriculum mainly built on this issue, the books that are used to guide the teaching and learning process do not present each element of scientific literacy to get the teachers attention on the issue.

The teachers were raised with a positivist science understanding where science was introduced them as absolute true information (DeBoer, 1991). As the people developed their beliefs from their previous experiences, their understanding of science was developed based on how and what they were taught. This shaped their understanding of how scientific knowledge is generated. Teachers' views of science (DeBoer, 1991) and "knowledge and understanding of NOS" (McComas, Clough & Almazroa, 2000, p. 19)

affect their teaching practice. Where their students' science and technology view is shaped by teachers "instructional behaviors activities and decisions" (Lederman, 1992, p. 351). Abovementioned points are important while considering the teachers science literacy.

5.4 Discussion on Elementary Teachers ICT Use

Elementary teachers ICT use regarding to research questions 4 and 7 are discussed in this section. ICT was used both for lesson preparation and instruction delivery purposes by elementary teachers. However, teachers' classroom use of ICT is lower than their preparation use. This result was aligned with the literature where teachers mostly utilize technology for lesson preparation instead of it using as learning tool to facilitate students' higher order thinking skills (O'Dwyer, Russell, & Bebell, 2004; van Braak, Tondeur & Valcke, 2004).

With this study, teachers' ICT use pattern showed that most of teachers generally use ICT and internet at their home where half of the teachers presented their use of ICT and internet at teachers' rooms. Almost half of the teachers stated their use of ICT in their classrooms. However, internet use is very low. Although the schools mostly have ICT labs, few teachers facilitate this opportunity. Kuskaya-Mumcu and Kocak-Usluel (2004) also found that the teachers mostly use ICT at their homes and the more the teachers have the opportunity to facilitate technology the more they likely to use it for educational purposes.

Computers, printers, and televisions were the most frequently used hardware among the teachers for educational purposes where the least used hardware was a camera. The word processor was the most commonly used application among teachers. E-mail, educational software, presentation software, and the internet rated respectively. E-dictionary and web design applications were rated very seldom.

Their use pattern was supported by the interview results. Elementary teachers use ICT for both supportive and instruction delivery purposes. It was identified that the elementary teachers use computers very often. Teachers generally use word processors

to prepare course plans and materials, multiple choice tests, exams, and some paper-pencil classroom activities. However, e-mail use for educational purposes was stated by only one teacher from the constructivist group, where she used it to communicate with the students and parents. The result is in line with the study conducted in the UK (ETI, 2005), and Becker (2000) where the most common ICT application is found in word processing whereas electronic communication development and use of own websites have seldom use among teachers.

Tondeur, van Braak and Valcke (2007) and van Braak, Tondeur and Valcke (2004) study findings revealed that teachers mostly use ICT for supportive purposes. Most of the teachers use the internet to find content, test/questioners, examples, pictures, presentations, and activities. This result is parallel with Yang and Tzuo (2011) where the teachers frequently used the internet to search information. The flexibility and availability feature of the internet is valued by teachers. This feature of ICT is also presented by the study teachers. One of the teachers mentioned the importance of the internet to reach a number of different sources, such as pictures, poems, songs, or the activities, projects, and presentations that prepared and uploaded to teacher sites, from portals by other teachers.

The ICT use pattern presented differences between constructivist and behaviorist group teachers. When internet use was considered, constructivist teachers mostly search for visuals, examples, presentations, and activities whereas content and test/questioners were mostly searched for by behaviorist teachers. This difference was also present for teachers' material preparation. Most of the constructivist teachers prepare their own presentation materials and test / questioner, however, few numbers of behaviorist teachers stated their own presentation and material preparation by using ICT. Although both group teachers' classrooms have similar technological devices, their classroom use of ICT differs in favor of constructivist teachers. Both the number and frequency of use is high in the constructivist group. They presented their effort to use ICT in their classroom by bringing their own laptops, or trying to get appointments in projection classes. On the other hand, half of the teachers from the behaviorist group prefer not to integrate the available devices, TVs, DVDs, or PCs, in to their teaching practice. This result supports the idea that simply furnishing the schools and classrooms with

technology is not a solution for technology integration in teaching and learning (Becker, 2000; Cuban, 2001). This pattern was found to be the same for teachers to apply ICT use to different teaching strategies, such as using presentation, educational software, and activities. This finding aligned with the literature that teachers holding parallel pedagogical beliefs with constructivism are more likely to adopt new strategies and learning tools (Hermans et al., 2008; Riel & Becker, 2000)

From quantitative and qualitative data, it was found that the elementary teachers' use of ICT is aligned with the studies on the teachers' pedagogical beliefs and ICT use studies where the constructivist pedagogical belief is a powerful factor to determine the teachers ICT use patterns (Becker & Ravitz, 1999; Becker, 2000; Higgins & Moseley, 2001; Riel & Becker, 2000; Tondeur, Valcke, & van Braak, 2008). The obvious reason for this difference is how they view teaching and learning. The difference on ICT use of teachers present that constructivist teachers generally use ICT to create materials, or find materials for different teaching strategies (ETI, 2005). They clearly value the students' own knowledge construction and they are trying to create learning environments for them. During this process, ICT helped them to facilitate their teaching.

