




Yavuz Mumcu, H. (2018). Examining mathematics department students' views on the use of mathematics in daily life. *International Online Journal of Education and Teaching (IOJET)*, 5(1), 61-80. <http://iojet.org/index.php/IOJET/article/view/221/220>

Received: 15.06.2017
Received in revised form: 22.08.2017
Accepted: 21.09.2017

EXAMINING MATHEMATICS DEPARTMENT STUDENTS' VIEWS ON THE USE OF MATHEMATICS IN DAILY LIFE

Hayal Yavuz Mumcu 
Ordu University, Turkey
hayalym52@gmail.com

Hayal Yavuz Mumcu has been working as an assistant professor in Ordu University since 2012. Her research interests include the use of mathematics in real life, mathematical thinking and process skills, teacher education and related topics. She is a member of the Bil-Mat study group and Mathematics Education Society which are associated with her graduated university.

Copyright by Informascope. Material published and so copyrighted may not be published elsewhere without the written permission of IOJET.

EXAMINING MATHEMATICS DEPARTMENT STUDENTS' VIEWS ON THE USE OF MATHEMATICS IN DAILY LIFE

Hayal Yavuz Mumcu

hayalym52@gmail.com

Abstract

Some researchers report that especially the students of the faculty of arts and science do not have sufficient knowledge of the practicability of mathematics since they are mostly interested in the pure aspect of mathematics, and they have difficulty in using their pure mathematical knowledge properly. So, this study aims to examine the views of mathematics students registered in the pedagogical formation program about the use of mathematics in daily life. To this end, an interview form with open-ended questions was administered to 86 pre-service mathematics teachers. The findings showed that pre-service teachers viewed mathematics as an indispensable part of life, but they treated real-life math and school math as separate types of math and had difficulty in relating them to each other. We recommend the use of real or real-like situations in the classroom environment in order to train individuals who can associate mathematics with everyday life and use it more effectively.

Keywords: use of mathematics, real life mathematics, teacher education.

1. Introduction

Henn (2007) states that mathematics has two important sides. First, it has its own aesthetics and beauty, just like fine arts and music. Second, mathematics possesses an extraordinary functionality that helps us to bring order and understanding to all parts of our life. The reason why mathematics is the only and biggest educational phenomenon is that it is used in various non-mathematical contexts in a wide variety of ways. It is widely used in all basic sciences (mathematics, physics, chemistry, biology and astronomy) and their areas of application (medicine, pharmaceuticals, agriculture, food industry etc.) as well as technology, all branches of engineering and such fields as commerce, economics, business administration, industry, accounting, military etc. It is used in any area you can think about including banking, finance, manufacturing and industry, electrical-electronics and communication technologies, transportation, roads and bridges, defense industry, astronomy and space studies, meteorology and geography. Due to the constant technological changes, mathematics finds further application areas (Bondi, 1991, Neyland, 1994, Restivo, van Bendegen, & Fischer, 1993), together with the increasing need for individuals with mathematical knowledge and the ability to use it in their daily lives.

NCTM (2000, p. 4) states that the need for individuals who have mathematical knowledge and the ability to use it in real life has not ever been that vital. Therefore, the importance of mathematics, a discipline intertwined with the life this much, is increasing more and more for all countries and the largest instruction time is allocated for mathematics in the curriculums. Baki (2014, p. 35) categorizes the main motives of school math under the title “*mathematics teaching in schools*” as follows:

- Teaching students to value mathematics,
- Helping students attain mathematical thinking skills,
- Teaching students to use mathematics as communication tool,
- Helping students acquire problem solving skills.

These motives refer to interrelated processes and they can also be expressed as the main purposes of mathematics teaching. The first purpose, i.e. *valuing mathematics*, plays an important role in understanding mathematics and using it efficiently in daily life. For a student who does not value mathematics and is not interested in it, no mathematical activity makes sense; thus the student is not willing to take part in mathematical thinking and problem solving processes. Baki (2014, p. 13) argues that one of the biggest problems in mathematics teaching is the conventional point of view towards the nature of mathematics; therefore students consider mathematics as a field comprising of abstract and disjointed principles, equations and formulas that have no concern with the needs of daily life, instead of viewing it as a tool able to be used in various areas of life.

A student with such point of view who is not aware of the relation of mathematics to real life will not give due importance to it, will find math-related activities meaningless and unnecessary and will have poor academic performance in mathematics. Such a student will also not be able to use mathematics as an effective tool in his/her daily life due to the inability to associate it with everyday events. Hence, individuals need to understand the nature of mathematics and its relation to life in order to use it in their everyday life. Mathematics will make sense to students who understand the numerous advantages of mathematical knowledge and know the place of math in daily life as a discipline, its various areas of application and what they could achieve by using math in their life. For such students, studying math will be more fun, which will undoubtedly affect their academic performance.

The second purpose of school math, i.e. *mathematical thinking skills*, can be defined as *direct or indirect use of mathematical techniques, concepts and methods in the problem solving process* (Henderson et al., 2004, p. 2). Individuals are involved in problem solving processes at school, work or daily life throughout their life (Blitzer, 2003), thus have a need for mathematical thinking. Therefore, individuals use their mathematical thinking skills knowingly or unknowingly in all stages of their life while solving the problems and facts they face (Arslan & Yıldız, 2010). As one of the other purposes of school math, using mathematics as a communication tool is one of the basic skills required to understand, use and relate mathematics to other disciplines. Those who use this skill efficiently can use math in different situations they encounter and make mathematical interpretation of different events. Problem solving is one of the basic skills that helps individuals to cope with real life situations and is shown by various studies as one of the abilities to use math (OECD, 2012; Writer, 2015).

Based on these, it can be said that the main purposes of school mathematics serve not only to the process of acquiring mathematical knowledge, but also to the processes of using this knowledge in real life. Muller and Burkhardt (2007, p. 267) define the purpose of learning mathematics as learning mathematical concepts, skills and strategies and using these tools in solving real life problems. Therefore, determining to what extent the school math achieves the main objectives which can be expressed as the skills to teach math and develop the ability to use math is important in seeing the outcomes of education systems, making necessary assessments and shedding light on the future. Although there are various studies making such assessments, the most comprehensive one is the Programme for International Student Assessment (PISA) test. PISA is one of the most comprehensive educational studies organized by the Organization for Economic Co-Operation and Development (OECD). Since 2000, the PISA test has been carried out every three years to assess the extent to which 15 year-old students in the OECD member countries and other participants have acquired the basic knowledge and skills required to have a place in the modern society. It aims to assess the extent to which 15 year olds who are close to completing compulsory education can use

their knowledge in and out of school and can use their knowledge and skills to understand the problems they face, to solve them, to make predictions about the situations they are unaware of and to question them. This purpose distinguishes the PISA from other assessment approaches. Around the world, policy makers use the PISA test results to develop standards for increasing the level of education and to determine the strengths and weaknesses of their education systems (OECD, 2013). Students are assessed in reading, math, science and problem solving every three years. On each occasion, the emphasis is on only one subject. In 2003 and 2012, the emphasis was on math. Turkey ranked 35th among 41 countries in the PISA (2003) and 43rd among 65 countries in the PISA (2012). PISA tests results in math are structured into seven levels, from the level below “Level 1” to Level 6. Students who are not able to answer even the easiest questions are classified as below Level 1, while those who are able to solve the most complex and difficult questions are classified as Level 6. The PISA test results of 2012 showed that most of the Turkish students scored Level 2 and below (67.5%) (OECD, 2014, p.90). It can be seen that Turkish students are notably unsuccessful in using math in their daily life. This is one of the most powerful indicators of the failure of achieving the purposes of school math in Turkey.