5.5 Discussion Regarding to Teachers' Perceptions about ICT Integration and Its Effect on Teaching and Learning

In this section, findings regarding to question number 5, 6 and 7 are discussed. In this study multiple regression analysis was used to investigate the relations between elementary teachers ICT integration perception and their pedagogical views, scientific literacy, their ICT use frequency and years of teaching experience. Two simultaneous regression analyses were conducted to find out to what extend that the same sets of predictors had significant effect on teachers' perceptions of ICT integration in education and their perceptions of the effect of ICT integration on their teaching profession. The results demonstrated that elementary teachers' perceptions of ICT integration in education and its impact on their teaching can be predicted with different sets of variables.

The first regression analysis result presented a significant relation between teachers ICT integration perception towards education and teachers' constructivist pedagogical beliefs, ICT use frequency and teachers' years of experience. Teachers' behaviorist pedagogical beliefs and scientific literacy were not significant predictors of their perceptions of ICT integration in education. Teachers' constructivist pedagogical view and their ICT use frequency positively and their years of teaching experience were found negatively correlated with their ICT integration perception towards education.

The second regression analysis presented that the teachers' perceptions about ICT integration and its effect on their teaching are significantly correlated and can be predicted by all study variables. Teachers' constructivist pedagogical beliefs, scientific literacy, and their frequency of technology use are positive, while teachers' behaviorist pedagogical beliefs and years of teaching experience are significant predictors.

Both regression analysis results showed that the teacher's perceptions towards ICT integration in education and in their teaching profession are positively related with both their constructivist pedagogical beliefs and their technology use frequency and negatively with their years of teaching experiences. Although these variables presented the same patterns, teachers' behaviorist educational beliefs and their scientific literacy also significantly affect the teachers' perceptions towards ICT integration on their teaching.

Pedagogical Beliefs

The two regression analyses sought to find out elementary teachers' ICT integration perceptions, gave parallel results with the previous research. In the literature, it has been identified that the teachers' ICT perceptions in teaching and learning are related with their teaching beliefs (e.g. Becker, 2000; Sang et al. 2009; Tondeur, Valcke, & van Braak, 2008) and their pedagogical beliefs have an important role on designing the learning environment (Cox et al., 2004). Webb (2005) argued that the teachers should use their both subject and pedagogical knowledge to select and use appropriate ICT resources to meet the learning objectives.

The result of the first multiple regression analysis proposed that those teachers having constructivist view of teaching and learning was more likely to value ICT integration in

education. On the other hand, teachers' behaviorist teaching beliefs did not have a significant effect on their perceptions towards ICT integration in education. Second multiple regression analysis illustrated that the elementary teachers' perceptions of the impact of ICT integration into their teaching was also related to their pedagogical views. The regression equation presented similar findings with the previous analysis where the teachers' constructivist pedagogical beliefs affected their perceptions positively (Becker, 2000; Tondeur et al. 2007). However, the teachers holding behaviorist pedagogical views do not value ICT integration in their teaching.

The interview data also supports this finding. Both constructivist and behaviorist group teachers stressed that ICT helps to enhance students' learning by using different media. They argued that ICT integration helps to motivate students in the learning process. Additionally, teachers valued the students' ICT use which helped them to develop new skills such as information literacy (searching different information sources) and technology literacy (using technological devices to find necessary information and to prepare necessary documents, reports or presentation) (CARET; Roblyer & Edwards, 2010).

Although the interview results presented that both constructivist and behaviorist oriented teachers value ICT integration in education differences were also detected between the constructivist and behaviorist group members. When the number and frequencies were considered, the domination of constructivist oriented teachers over behaviorist teachers can be detected.

The behaviorist teachers stated the use of ICT enabled their students to reach information from different information channels. Whereas the same issue has been presented by a constructivist teachers as "now I am not the only information source for my students, now they are getting information from different channels", which helps them to internalize the information from different sources Another constructivist teacher stated that the both classroom use of ICT and their students' use of ICT motivated the students to understand the subject. Especially students' own information sources are valued by the teachers since this helps the students in developing information literacy.

The researchers showed that the teachers holding a constructivist view are more likely to use different teaching strategies and incorporate ICT in their teaching practice (Becker, 2000; ECT, 2005). The current study verifies these findings and argues that teachers' pedagogical views are important factors shaping their ICT integration in their practice.

Scientific Literacy

The results of the two regression analysis presented that only one of the predictor variables was significantly predicted by the teachers' scientific literacy. The first regression analysis on the teachers' perceptions towards ICT integration in education showed no significant contribution to the regression equation. In the next analysis, teachers' scientific literacy is a statistically significant predictor of teachers' perceptions on the effects of ICT integration on their teaching. Result indicated that scientifically literate teachers are more likely to appreciate the ICT integration in their teaching. However, it did not present any effect on their perceptions towards ICT integration in education.

Scientific literacy is recognized as a valuable educational goal all over the world. The major aim of science education is to raise scientifically literate civilians. The following paragraphs are used to show the characteristics of the scientifically literate person by Hurd (1998),

> "The ability to discern experts from novices, theory from dogma and data from myth; recognize that almost every aspect of one's life has been influenced by science/ technology; understand that science often has dimensions in political, judicial, ethical and sometimes moral interpretations; use science knowledge to make life and social decisions; distinguish science from pseudo-science; recognize risks, limits, and probabilities in making decisions involving knowledge of science and technology; know that science-related everyday problems may have more than one correct answer, especially problems that involve ethical, judicial, and political actions; recognize when a cause and effect relationship cannot be drawn; recognize that the global economy is influenced by advancements

in science and technology; recognize when one does not have enough data to make a rational decision; consider the need to synthesize knowledge from different fields in solving science-social and personal civic problems; and recognize the need for collaborative work in solving science-social problems" (p. 413–414).

This description shows that such a person will contribute to a nation's economic standing, politic presence, and cultural entities. McEneaney (2003) argues that "A scientifically literate workforce is understood to be a more productive and efficient workforce, one that can absorb technological innovation appropriately. The average worker thus would have the skills and knowledge to use technology productively" (p.221). In the teaching profession it is expected from those scientifically literate teachers to integrate ICT in their teaching to promote their students' learning. The result of the study supports McEneaney's argument that scientifically literate persons are more likely to integrate ICT into their teaching.

Technology Use Frequency

Celik and Bindak (2006) found that the computer use frequency of teachers is related with their attitudes towards technology. Those having positivist views on technology are more likely to be frequent users. The study supports this situation. Although the study result showed that elementary teachers hold positive ICT integration, their technology use frequency was not high enough to report that all teachers frequently use technology for educational purposes. There may be reason for this as has been previously explained by barriers affecting the ICT integration process. The crucial issue is then the technological availabilities for teacher and student use in schools and classroom.

There has been a great effort to furnish the classrooms and schools with the latest technological devices (SPO, 2006). Recently, in the FATİH project, the focus has been to put computers and smart boards for each classroom. Gulbahar (2007) stated that "by choosing the appropriate technology, teachers have opportunities to change and adapt curriculum in different ways or to improve the quality of classroom activities" (p. 945).

The result of the study indicated that the teachers use the available devices. Those constructivist group teachers mentioned their use of technological devices during their teaching practice. Moreover, they are trying to use different resources, like their own laptops, or appointing time from ICT labs and projection classrooms. Although the technological availabilities of the behaviorist group are better than the constructivists', they are not using ICT and related devices as the constructivists do. Although the availability of technological devices is an essential part of teachers' ICT integration, "just filling schools with the necessary ICT neither improves the quality of instruction nor creates more effective learning environments" (Gulbahar & Guven, 2008, p. 38).

The main result of the study proposes that even if the technological availabilities are similar, the teachers' ICT integration is related with how they value students' learning and their role as teacher. Constructivist-oriented teachers stated the main reason for them to integrate technology into their teaching is that it helps to enhance students' learning by capturing their attention via different media use and enabling teachers to prepare course materials. By using such technologies teachers can use different teaching strategies other than instructing. Although the behaviorist teachers also presented some of the above, generally they do not value the ICT use in the teaching and learning process.

Years of Experience

The result illustrated that the teachers' years of teaching experience was negatively correlated with their perceptions towards ICT integration in education. Years of experience was also found to be the negative predictor of teachers' perceptions of the effects of ICT on their teaching. This result is parallel with the previous studies (Bebell et al., 2004; Gur, Ozoglu, & Baser, 2010; Inan, 2007; Karaca, 2011, Kuskaya-Mumcu & Kocak-Usluel, 2004). Karaca (2011) reported a negative indirect effect on teachers' technology integration process and a direct negative effect on their technology competency, attitudes, and beliefs towards technology. Likewise, Inan and Lowther (2009) pointed out a similar negative relationship between teachers' years of teaching experience and their ICT proficiency and their readiness. The studies showed that recently graduated teachers are more likely use ICT tools than the veterans (Koca, 2006) in "that new graduates have more knowledge on technology integration and feel better

prepared compared to more experienced peers" (Inan & Lowther, 2009, p. 147). Moreover researches verified that the recently graduated teachers are more confident in using ICT than the veterans (Russell, Bebel & O'Dwyer, 2003). The affordability of technological devices and the education received during the teacher preparation programs can be considered as the most important reasons for this disposition.

Technology is no longer a luxury for people. SPO (2010) reported that the 65 % of the Turkish people use computers and internet from their homes and this statistic also parallels with the result of the study where the majority of them use ICT at their home. Additionally, with the high budget allocations schools also furnished with technological devices. Kuskaya-Mumcu and Kocak-Usluel (2004) argued that the higher the availability of the technological devices, the higher the use of ICT by teachers.