Although there are various factors affecting success in math, Underhill (1988), Frank (1990), Carter and Norwood (1997) reported that students’ beliefs about the nature of math and its instruction were effective in attaining the objectives of teaching math. Schoenfeld (1985, p. 45) defined mathematical belief system as one’s mathematics world view as a perspective that he/she approaches mathematics. Similarly, Lester, Garofalo and Kroll (1989, p. 5) stated that mathematical belief systems comprise one’s subjective knowledge about the self as a doer of mathematics, the nature of mathematics, the environment of mathematics, and mathematical tasks. Raymond (1997) defined mathematics beliefs as personal judgments about mathematics, including beliefs about the nature of mathematics, learning mathematics, and teaching mathematics. Ernest (1989) classified these beliefs under three categories: beliefs about the nature of mathematics; mathematics teaching and mathematics learning. The beliefs about the nature of mathematics are those concerned with the advantages and properties of mathematics (Baydar & Bulut, 2002; Ernest, 1989). Ernest (1989) assumed that these three types of beliefs are interrelated, and the beliefs about the nature of mathematics laid the foundations for the beliefs about mathematics teaching and mathematics learning. His assumption is also compatible with the findings of the study by Feiman-Nemser, McDiarmid, Melnick and Parker (1988). Feiman-Nemser et al. (1988) believe that many teachers and pre-service teachers have operational points of view towards the nature of mathematics, and mathematics teaching occurs by explaining the students how to do things, while mathematics learning occurs by doing exactly what the teacher says and does (Dede, 2014). Therefore, it is evident that teachers’ beliefs about mathematics affect their teaching practices, and consequently the students’ views on mathematics and their mathematical performance (Wallace & Kang, 2004). Making an analysis of the TIMSS data, Köller, Baumert and Neubrand (2000) detected substantial relationships between teachers’ beliefs and their students’ achievement in mathematics. Peterson, Fennema, Carpenter & Loef (1989) also determined significant relationships between teachers’ beliefs and students’ achievement. Moreover, conducting a longitudinal study, Staub and Stern (2002) revealed that students of teachers having constructivist beliefs as opposed to a more traditional view regarding mathematics teaching achieve a higher level of performance gains for advanced mathematics tasks (as cited in, Felbrich, Müller, & Blömeke, 2008).

Therefore, examining the beliefs of math teachers and pre-service math teachers about mathematics has become important in contributing to mathematics teaching and helping students develop positive attitudes towards mathematics (Aksu, Demir, & Sümer, 1998;

Baydar, 2000; Carter & Norwood, 1997; Manauchehri, 1997; Raymond & Santos, 1995; Thompson, 1992). Taking the problem of Turkish students' inability to efficiently use math in real life and the effect of mathematical beliefs on academic performance, this study will reveal the views of pre-service mathematics teachers about the nature of mathematics and its use in daily life as well as examining their ideas on how to shape learning environments to help students improve their ability to use mathematics. In order to help students connect school and out of school mathematics, we need to know how students use and perceive mathematics in everyday situations (Masingila, 1995). The pre-service teachers involved in this study were those fourth graders studying mathematics and registered in the pedagogical formation program. We believe that the findings of this study will be of significant importance in revealing the views of prospective Turkish teachers about the use of math in everyday life. Indeed, there is no study conducted in Turkey to examine pre-service teachers' views on the nature of mathematics and its applicability in real life. This study will seek answers to the following sub-questions:

- What are the views of pre-service teachers about the necessity of mathematics as a discipline?
- What are the views of pre-service teachers about the similarities and differences between real-life math and academic math?
- What are the views of pre-service teachers about the ability to use mathematics?

2. Method

This study was conducted using the descriptive research design. Descriptive researches "describe a given situation as exactly and carefully as possible" (Büyüköztürk et al., 2011, p. 21). Such studies aim to define a case and describe its parts and compare, classify and analyze them for the purpose of interpretation (Cohen, Manion, & Morrison, 2000). This study also used the case study method, which is a qualitative research method. Case studies are used in cases where the aim is to examine a contemporary event in its own context by minimizing the effect of the researcher on it, and there is more than one evidence or data resource available. To Yin (2009, p. 4), case studies are focused on why and how research questions and are suitable for examining a target event in detail. The case study method has been preferred in this study, since the aim is to examine in detail the views of pre-service teachers on the use of math in everyday life.

There are different types of case study. Yin (2009, p. 17) states that single case study can be used when a given case is studied in its own social context without any comparison and in a way limited to the participants. This study was conducted with pre-service teachers in its own social context without making any comparison about the use of mathematics in real life. Therefore, it is a single case study.

2.1. Study Sample

The study sample consisted of 86 fourth-grade students attending mathematics department at a state university and registered in the pedagogical formation program at the same university in the 2015-2016 academic year. They were chosen by typical sampling, which is a purposeful sampling approach. According to Patton (1987), studies that use typical sampling do not aim to generalize to the population by choosing typical cases, but to study average cases to get an idea about a specific area or inform those who do not have sufficient information about this area, practice or innovation.

2.2. Data Collection Tools

A semi-structured interview form prepared by the researcher to reveal the views of pre-service teachers on the use of mathematics in real life was used in this study. The questions in the form are structured in a way to answer the sub-questions of the study. They are as follows:

1. Do you think mathematics is necessary as a discipline? If so, please explain your reasons?
2. Do you think real-life math and school math are similar? If so, what are the similarities?
3. What conditions do you think the efficient use of math in daily life depends on?
4. What is your part as a teacher in training individuals who use math more effectively?

The questions were administered in advance to a different group with similar characteristics of the study sample to test their applicability. Content validity of the form was assessed by two expert faculty members and the form was edited into its final form based on their opinions.

2.3. Data Analysis

The interview form was administered to the participant pre-service teachers through individually held interviews. The sessions with each pre-service teacher took about thirty minutes. The sessions were recorded and then transcribed. The transcribed data was analyzed using semantic content analysis in relation to the sub-questions of the study. Semantic content analysis is the process of categorization to reveal the main themes and the specific sub-themes under them (Tavşancıl & Aslan, 2001). In this study, first a general framework was structured to define the general categories under which the answers of the participants would be addressed, and then the conceptual framework was modelled using NVivo 10.0. The conceptual framework model is as follows:

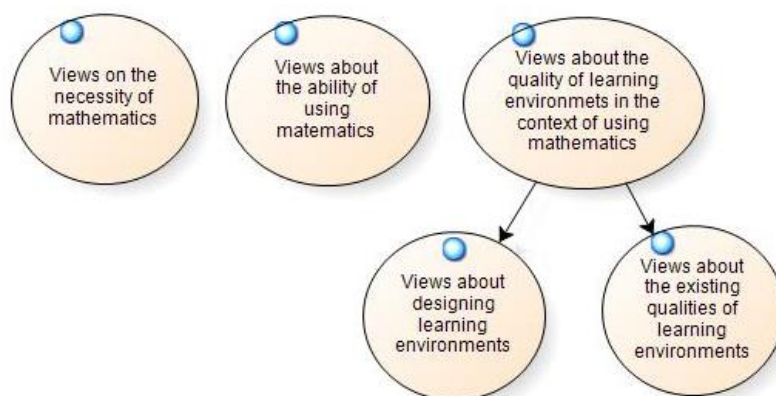


Figure 1. The conceptual framework model used in data analysis

Each theme in Figure 1 was divided into sub-themes and codes using NVivo 10.0. The categories and codes were identified as the number of participants who mentioned the category (N), frequency of mention (f), total frequency of each category (tfc) and ratio of mention (%). In some questions, a couple of pre-service teachers were observed to use expressions regarding different codes in a single answer. In such cases, the findings were analyzed based on the frequency of mention and total category frequency, while they were

analyzed by means of the number of participants (N) and the ratio of mention (%) in other cases.

The concept of validity is closely related to correct measurement of what is intended to be measured by the measurement tool. Thus, the data collected in a study reflects the truth and contributes to the validity of findings (Yıldırım & Şimşek, 2005). In a qualitative research, validity refers to observation of a phenomenon by a researcher as it is and as objective as possible (Kirk & Miller, 1986). Qualitative studies by nature have high level of validity. The factors enriching validity in these studies are: familiarity with the research field; collection of detailed and in-depth information; collection of information directly and in the natural environment; to collect information for a long time; to go back to the area to confirm the findings and to collect additional information (Yıldırım & Şimşek, 2005). In a descriptive study, using direct quotes of the participants and interpreting the findings based on them are also important factors that increase validity.

Reliability is concerned with the repeatability of research findings (Le Compte & Goetz, 1982). One of the basic principles of qualitative research is to accept that facts are in a constant change depending on the individuals and the environment, and repeating the study with similar groups does not make it possible to reach the same results. Thus, reliability in qualitative researches is explained using the concepts of consistency and repeatability (Lincoln & Guba, 1985). In this sense, there are some measures taken to increase reliability of qualitative researches. To increase the reliability of this study, the researcher: did not keep her status position secret; used a purposeful sampling method; clearly defined the individuals serving as a source of data and the conceptual framework to be used in the data analysis; explained in detail how the interviews would be held and the data would be recorded and analyzed. Besides, coding of the data was also carried out by two expert faculty members using Nvivo in order to ensure consistency. To see the consistency among the coders, the number of agreements and disagreements were found and the reliability of the study was determined using the formula ($\text{Reliability} = \frac{\text{agreement}}{\text{agreement} + \text{disagreement}}$) developed by Miles and Huberman (1994, p. 64). Table 1 shows the coefficients of agreement.

Table 1. *Coefficients of agreement among the researcher and the experts*

Categories	Reliability
Views on the necessity of mathematics	$72/(72+14)= 0.83$
Views on the ability to use mathematics	$75/(75+11)= 0.87$
Views on the relationship between real-life math and school math	$69/(69+17)=0.80$

Table 1 shows that the reliability for each category is greater than 0.70, which indicates that the categories prepared by the researcher are reliable (Miles & Huberman, 1994).

3. Findings

3.1. Findings Obtained from the 1st Question

Table 2 shows the findings obtained from the answers of the pre-service teachers to the first question in the interview form.

Table 2. Answers to the 1st question

Categories	Expressions	f	Tcf
We need math	Mathematics is necessary as we use it in our daily lives/need it in all facets of life.	57	77
	It is necessary to solve our daily life problems/facilitate our lives.	12	
	It is in the center of all technological inventions that help us in our life.	8	
Other disciplines need mathematics	It is an indispensable part of/contributes to the development of all other disciplines from physics and chemistry to astronomy and medical sciences.	26	35
	It is used by various disciplines such as medicine, astronomy, economics, engineering etc.	9	
Mathematics is the language of the universe	Mathematics is the language of the universe/It expresses itself in everything in the nature.	6	10
	Math is necessary to know and understand various things in life.	3	
	It changes one's perspective on life.	1	
Math boosts brain activity	It improves the mind power, intuition and reasoning.	5	7
	It helps us think quickly.	1	
	It improves our numeracy skills.	1	

According to Table 2, the expressions used by the participants were as follows in order of frequency: “*We need math*” (77), “*Other disciplines need mathematics*” (35), “*Mathematics is the language of the universe*” (10) and “*Math boosts brain activity*” (6). Under the main category of “*We need math*”, the participants expressed they viewed mathematics as a tool used in daily life (57) and math facilitated their life (12). Besides, they also indicated that math is necessary to be able to benefit from technology since manufacturing of all technological devices is only possible through math (8). Under the category of “*Other disciplines need mathematics*”, the participants expressed that math is necessary for the existence of other disciplines (26) and math is used by other disciplines (9). Under the category “*Mathematics is the language of the universe*”, they stated that math expresses itself in everything in the nature (6), it is necessary to know math to understand the life (3) and math changes one's perspective on life (1). Some of the pre-service teachers indicated that math improves the mind power (5), helps thinking quickly (1) and improves the numeracy skills.

The expressions outside these categories are as follows:

“*Mathematics helps people communicate with each other.*” (P₆)

“*It was only through mathematics that everything became useable.*” (P₇₈)

“*Math is necessary for a more ideal and fairer life.*” (P₁₁)

The answers of the pre-service teachers who do not consider mathematics that crucial for life are as follows:

“*To be honest, it is partially necessary. Yes, math exists as a discipline and is necessary. For instance, it is not necessary for a person living in a village on his/her own land. But, any individual living and studying in a city needs math. It holds true for the whole world. Not only in our country. Well then, this being the case, the question is: Is math necessary? Partially. If math is necessary, then it is because people sort of need it. It is necessary depending on the areas of life. It is like water or breathing for us (undergraduate math students), but for those studying in other disciplines (say history, literature), it is only necessary for calculating grades.*” (P₁₇)

“Mathematicians do not use math much in their daily life. But, it is used in various fields such as engineering, construction etc. Knowing math helps us in other courses. For example, it helps us achieving more success in physics.” (P₅₅)

3.2. Findings Obtained from the 2nd Question

Table 3 shows the findings obtained from the answers of the pre-service teachers to the second question in the interview form.