Along with the availability of ICT, computer training is important for explaining the relationship between teachers' years of experience and the ICT integration perception. Van Braak et al. (2004) mentioned that the teachers' support and class use of ICT are affected by the training that they received during their undergraduate program. Parallel to this Dusick and Yildirim (2000) proposed that teachers' computer competencies, attitudes, and use of technological devices for educational purposes were significantly affected by the courses taken. Both the availability of technical devices and the policies of educational faculties that support the ICT integration in education make a difference on teachers' ICT integration perception. The abovementioned literature illustrates that the undergraduate training and the availability of technological devices helps teachers to develop positive attitudes towards ICT integration in the teaching and learning process. This is not a surprising finding since recently graduated teachers have the opportunity to work with computers and related devices (O'Dwyer, Russell, & Bebell, 2004) and are encouraged to use those applications during their professional practice.

5.6 Summary

The study results showed that teachers can hold multidimensional pedagogical beliefs (constructivist, behaviorist, high and low scored groups). Teachers who hold

constructivist pedagogical beliefs (including constructivist and high scored group) value the ICT integration process in education. Along with this, teachers' frequency of technology use was another determinant of their perceptions of ICT integration in teaching and learning. Teachers' years of experience were a significant factor that shapes their perceptions of ICT integration. Parallel with the literature, veteran teachers were less likely to integrate ICT.

Teacher-related variables also affect their perceptions of the effect of ICT on their teaching. Moreover, teachers holding a constructivist view, but not a behaviorist one (addressing only the constructivist group) were likely to value and use ICT to facilitate their teaching practice as well as their students' learning. Like having constructivist pedagogical beliefs, scientifically literate teachers also value the ICT integration in their teaching practice.

From all these variables, teaching belief systems played an important role in incorporating ICT into the teaching and learning process. Although most of the elementary teachers value the role of ICT in education, their ICT integration into their teaching practice was significantly affected by their belief system. Constructivist oriented and scientifically literate teachers were more likely to use ICT during their classroom practice. The reason behind this is how they view teaching and learning.

5.7 Implications and Recommendations for Practice

This study suggests that teachers' pedagogical views play an important role in their ICT integration. Teachers themselves also play an important role in the ICT integration process. Their practice is affected from both external and internal factors. In the literature, there are many studies focusing on these obstacles and their relationships. Although many factors were found that affect the ICT integration process, Cagiltay et al. (2001) pointed out the role of teachers in this process. In this study, the focus was given to teachers' perceptions of ICT integration and ICT use in teaching and learning process.

This study identified elementary teachers' pedagogical beliefs, scientific literacy, and their ICT use patterns. The study result will help to shape the ideas of educational policy makers, curriculum developers, educators since "a better understanding of educational beliefs of teachers is essential to influence and improve teaching practices and the potential success of educational reforms" (Sang et al, 2009, p.363).

Pedagogical belief is a significant feature for teachers' practice. This is an important factor in order to shape a fruitful learning environment (Shulman, 1987) since it covers knowing and applying different techniques or activities for different learner needs, using different ways to assess and evaluate their students and knowing how to access a diverse range of sources. As the abovementioned literature suggest the importance of pedagogical beliefs, both educators and curriculum developers should consider the both elementary teachers' pedagogical beliefs while developing in-service and pre-service teacher training programs and revision of the curriculum. The new trend in K-12 all over the world is student centered teaching and learning. Turkish K-12 curriculum was also affected by this and beginning with elementary grades, teachers are urged to implement this change into their teaching practice. Fullan (1991) argues that in this process of change teachers play an important role and teachers' adoption of new practices will only occur if the teachers' epistemological beliefs are parallel to the new practice (Windschitl & Sahl, 2002). In order to guarantee a better outcome with the new curriculum built on the constructivist epistemology, practitioners' teaching and learning views should be considered.

The result of the study showed that the elementary teachers' perceptions of ICT integration are positively related with their constructivist pedagogical beliefs. From the follow up study, the main reason there is a difference in ICT use is teachers' beliefs about how they value teaching and learning. This result is aligned with the studies on teachers' pedagogical beliefs and ICT practice (Becker 2000).

The educators and curriculum developers need to understand the power of beliefs in shaping classroom practice. Many researchers pointed out the importance of teachers' beliefs on shaping their classroom practice (Pajares, 1992; Ertmer, 2005, Mishra &

Koehler, 2006). The result will contribute to the shape of in-service professional development programs and the teaching training programs in educational faculties.

An existing set of beliefs that the teachers hold before a teacher education program and the experience that they had during this program has a critical role in shaping their practice (Richardson, 1996). This shows that the K-12 and undergraduate experiences of teachers affect their teaching profession decisions.

Only a quarter of teachers that participated in the study held constructivist educational views, whereas the remaining have either a behaviorist orientation or no influential teaching belief with low scores on both constructivist and behaviorist items. Two implications can emerge from this result. The first one is concerned with preparing professional development programs (in-service training) for K-12 teachers, especially for elementary teachers. Those programs can cover teaching strategies ranged from teachers centered to students centered. Specific contents and example classroom activities can be used to both implicitly and explicitly to give different pedagogical approaches. The second one is about the undergraduate teacher training programs. The courses can be designed to reflect all types of pedagogical view to help prospective teachers' to shape their own pedagogical views. From this point, both the K-12 and undergraduate programs should be designed to reflect student-centered views of education so as to develop an understanding of such pedagogical views for future educators.