Table 3. Answers to the 2nd question

Expression	N	(%)
Have similar aspects	27	31
Mostly not similar	27	31
Similar	12	14

According to Table 3, 31% of the pre-service teachers stated that real-life math and school math have some similarities and 31% stated they are mostly not similar, while 13% indicated that they are not similar at all. Table 4 shows the answers to the second part of the 2nd question. According to Table 4, 30% of the pre-service teachers stated that real-life math and school math are actually the same, but they are not similar since no relationship is established between them. Besides, 21% of the participants indicated that subjects are taught in-depth in schools, but people mostly use the four basic operations and calculations in the everyday life. On the other hand, 14% stated that abstract concepts are taught in schools, but people use concrete math in real life. Furthermore, 8% of the participants expressed that people do not learn real-life math in schools, while 6% said we put into practice the theoretical math knowledge taught in schools in our daily lives. The final 6% of the participants indicated that math taught within the scope of basic education is similar to real-life math, while the math taught in universities is not.

Table 4. Answers to the 2nd question in the interview form

Expressions	N	Frequency (%)
They are the same, but are not similar since no relationship is established between them.	26	30
Subjects are taught in-depth in schools, but they are not used in daily life. Mostly the four operations and calculations are used.	18	21
Abstract (theoretical) concepts are taught in school. In real-life, concrete concepts are used; practical and experimental results are observed.	12	14
In school, we learn conceptual things, not real-life math. It is hard to use what we learn in schools in our everyday life.	7	8
The theoretical part of mathematics is taught in schools and we try to use it (some part of it) in our daily life	5	6
Yes for basic education, but not for higher education.	5	6

The answers outside these categories are as follows.

“They are similar, but differences are more than similarities. Math is taught using too much mathematical language. This leads us to think that we learn things different from real-life math which we will never use. For example, a grocery in real life. The areas used in the store, design and placement of the products, the interest rate applied, promotional products etc. They all involve mathematics in addition to the four operations. But the language is different. I mean, math is used without formulas.” (P₈₇)

“There are always similarities between real-life math and school math. But there are also differences. I think the school math refers to obtaining precise results. There is a precise result. However, it may not be valid in daily life. For instance, a grocer can give a product to

a customer by the rule of thumb, without seeking certainty. But school math requires a certain result.” (P₉)

“I think establishing equations is something that every individual needs to learn. Every aspect of life involves equations and solving them. Teaching certain topics in schools is absolutely good, but only up to the level that they are used in everyday life. The topics such as derivatives, integrals and limits should be learned only by those who will use them in their occupational life. Teaching some topics is unnecessary.” (P₁₂)

“The real-life math and school math are not similar at all. The school math consists of formulas which we do not know where they come from and why they are used. However, the real-life math is the type of mathematics that has a specific aim and we can see and feel what the result will be even if just a bit.” (P₃₀)

“Now, they have no similarities other than the four operations. Even if there is, I cannot see any. For instance, I have never consciously used derivatives in my life. But I learned it at school. There are so many examples like that.” (P₂₅)

“They have similarities, but differences are more. For example, I don’t know how we can use complex numbers in our daily life.” (P₄₁)

“I still don’t know how some topics we learned at school can be useful for us in our daily life. For instance, integrals. I have never associated this topic with daily life.” (P₄₃)

“We do not need much knowledge for the math we use in daily life, but we need for the math we learn at school.” (P₄)

“There are similarities, but most of the school math does not mean anything in daily life. We can associate only about 10% of math with our daily life. For instance, most of the people do not know how trigonometry, continuity, derivatives, integrals and complex numbers are useful in daily life.” (P₃)

3.3. Findings Obtained from the 3rd Question

Table 5 shows the findings obtained from the answers of the pre-service teachers to the third question in the interview form.

Table 5. Answers to the 3rd question in the interview form

Categories	Expressions	Total	(%)
School	Quality of Education	15	27
	Teacher	5	
	Knowledge about math’s areas of use/how to use math	3	
Quality of the Activities of Daily Life	The extent of the use of math in daily life/Individual’s occupation	19	22
Interest	Liking math	10	21
	Interest in math	6	
	Willingness to use math	2	
Individual Efforts	Self-improvement	8	15
	Researching math	2	
	Sense of wonder	2	
Mathematical Competence	Awareness	1	14
	Ability to understand/internalize math	2	
	Math success	2	
Family	Family	1	1
Age	Age group	1	1

The answers to the third question were examined by categorizing them into particular groups. Table 5 shows the frequencies of the answers to the question, “What conditions do you think the efficient use of math in daily life depends on?” As can be seen in Table 5, the pre-service teachers involved in this study stated that the ability to use math depends mostly on the school environment (27%), the quality of the activities of daily living (22%), individual’s interest in math (21%), individual efforts (15%) and mathematical competence (14%).

The answers outside these categories are as follows.

“Four operations are commonly used in everyday life. Therefore, they must be well taught in the elementary school. Thus, it is not very much dependent on the conditions.” (P₇)

“In order to use math efficiently in daily life, we do not have to know math as well as the education we receive in school. Just like the example I gave for the previous question, it is sufficient for people to know math to the extent they can shop. If we learn math to the extent sufficient to help us not to have trouble in daily life, then we can use math efficiently in daily life.” (P₃₆)

“Sure, operations are the most important topics one should learn in school. The people who receive education in the school can perform these operations better. However, there are also some exceptions. For instance, some people have had poor education, but can perform some calculations in their mind in a perfect way and use this ability in trading. Four operations constitute the most important topic that needs to be learned in school.” (P₂₁)

“Math directly comes to mind when we think about calculation of money operations in daily life. For example, when we get on a minibus, we pay a certain amount of money. It is always used while shopping. In other words, math is used mostly while performing four operations in daily life. Thus, elementary math is really important.” (P₄₇)

“Efficient use of math in daily life depends on the educational background and characteristics of individuals.” (P₁₈)

3.4. Findings Obtained from the 4th Question

Table 6 shows the findings obtained from the answers of the pre-service teachers to the fourth question in the interview form.

Table 6. Answers to the 4th question in the interview form

Categories	Expressions	f	tfc
Students’ Attitudes Towards Math	We should help students love math	34	76
	We should help students be interested in math/get students’ attention to the course	9	
	We should help students break down their prejudices toward math	9	
	We should help students overcome their fear of math	7	
	We should make students feel that math is necessary	6	
	We should make students understand the importance and place of math in daily life	5	
	We should change students’ views towards math	4	
Quality of the	We should make each individual feel that they can be successful	2	53
	We should move away from rote-learning	11	
	We should achieve permanent/meaningful learning	9	
	We should use different teaching techniques	7	
	We should concretize the abstract concepts	7	
	We should use visual/real materials in the course	5	
	We should adopt a simple to complex teaching method	4	
	We should teach math in a way that students can understand	2	

Education Period	We should awaken mathematical creativity	2	
	We should enable active participation of students	2	
	We should provide students with the opportunity to promote/discuss their ideas	2	
	We should support learning by discovery	1	
	We should adopt a student-centered learning approach	1	
Associating Math with Daily Life	We should teach math by associating it with daily life	33	44
	We should teach math by associating it with the nature	6	
	We should ask striking/thought-provoking questions/give assignments and projects that require students to use math	5	
Teachers' Self- improvement	We should know math well	8	21
	We should improve ourselves	8	
	We should love and embrace math first	2	
	We should use math efficiently	2	
	We should be innovative and inquisitive	1	
Teacher- Student Relationship	We should endear ourselves to the students	9	20
	We should communicate effectively with students and understand them	5	
	We should work with/guide students based on their talents	2	
	We should value our students	2	
	We should love our students	1	
	We should be cheerful and thoughtful	1	

Answers to the fourth question in the interview form show that the expressions mostly used by the pre-service teachers are in the following categories, respectively: quality of the education period (97), students' attitudes towards math (76), teachers' self-improvement (21) and teacher-student relationship (20). The most commonly used expressions in the category, "quality of the education period" are as follows: "We should teach math by associating it with daily life" (33), "We should move away from rote-learning" (11), "We should achieve permanent/meaningful learning" (9), "We should use different teaching techniques" (7), "We should concretize the abstract concepts" (7), "We should teach math by associating it with the nature" (6), "We should use visual/real materials in the course" (5) and "We should adopt a simple to complex teaching method" (4). Under the category, "students' attitudes towards math", the most frequently used expressions are as follows: "we should help students love math" (34), "We should help students be interested in math" (9), "We should help students break down their prejudices toward math" (9), "We should help students overcome their fear of math" (7), "We should make students feel that math is necessary" (6), "We should make students understand the importance and place of math in daily life" (5) and "We should change students' views towards math" (4). Under the category, "teachers' self-improvement", the most frequently used expressions are as follows: "We should know math well" (8) and "We should improve ourselves" (8). Finally, under the category, "teacher-student relationship", the most frequently used expressions are "We should endear ourselves to the students" (9) and "We should communicate effectively with students and understand them" (5).

Some of the answers were as follows:

"I think our most important duty is to teach math in a fun way and as a simple thing used in daily life instead of a boring and difficult course, and to teach it by associating it with daily life." (P₄₀).

"During the pedagogical formation process, I saw that I had actually learned nothing about mathematics in my previous educational life and our brains had been dulled. I learned that math could be taught both in a striking and instructive way by means of expository instruction, discovery learning, realistic math education (rme) and the 5E model of instruction. I would especially like to teach students that math is not a problem, but

something that exists and can be invented to solve problems and they should use math like that in their daily life.” (P₂₃)

“First we should learn and use math efficiently and know how to teach it. While doing so, we should have much knowledge about the related topic and should be able to tell its areas of use in real life. We should make much research and know how to learn and convey our knowledge in order to be able to find an answer to the question, “how will this be useful to us?” asked by all students.” (P₁₅)

5. Conclusion and Discussion

This study aims to examine the views of pre-service math teachers about the nature and use of mathematics in daily life. In this sense, semi-structured interviews were held with the participants and their views were defined by means of the questions prepared. The findings obtained through interviewing with the participants will be presented in line with the general framework of this study.

The views of the pre-service teachers about the nature and necessity of mathematics show that most of them view math as a discipline used in daily life and in other disciplines, thus they care about mathematics. Another opinion on the importance and necessity of math was about the importance of math for solving the daily life problems. Although some of the pre-service teachers emphasized the importance and necessity of math by means of indicating its relationship with the nature and nature events, the number of such participants was not that many. Despite the great number of studies in the literature on attitudes, beliefs and perceptions towards mathematics, the number of studies particularly examining pre-service teachers' views on the importance and necessity of math is quite limited. Among the studies conducted in Turkey, the one by Paksu (2008) was conducted with 324 teachers. At the end of the study, Paksu (2008) found that teachers did not believe that mathematics makes everyday life easier, because of they care about finding the correct answers to the questions rather than understanding how mathematics is being used in real life situations. Gülten, Ilgar and Gülten (2009) examined the ideas of 440 first grade high schoolers about the use of math in daily life. At the end of the study, only 8.9 % of the students stated that mathematics is unnecessary for life. Apart from these studies, there are also some studies conducted outside of Turkey. Some of these studies stated that teachers believe that mathematics is not related with daily life so can not make life easier (Ball, 1988; Beswick, Watson, & Brown, 2006; Cooney, 1985; Schoenfeld, 1985). However, Beaton et al. (1996) showed most teachers believe that mathematics is an essential vehicle to model the real world. According to Ball (1988), pre-service teachers often believe that math is abstract and symbolic and is not related to real life much. Beswick et al. (2006) carried out a project that involved profiling 42 middle school mathematics teachers. Of their findings, they revealed that teachers do not seem to believe the idea of mathematics makes everyday life easier. Related with the beliefs about the nature of mathematics, teachers do not believe that mathematics is problem solving. This result is similar with Schoenfeld (1985) argument that preservice teachers believe that formal mathematics has little or nothing to do with real thinking or problem solving and contradicts with the result of Cooney (1985) who found that beginning high school teachers believed that mathematics was primarily problem solving.

The findings of this study showed that teachers and pre-service teachers expressed different views on the necessity of math in daily life. To form a more general perspective about the current situation, we will present the TIMSS (1995) results. The International Mathematics and Science Study (TIMSS) is one of the most comprehensive international studies conducted to this date. With the main purpose of comparing math and science success of 7th and 8th grade students in different countries, TIMSS exams are focused on the basic

skills in the curriculums. TIMSS (1995) aimed to reveal the beliefs of teachers about the nature of mathematics as well as the success of students. TIMSS (1995) showed that teachers in many countries viewed math as an essential tool used for modelling the real world. However, the extent of agreement on such nature of mathematics varied much across different countries. According to TIMSS (1995), almost all students in Thailand and Iran had teachers who believed that mathematics is a crucial tool used for representing the real world. On the other hand, math teachers of almost 40% or fewer of the students' in many central or Eastern European countries were in full agreement with this view. In TIMSS (1995), most teachers around the world believed that it was of crucial importance for students to realize the use of math in real life. However, the extent of agreement on this view varied across different countries. In Latvia, Korea, Thailand, Belgium, Hong Kong, France, Israel, the Netherlands, Switzerland and Ireland, teachers of fewer than 40% of the eight grade students believed that understanding the use of math in real life was important. It's quite surprising that these two aspects of mathematics are not found to be much important by the teachers in these countries (Beaton et al., 1996). With respect to student achievement, in an analysis of the TIMSS data, Koller, Baumert and Neubrand (2000) found substantial correlations between teachers' beliefs and their students' achievement in mathematics. According to the findings of the studies presented above, pre-service teachers' ideas about the necessity of mathematics in daily life are different from each other. The findings also show that teachers usually view math as a tool necessary for real life and believe that they should teach their students how this tool can be used. We have reached this conclusion based on the scope of TIMSS.