In current elementary school science the main aim is to raise scientifically literate students. It is well known that teachers' practices are shaped by their belief system. Levin and Wadmany (2006) argues that "personal belief systems have a powerful effect on what teachers learn from educational reform schemes and professional development programs, as well as on the teachers' curricular decision-making and teaching practices"(p.159). With relation to this, teachers are more likely to adopt new practices when their underlying assumptions are parallel with their own epistemological beliefs (Windschitl & Sahl, 2002).

Although changing one's belief system is very challenging procedure, in-service professional development programs can help to inform the elements of new science and

technology understanding. In their study, Evans and Rennie (2009) revealed that teachers changed their teaching focus from content to some elements of scientific literacy after taking an in-service professional development program designed to develop scientific literacy.

The study result proposed that although elementary teachers hold some elements of scientific literacy. As discussed in the previous section, this may because of their science education, which was designed based on a positivist-oriented scientific understanding. Two approaches were proposed by Abd-el Khalick and Lederman (2000) to change scientific epistemological views. The first one is to design science courses based on inquiry activities aiming to give both scientific process and content implicitly. The second one is to include other scientific literacy elements related to history, philosophy, and the sociology of science explicitly. Both pre-service and in-service training can be redesigned based on implicit and explicit science education to elevate the elementary teachers' scientific literacy levels.

Another issue can be the science and technology course books which are the main guide for teachers. Based on the curriculum the teachers ought to include all aspects of the scientific literacy, including nature of science, impact of technology on society and the science and technology content. As the teachers generally follow the course books to get the students to the desired level, the content of the science and technology course books should cover all aspect of SL. However, Koseoglu et al. (2008) findings showed that course books mainly emphasize science content, whereas NOS and STS elements are not. In this sense, designing course books parallel to implicit and explicit science teaching can help teachers to be aware of these elements and to raise scientifically literate students.

5.8 Implications and Recommendations for Research

The study data provided valuable information about elementary teachers' ICT integration perception, pedagogical beliefs, ICT use patterns, and scientific literacy.

The study profiled the elementary teachers based on their pedagogical beliefs. Such studies can be conducted among the upper K-12 teachers. More specifically subject teachers' teaching profiles can be identified and enable researchers to link the subject matter and the teachers' role.

Additionally, pre-service teachers' pedagogical beliefs can be identified and the relation between the courses taken can be identified. This information can help teacher educators to shape their courses.

Moreover, teacher educators' pedagogical beliefs can be identified. The teaching practice is an important factor shaping the students belief systems. The relationship between teacher educators and their students' pedagogical belies can be valuable data.

Besides studies related to teachers' ICT integration process, teachers' pedagogical views should be included along with the other variables. Especially today modeling studies are very popular, however, in those studies teachers' pedagogical beliefs are not taken into account. For those planning to work on technology acceptance modeling studies, researchers should consider the teachers pedagogical views. While conducting such studies, both behaviorist and constructivist pedagogical views must be considered since one person can hold two different pedagogical entities.

This study provided information about the valuable relationship between elementary teachers' pedagogical belief and their ICT integration process. Further studies should be conducted in the upper grade of K-12 to decipher whether the pattern is consistent or not. Additionally, similar studies should be conducted in pre-service teachers to identify the relationship. Teacher educators' ICT integration can be studied as to whether their technology use affected by their pedagogical beliefs. Moreover, studies on the relation between teacher educators' ICT integration process and pedagogical beliefs, and their students can be valuable information to expand the teachers' ICT integration process.

One of the important findings of the study is the relationship between teachers' perceptions of ICT integration and their scientific literacy. Scientifically literate teachers are willing to integrate technology into their teaching. Further studies can be conducted by using science content, NOS, and STS to identify teachers scientific

literacy and its relation with the ICT integration process. Similar research can be conducted among science teachers.

The study demonstrated that the scientifically literate persons are more likely to facilitate ICT in their teaching practice. Although this data was obtained by quantitative data, further qualitative studies can be conducted to shed light on the issue. One should study the ICT use patterns of scientifically literate persons. From such a study, data can be used to design multidisciplinary courses on ICT and science inquiry, or any other.

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APPENDIX –A

STUDY INSTURUMENT FOR ELEMENTARY TEACHERS (TURKISH)

Değerli öğretmenler;

Bu çalışma dört farklı bölümden oluşmaktadır. Amacımız, bilim okuryazarlığı, öğretime ilişkin görüşleriniz, teknolojiye karşı tutum ve teknoloji kullanma konularında düşüncelerinizi ortaya koymaktır. Sizden, kendi düşünceleriniz doğrultusunda samimi olarak bütün ifadeleri cevaplamınızı rica ediyoruz.