In this study, only 12 pre-service teachers answered, "*Yes, they are similar*" to the 2nd question in the interview form about whether school math is similar to real-life math. Other participants usually used the expressions, "*they are not similar*" or "*they have similar aspects*". Categorization of the answers to the question using different codes showed that there were pre-service teachers who stated that school math and real-life math were actually the same, but they did not seem similar since no relationship was established between them. However, there was also a considerable number of participants who held different views. Those with different views indicated that math topics are taught in an in-depth way in schools, but people mostly use four operations and calculations in daily life. They also stated that abstract concepts are taught in schools, but people use concrete math in real life. Some of the pre-service teachers emphasized that people learn the theoretical part of mathematics in schools and put their knowledge into practice in daily life. Besides, some of the participants also indicated that math is only used in calculations and four operations, thus teaching some of the topics is unnecessary, while some others stated that some mathematical concepts are never used consciously and school math consists of formulas which they do not know where they come from and why they are used. Therefore, the findings of this study revealed that most of the pre-service teachers involved in this study described school math and real-life math using different definitions and had difficulty in relating them to each other.

The 3rd question in the interview form was about the conditions on which the efficient use of math in daily life depends. The most frequently used expressions were as follows: "*the extent of the use of math in daily life*", "*quality of education*", and "*liking math*", respectively. The frequency analysis shows that the categories of "*school*", "*quality of the activities of daily living*" and "*interest*" have similar frequencies. Therefore, the findings we obtained show that the pre-service teachers view the quality of education as an important factor in developing the ability to use math, but also gave importance of a similar degree to an individual's occupation and math love. We think that the reason might be pre-service teachers' views about the use of math in daily life. The pre-service teachers who think that math is used in a limited number of situations attach considerable importance to the role of

the factors outside the school in the development of this ability. Indeed, the participants frequently used similar expressions, emphasizing that math is mostly used in four operations and calculations in daily life, thus elementary education is highly important. The answers to the 4th question in the interview form showed similar patterns. The most frequently used expressions were observed to be “*we should help students love math*” and “*we should teach math by associating it with daily life*”, respectively. These expressions can be interpreted that the pre-service teachers think students who have achieved meaningful learning in the math course and have positive attitudes towards math can efficiently use it in their daily life. Although the pre-service teachers were of the opinion that math should be associated with daily life while teaching in order to be used efficiently in daily life.

The findings obtained in this study can be summarized as follows:

- The pre-service teachers mostly express that math is always used in daily life and it is almost impossible to live a life without mathematics, adding that math is the life itself and it is necessary to learn math to understand the life. However, they view math as a tool only used in numerical calculations and ignore its other areas of use. The pre-service teachers who think so indicate that individuals just with the knowledge of four operations can efficiently use math in their daily life.
- Most of the pre-service teachers think that school math and real-life math have different features. They also believe that most of the topics in math (limits, derivatives, integrals etc.) are not used in daily life and are hard to be transferred into everyday life, thus teaching such topics is unnecessary.
- Many pre-service teachers think that the ability to use math depends on the quality of the activities of daily living. From this point of view, a farmer and another individual living in a large city center do not use math to the same degree. Therefore, a farmer is not expected to use math that efficiently, and indeed does not need to do so.
- Many pre-service teachers believe that they should first help students love math, achieve meaningful learning and should teach math by associating it with daily life in order to raise individuals who can use mathematics efficiently in their life.

Among the studies in the literature on the use of school math in real life, the number of those conducted in Turkey is quite limited. Among these studies, Civelek’s (2003) study aimed to reveal the reasons of setbacks in mathematics education in Turkey. At the end of the study, the author obtained the following findings: high school students view math only as a course and do not know how to use it in their daily life; students view math as a jungle of formulas and think that the knowledge beyond four operations does not mean anything in daily life; students approach math with such a thinking, “*Why should we learn math if it will not be useful?*” and perceive math as a course required to get a better score in the placement exam and get into a better university. Thus, the findings of this study are in conformity with those of Civelek’s (2003). It is not surprising to see that individuals growing up with such perceptions and ideas maintain the same thoughts in their college years. Especially given the fact that these students study math and use it only in the mathematical world, the findings of this study can be said to be more meaningful. Another study in this field is the one conducted by Kılıç (2011). At the end of the study, the author indicated that the pre-service teachers directed towards a direct numerical result by using one or more of the four operations without relating the facts in the problems to daily life practices, and failed or had difficulty in making an interpretation about whether the results they found would be useful in real life, or not.

Although not directly related to this study, Güzel’s (2008) study is another study on how elementary students relate school-math to real-life math. Güzel’s (2008) study revealed that elementary students are at the arithmetic level in relating math to real life. The study by Erturan (2007) also examined the relationship between in-class math success of 7th grade

students and their ability to realize the importance of math in daily life, and found that students were aware of the real-life math, but were not able to transfer the math topics they learned in the classroom to the life. Similarly, the study by Çontay and İymen (2011) examined third grade students' ability to put school-math into practice in daily life. At the end of their study, they observed that students failed to apply math to their current situation while solving the problems and envisaged the operations that they normally performed using pencil and sheet. Although the students did not make any mistake while solving the problems on the sheet, they made mistakes while solving in their minds. The authors concluded that students failed to apply their knowledge to a new situation they encounter. In conclusion, both the students in Turkey and abroad (Greer, 1993, 1997; Reusser, 1995; Reusser & Stebler, 1997; Öktem, 2009; Verschaffel, De Corte, & Lausure, 1994; Verschaffel, De Corte, & Borghart, 1997; Yoshida, Verschaffel, & De Corte, 1994) undergraduate math students (Inoue, 2005) and pre-service teachers (Verschaffel et al., 1997) had difficulty in establishing a relationship between math and real life while solving non-standard word problems and failed to give realistic answers (Kılıç, 2011).

Masingila (1995) carried out a study on how secondary students perceive the math they use in daily life. 20 students were asked open-ended questions like "How do you use mathematics outside the mathematics classroom?" "Describe a situation where you use mathematics outside the mathematics classroom." "What do you think mathematics is?" At the end of the study, the author found that students perceived math as the one they learned in school. When the students were asked, "*How do you use mathematics in daily life?*", they perceived the question as "*How do you use school-math in daily life?*" and gave answers taking account of the situations that require numerical calculations in daily life. In short, they have a perception that numbers and calculations must definitely be used when it comes to the use of math in daily life. The findings of this study are in conformity with those of the one conducted by Masingila (1995). Therefore, it is observed both in Turkey and other countries that students usually have limited knowledge about the use of math in real life and are not aware of the fact that they mostly use math in their daily life. Hence, only the figures and calculations come to their mind when they heard the term "real-life math".

It is believed that student will be able to associate math more with real life and use it more effectively in their lives if they are provided with the knowledge about how and where to use math in daily life, similar environments to those where math is used in daily life are established in the classroom environment and they are made to feel the traces of math in the real life and nature. Similarly, Masingila (1995) indicates that teachers should enable students to take part in in-class practices similar to those in real life in order to change their perceptions on what math is and how it is used in real life. Today, there are many reform documents about mathematics education that try to further associating school problem solving to the experimental worlds of children through the use of more complicated and authentic problem situations in the courses (De Corte, Greer, & Verschaffel, 1996; National Council of Teachers of Mathematics, 1989; Treffers & de Moor, 1990; Verschaffel et al., 1997). Therefore, the use of real or real-like materials and situations in the teaching environments is recommended to promote the use of school-math in real life, together with the activities mentioned in the study by Gainsburg (2008). They would help students see the connection between real-life and mathematics. More specifically, a variety of activities can be planned to introduce students to real life applications of mathematics. Various scientists can inform students about the place and the importance of mathematics in different disciplines. For example, he/she may be asked how to use mathematics in his/her profession by talking to a construction or computer engineer. Or, people from various professions can be brought into the classroom to conduct negotiations with them on the importance of

mathematics. With these kinds of activities, students will be able to feel how mathematics is a discipline that people need in different ways in life.

The extent of the data collection tools and the quantity of the student group reached can be shown among the limitations of this research. So, it is recommended to plan more specific studies in which the underlying causes of student opinions are explored or experimental studies involving different variables carried out with larger samples. Besides, different studies can be investigated by taking the related subject in relation to the ability of using mathematics.

References

- Aksu, M., Demir, C., & Sümer, Z. (1998). *Mathematics teachers and students' beliefs about mathematics*. Paper presented at the III. National Science Education Conference, Karadeniz Technical University, Trabzon, Turkey.
- Arslan, S., & Yıldız, C. (2010). Reflections from the experiences of 11th graders during the stages of mathematical thinking. *Eğitim ve Bilim*, 35(156), 17-31.
- Baki, A. (2014). *Kuramdan uygulamaya matematik eğitimi* (5. Basım). Trabzon: Derya Kitabevi.
- Ball, D. L. (1988). *Research on teaching mathematics: Making subject matter knowledge part of the equation (Research Report 88-2)*. East Lansing: Michigan State University, National Center for Research on Teacher Education.
- Baydar, C. S. (2000). *Beliefs of pre-service mathematics teachers at the Middle East Technical University and Gazi University about the nature of mathematics and the teaching of mathematics* (Unpublished master's thesis). Middle East Technical University, Ankara.
- Baydar, S. C., & Bulut, S. (2002). Importance of teachers' beliefs about nature of mathematics and teaching of mathematics in mathematics education. *Journal of Hacettepe University Education Faculty*, 23, 62-66.
- Beaton, A. E., Mullis, I.V.S., Martin, M.O., Gonzalez, E.J., Kelly, D.L., & Smith, T.A. (1996). Mathematics achievement in the middle school years. *IEA's Third International Mathematics and Science Study*. Chestnut Hill, MA: Boston College, Center for the Study of Testing, Evaluation, and Educational Policy.
- Beswick, K., Watson, J., & Brown, N. (2006). Teachers' confidence and beliefs and their students' attitudes to mathematics. In P. Grootenboer, R. Zevenbergen and M. Chinnappan (Ed.), *Identities, cultures and learning spaces: Proceedings of the 29th annual conference of the mathematics education research group of Australasia* (pp. 68-75). Australia: MERGA.
- Blitzer, R. (2003). *Thinking mathematically*. New Jersey: Prentice Hall.
- Bondi, C. (1991). *New applications of mathematics*. London: Penguin.
- Büyüköztürk, Ş., Çakmak, E. Kılıç, A., Özcan, E., Karadeniz, Ş., & Demirel, F. (2011). *Bilimsel araştırma yöntemleri*. Ankara: Pegem Akademi Yayınları.
- Carter, G., & Norwood, K. S. (1997). The relationship between teacher and student beliefs about mathematics. *School Science and Mathematics*, 97(2), 62-67.
- Civelek, Ş., Meder, M., Tüzen, H., & Aycan, C. (2003). Matematik öğretiminde karşılaşılan aksaklıklar. Retrieved from http://www.matder.org.tr/index.php?option=com_content&view=article&catid=8:matematik-kosesi-makaleleri&id=62:matematik-ogretiminde-karsilasilan-aksakliklar-&Itemid=38
- Cohen, L., Manion, L., & Morrison, K. (2000). *Research methods in education* (5th ed.). London: Routledge Falmer.
- Cooney, T. J. (1985). A beginning teacher's view of problem solving. *Journal for Research in Mathematics Education*, 16(5), 324-336.