Posta adresi: Bilgisayar ve Öğretim Teknolojileri Eğitimi
ODTÜ – ANKARA 06531 E-posta: vbaser@metu.edu.tr

Arş. Gör. Vesile Gül Başer

Doç. Dr. Soner Yıldırım

Cinsiyetiniz: □ Bay □ Bayan Branşınız:: …….....

Kaç yıldır öğretmensiniz? :..... Okuttuğunuz sınıf :……. Öğrenci sayısı :…….

Mezun olduğunuz okul: □ Eğitim Önlisans □ Eğitim Enstitüsü /Yüksek okulu □ Eğitim Fakültesi □ Diğer:…….

1.Bilişim Teknolojilerinin Öğretimde Kullanılması

1. Derslerinizde ve derslerinize hazırlanırken bilişim teknolojilerinden yararlanıyor musunuz?	□ Evet	□ Kısmen	□ Hayır	
2. Derslerinizde okulunuzdaki bilgisayar lâboratuvarlarından yararlanabiliyor musunuz?	□ Evet	□ Kısmen	□ Hayır	□ Yok
3. Bilişim teknolojilerini kullandığınız yerleri işaretleyiniz. (Birden fazla işaretleyebilirsiniz)	□ Sınıf	□ Öğretmen odası	□ Lab	□ Ev
4. İnternet kullandığınız yerleri işaretleyiniz. (Birden fazla işaretleyebilirsiniz)	□ Sınıf	□ Öğretmen odası	□ Lab	□ Ev
5. Haftada kaç saat bilişim teknolojilerinden faydalanıyorsunuz?	□ 1 saatten az	□1-4 saat	□ 5-8 saat	Diğer:
6. Haftada kaç saat internette zaman harcıyorsunuz?	□ 1 saatten az	□1-4 saat	□ 5-8 saat	Diğer:

2. Derslerinizde ve derslerinize hazırlanırken aşağıdakilerden hangisini, ne sıklıkta kullanıyorsunuz?

	Sürekli her gün	Sıklıkla haftada 2-3 kez	Bazen haftada 1kez	Hiç	Fikrim Yok
Bilgisayar					
Yazıcı / Tarayıcı					
Projeksiyon Cihazı / Tepegöz					
Televizyon					
Video / DVD					
Kamera / Teyp kayıt					
Kelime işlemci					
Elektronik tablolama					
Sunum yazılımı					
İnternet göz gezdirici					
Elektronik posta					
İnternet yayıncılığı (Örn. Frontpage)					
Öğretim yazılımları, Eğitsel oyunlar					
Referans yazılımları (Örn. Sözlük)					
Diğer:	……				

BÖLÜM I	Kesinlikle katılmıyor	Katılmıyor	Kararsızım	Katılıyorum	Kesinlikle katılıyorum
1. Bilim adamlarında ortak tutum ve inanış vardır.	1	2	3	4	5
2. Bilim doğanın işleyişine dair temel kuralların bütün evren için aynı olduğunu varsayar.	1	2	3	4	5
3. Yaşantımızın bilimsel yolla incelenemeyecek birçok yönü vardır.	1	2	3	4	5
4. Bilim adamları bilimsel bilgiye yanılgıya düşmeden ulaşabilmek için, belirli işlem basamaklarını izlemeleri gerekir.	1	2	3	4	5
5. Bilimsel iddiaların geçerlilikleri, doğrulukları eninde sonunda gözlemlere dayanarak ortaya konulabilir.	1	2	3	4	5

	Kesinlikle katılmıyorum	Katılmıyorum	Kararsızım	Katılıyorum	Kesinlikle katılıyorum
6. Bilim adamları kanıtları yorumlarken farklı mantıksal muhakeme ilkeleri kullanabilirler.	1	2	3	4	5
7. Hipotez ortaya atmak, hipotezleri sınamak bilim adamlarının en önemli etkinliklerinden biridir.	1	2	3	4	5
8. Bilimsel kanıtlar, verilerin kaydedilmesi, seçilmesi, raporlaştırılması, yorumlanması esnasında yanlı hale gelebilir.	1	2	3	4	5
9. Bilim adamları kanıtları kişisel inançlarına, değerlerine, geçmişine göre farklı yorumlayabilirler.	1	2	3	4	5
10. Bilim adamları, diğer bilim adamlarının çalışmalarındaki olası yanlılıkları görmeye çalışırlar.	1	2	3	4	5
11. Bilim bir çok farklı insanın uğraşı olmasına karşın toplumsal, kültürel değerleri ve görüşleri yansıtmaz (örn:politik inançlar, kadına bakış açısı vb.)	1	2	3	4	5
12. Bilimsel bilginin yaygınlaştırılması, bilimin ilerlemesi için önemli değildir.	1	2	3	4	5
13. Araştırmalar için maddi destek sağlayan kuruluşlar (örn; farklı devlet kurumları) bilim üzerinde yönlendirici olurlar	1	2	3	4	5
14. Bilimsel ahlak bilimsel araştırma süreci sonunda elde edilen bulguların uygulanmasından doğabilecek zararla da ilgilidir.	1	2	3	4	5
15. Bilimsel ahlak bilimsel deneylerden doğabilecek zararla da ilgilidir.	1	2	3	4	5
16. Teknoloji ile birlikte yeni araçlar, teknikler bilimsel araştırmalara pek fazla katkı sağlamazlar.	1	2	3	4	5
17. Teknoloji bilime sadece daha fazla araç gereç temin eder; bilimsel araştırmalarda ve teori geliştirmede nadiren yönlendirici olur.	1	2	3	4	5
18. Mühendislerin çözüm üretemeyeceği problem yoktur.	1	2	3	4	5
19. Mühendisler kısa vadede toplumları, kültürleri bilimsel araştırmalara göre daha doğrudan etkilerler.	1	2	3	4	5
20. En ufak teknolojik gelişmeler bile bir araya gelince büyük etkiler yaratır.	1	2	3	4	5
21. Yeni teknolojik tasarımların doğurabileceği bütün olumsuz etkiler önceden tahmin edilebilir.	1	2	3	4	5
22. Bir ülkede sosyal, ekonomik güçler o ülkede hangi teknolojilerin geliştirileceğinde etkili olur.	1	2	3	4	5
23. Teknoloji ile ilgili konularda alınan kararların çoğu yeterli bilgiye sahip olunmadan alınmaktadır.	1	2	3	4	5

BÖLÜM II	Kesinlikle katılmıyorum	Katılmıyorum	Kararsızım	Katılıyorum	Kesinlikle katılıyorum
1. Öğretilecek konuları öğrencilerin düşüncelerinden yola çıkarak seçmemin etkili bir yöntem olduğuna inanırım.	1	2	3	4	5
2. Öğrencilerin, tüm gerekli bilgi ve becerileri öğrendiklerinden emin olabilmek için bir ders kitabı veya çalışma kitabı takip ederim.	1	2	3	4	5
3. Öğrencileri sınıf panolarının oluşturulmasına katılmaları için teşvik ederim.	1	2	3	4	5
4. Öğrenciler arasında rekabeti desteklemenin onları öğrenmek için daha istekli hale getirdiğini düşünüyorum.	1	2	3	4	5
5. Öğrencileri iyi birey oldukları için ödüllendirmenin birbirlerini önemsemelerini sağlamak için iyi bir yol olduğunu düşünüyorum.	1	2	3	4	5
6. Öğrencilerin grup çalışması sırasında karşılaştıkları problemleri kendi aralarında çözmeleri için onları teşvik ederim.	1	2	3	4	5
7. Öğrenciler neyi öğrenmeleri gerektiğini bilemeyecekleri için, onların adına konuları ben seçerim.	1	2	3	4	5
8. Öğrencilerin notlarını ödev, sözlü ve sınav sonuçlarına göre veririm.	1	2	3	4	5
9. Öğrenciler soruları kendi başlarına çözemedikleri zaman doğru cevabı *hemen* söylerim.	1	2	3	4	5
10. Öğrenci velilerini her zaman sınıfımızı ziyaret etmeleri ve derse gönüllü olarak katılmaları için davet ederim.	1	2	3	4	5
11. Sınıf içinde öğrencilerle birlikte öğrenen ve öğrenirken onların akranları gibi davranırım.	1	2	3	4	5
12. Öğrencilere ders problemlerini ve okul hayatlarıyla ilgili karşılaştıkları sorunları kendi başlarına çözebilmeleri için rehberlik ederim.	1	2	3	4	5
13. Dersimi hazırlamada kitaplar ve diğer basılı materyallerin en iyi kaynaklar olduğunu düşünüyorum.	1	2	3	4	5
14. Sınıfımı bir öğrenme ortamı haline getirmeye çalışırım.	1	2	3	4	5
15. Öğrencilerin kendi kararlarını vermekten çok, kurallara uymayı öğrenmeleri daha önemlidir.	1	2	3	4	5
16. Öğrencilerin toplumsal hayatı öğrenmelerine yardımcı olduğunu düşündüğüm için demokratik bir sınıf ortamı yaratırım.	1	2	3	4	5
17. Öğrencileri sorunlarını kendi başlarına çözmeleri için teşvik ederim.	1	2	3	4	5

BÖLÜM III	Kesinlikle katılmıyorum	Katılmıyorum	Kararsızım	Katılıyorum	Kesinlikle katılıyorum
1. Bilgisayarlar, öğrencilerimizin daha etkili düşünebilen bireyler olmasına yardımcı olur	1	2	3	4	5
2. Sınıfta bilgisayar ve ilgili teknolojilerin kullanılması öğrenciler için ders kitapları kadar önemlidir.	1	2	3	4	5
3. Kendi alanımla ilgili öğretim süreçlerinde bilgisayar kullanmayı çok isterim.	1	2	3	4	5
4. Günümde bilgisayar teknolojilerini kullanmak benim için daha fazla iş yükü demektir.	1	2	3	4	5
5. Bilgisayar Teknolojilerini günlük hayatımda kullanmaya ihtiyaç duymam.	1	2	3	4	5
6. Bir öğretmen olarak, bilgisayar teknolojilerini kullanmanın bana yararlı olacağını düşünmüyorum.	1	2	3	4	5
7. Bilgisayara dayalı öğretim öğrencilerin öğrenmeye karşı tutumlarını arttırır.	1	2	3	4	5
8. Bilgisayarların, öğrencilerin problem çözmeye yönelik aktivitelere dahil edilmesini sağlayacak yöntemlerle öğretilmesi gerektiğini düşünüyorum.	1	2	3	4	5
9. Bilgisayar teknolojisinden en üst düzeyde yararlanabilmek için müfredatımızın düzenleniş biçimini gözden geçirmemiz gerekir.	1	2	3	4	5
10. Öğrencilerin bilgisayara kolay erişimini sağlamak, eğitim sisteminin önemli bir amacıdır.	1	2	3	4	5
11. Bilgisayar teknolojilerinin yeni beceriler edinmemde nasıl yardımcı olacağını anlamıyorum.	1	2	3	4	5
12. Bilgisayar teknolojilerinin nasıl kullanılacağını bilmek, gelecekteki öğretmenlik mesleğimde bana yardımcı olmayacaktır.	1	2	3	4	5
13. Bilgisayar ve ilgili teknolojileri sınıfta kullanırsak, öğrenciler teknolojinin hayatlarına nasıl etkilediğini daha iyi anlayacaklardır.	1	2	3	4	5
14. Bilgisayar ve ilgili teknolojiler, öğrencilerin aktif öğrenenler olmalarını sağlar.	1	2	3	4	5
15. Sınıf içerisinde bilgisayar ve ilgili teknolojilerin kullanılmasına ilgi duyuyorum.	1	2	3	4	5
16. Eğer MS Word kelime işlemcisini kullanabilirsem, daha verimli bir öğretmen olabilirim.	1	2	3	4	5
17. Bütün öğretmenler elektronik posta (e-mail) gibi İnternet kaynaklarına açına olmalıdır.	1	2	3	4	5

Katılımınız için teşekkür ederiz.

APPENDIX –B

QUALITATIVE ANALYSIS RESULT

IMPACT OF ICT INTEGRATION ON TEACHING

		Constructivist		Behaviorist	
A.	**ICT Integration Appeals to Teacher**	**N**	**f**	**N**	**f**
i.	ICT use helps to enhance students learning				
	a. ICT use enables to capture students' attention	6	11	0	0
	b. ICT use ameliorates students learning and increase its quality	7	5	3	3
ii.	ICT uses ease their responsibility				
	a. ICT use eases classroom management	3	3	0	0
	b. ICT use provides convenience of dealing with students	2	2	0	0
	c. ICT use help to manage their time	5	5	2	3
	d. ICT use helps record keeping	3	3	2	2
	e. ICT use enables to manage course works	3	3	2	2
	f. ICT use helps to communicate with parents and students	1	1	1	1
	g. ICT use enables to reach up-to-date information	7	11	4	4
	ICT Integration Facilitates Their Teaching Practice				
i.	ICT use helps teachers to find and prepare				
	a. ICT helps to find content, test/questioner, examples, pictures, presentations, visuals, activities	9	30	7	16
	b. ICT helps to prepare teachers own material such as presentations, test, questioners	6	12	3	5
ii.	ICT helps to use various classroom applications	9	16	5	7
iii.	ICT integration helps to apply different teaching strategies	10	30	8	16

EDUCATIONAL BENEFIT OF ICT INTEGRATION

	Constructivist		Behaviorist	
A. Enhance Student Learning	**N**	**f**	**N**	**f**
i. Helps to present information via different				
a. Presenting information via different media supports learning	7	16	7	12
b. Presenting information via different media helps students learn easily.	6	8	1	1
c. Presenting information via different media supports permanency of learning	5	22	3	5
d. Presenting information via different media helps to make abstract and unfamiliar issues more concrete.	5	8	4	4
ii. Helps to motivate students				
a. ICT use helps to enhance students' imagination	5	5	0	0
b. ICT use capture students interest	5	5	6	6
c. ICT use improve students classroom engagement	2	4	2	2
d. ICT use create enjoyable learning	6	6	2	2
B. Foster Active Learning				
i. Students learn how to reach information				
a. Students can reach information trough internet, library, and software search	10	21	7	14
ii. Students learn how to use ICT to present their findings	4	4	3	3

CURRICULUM VITAE

Vesile Gül BaĢer Gülsoy was born in Isparta on March 20, 1978. She received high school degree from Kütahya Anatolian Teacher Training High School. She has completed her B.S. degree in Physics' Education in from Gazi University. She was awarded with a scholarship to pursue M.S. in USA, by the Council of Higher Education of the Republic of Turkey, in 2002 and received her M.S. degree in Science Education from University of Southern California in USA. After, her graduate education in US, she has worked as a research assistant at Suleyman Demirel University. Then, she started her PhD in the department of Computer Education and Instructional Technology at Middle East Technical University, and she completed her PhD in 2011. Her interests cover the subjects, technology integration in education especially in elementary grades, pedagogical beliefs, nature of science and technology. She is married and has one son.