- Çontay, E. G., & İymen, E. (2011). İlköğretim 3. sınıf öğrencilerinin okul matematiğini günlük hayata uygulama becerileri. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi*, 30(30), 63-77.
- De Corte, E., Greer, B., & Verschaffel, L. (1996). Mathematics teaching and learning. In D. C. Berliner & R. C. Calfee (Eds.), *Handbook of educational psychology* (pp. 491–549). New York, NY: Macmillan.
- Dede, Y., & Karakuş, F. (2014). The effect of teacher training programs on pre-service mathematics teachers' beliefs towards mathematics. *Educational Sciences: Theory and Practice*, 14(2), 804-809.
- Duatepe Paksu, A. (2008). Comparing teachers' beliefs about mathematics in terms of their branches and gender. *Hacettepe University Journal of Education*, 35, 87-97.
- Ernest, P. (1989). The knowledge, beliefs and attitudes of the mathematics teacher: A model. *Journal of Education for Teaching*, 15(1), 13-33.
- Erturan, D. (2007). *7. sınıf öğrencilerinin sınıf içindeki matematik başarıları ile günlük hayatta matematiği fark edebilmeleri arasındaki ilişki* (Unpublished Master's Thesis). Hacettepe University, Ankara.
- Feiman-Nemser, S., McDiarmid, G. W., Melnick, S., & Parker, M. (1988). *Changing beginning teachers' conceptions: A study of an introductory teacher education course*. East Lansing: National Center for Research on Teacher Education and Department of Teacher Education, Michigan State University.
- Felbrich, A., Müller, C., & Blömeke, S. (2008). Epistemological beliefs concerning the nature of mathematics among teacher educators and teacher education students in mathematics. *ZDM*, 40(5), 763-776.
- Frank, M. L. (1990). What myths about mathematics are held and conveyed by teachers? *The Arithmetic Teacher*, 37(5), 10–12.
- Gainsburg, J. (2008). Real world connections in secondary mathematics teaching. *Journal of Mathematics Teacher Education*, 11(3), 199-219.
- Greer, B. (1993). The modelling perspective on wor(l)d problems. *Journal of Mathematical Behavior*, 12, 239-250.
- Greer, B. (1997). Modelling reality in mathematics classrooms: The case of word problems. *Learning and Instruction*, 7(4), 293-307.
- Gülten, D. Ç., İlgar, L., & Gülten, İ. (2009). Lise 1. sınıf öğrencilerinin matematik konularının günlük yaşamda kullanımı konusundaki fikirleri üzerine bir araştırma. *Hasan Ali Yücel Eğitim Fakültesi Dergisi*, 11(1), 51-62.
- Güzel, E. B. (2008). Yapılandırmacı öğrenme yaklaşımına dayalı matematik öğreniminin bilimi tanıma, yaşam ile ilişki kurma, öğrenmeyi öğrenme, sorgulayarak ve iletişim kurarak öğrenme üzerindeki etkisinin belirlenmesi. *Abant İzzet Baysal Üniversitesi Eğitim Fakültesi Dergisi*, 135-149.
- Henderson, P. B., Hitchner, L., Fritz, S. J., Marion, B., Scharff, C., Hamer, J., & Riedesel, C. (2002, June). Materials development in support of mathematical thinking. In *ACM SIGCSE Bulletin* (Vol. 35, No. 2, pp. 185-190). ACM.
- Henn, H. W. (2007). Modelling in school-chances and obstacles. *The Monhama Mathematics Enthusiast, Monograph 3*, 125-138.

- Inoue, N. (2005). The realistic reasons behind unrealistic solutions: The role of interpretive activity in word problem solving. *Learning and Instruction*, 15, 69-83.
- Kılıç, Ç. (2011). İlköğretim matematik öğretmen adaylarının standart olmayan sözel problemlere verdikleri yanıtlar ve yorumlar. *Journal of Kirsehir Education Faculty*, 12(3), 55-74.
- Kirk, J., & Miller, M. L. (1986). *Reliability and Validity in Qualitative Research*. Beverly Hills: Sage.
- Köller, O., Baumert, J., & Neubrand, J. (2000). Epistemologische Überzeugungen und Fachverständnis im Mathematik- und Physikunterricht. In *Mathematische und physikalische Kompetenzen am Ende der gymnasialen Oberstufe* (pp. 229-269). Opladen: Leske + Budrich.
- LeCompte, M. D., & Goetz, J. P. (1982). Ethnographic data collection in evaluation research. *Educational Evaluation and Policy Analysis*, 4(3), 387-400.
- Lester, F., Garofalo, J., & Kroll, D. (1989). The role of metacognition in mathematical problem solving: A study of two grade seven classes. *Final report to the National Science Foundation of NSF Project*, MDR 85-50346.
- Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic Inquiry* (Vol. 75). Beverly Hills, CA: Sage.
- Manouchehri, A. (1997). School mathematics reform: Implications for mathematics teacher preparation. *Journal of Teacher Education*, 48(3), 197-209.
- Masingila, J.O. (1995). Examining students' perceptions of their everyday mathematics practice. *Proceedings of the Annual Meeting of the American Educational Research Association*. San Francisco. Retrieved from <http://files.eric.ed.gov/fulltext/ED387347.pdf>
- Miles, M. B., & Huberman, A. M. (1994). *Qualitative Data Analysis: A sourcebook*. Beverly Hills: Sage Publications.
- Muller E., & Burkhardt, H. (2007). Applications and modelling for mathematics-overview. In W. Blum, P.L. Galbraith, H. W. Henn, & M. Niss (Eds.), *Modelling and applications in mathematics education, The 14th ICMI-study* (pp. 265-275). New York: Springer.
- National Council of Teachers of Mathematics (1989). *Curriculum and Evaluation Standards for School Mathematics*. Reston, VA: Author.
- National Council of Teachers of Mathematics (2000). *Principles and standards for school mathematics*. Reston, VA : Author.
- Neyland, J. (1994). *Mathematics education: a handbook for teachers*. Wellington: Wellington College Press.
- OECD (2013). *PISA 2012 Assessment and Analytical Framework: Mathematics, Reading, Science, Problem Solving and Financial Literacy*. OECD Publishing.
- OECD (2014). *PISA 2012 results: What students know and can do: Student performance in mathematics, reading and science*. OECD Publishing.
- Öktem, S. P. (2009). *İlköğretim ikinci kademe öğrencilerinin gerçekçi cevap gerektiren matematiksel sözel problemleri çözme becerileri*. Yüksek lisans tezi, Çukurova Üniversitesi Sosyal Bilimler Enstitüsü, Adana.

- Peterson, P. L., Fennema, E., Carpenter, T. P., & Loef, M. (1989). Teacher's pedagogical content beliefs in mathematics. *Cognition and instruction*, 6(1), 1-40.
- Raymond, A. M. (1997). Inconsistency between a beginning elementary school teacher's mathematics beliefs and teaching practice. *Journal for Research in Mathematics Education*, 28(5), 550-576.
- Raymond, A. M., & Santos, V. (1995). Preservice elementary teachers and self-reflection: How innovation in mathematics teacher preparation challenges mathematics beliefs. *Journal of Teacher Education*, 46(1), 58-70.
- Restivo, S., Van Bendegen, J.P., & Fisher, R. (1993). *Maths World: Philosophical Social Studies of Mathematics and Mathematical Education*. New York: New York State University Press.
- Reusser, K., & Stebler, R. (1997). Every word problem has a solution – The social rationality of mathematical modeling in schools. *Learning and Instruction*, 7, 309-327.
- Schoenfeld, A. (1985). *Mathematical problem solving*. New York: Academic Press.
- Staub, F. C., & Stern, E. (2002). The nature of teachers' pedagogical content beliefs matters for students' achievement gains: Quasi-experimental evidence from elementary mathematics. *Journal of Educational Psychology*, 94(2), 344-355.
- Tavşancıl, E., & Aslan, E. (2001). *Content analyse and application examples*. İstanbul: Epsilon Yayıncılık.
- Thompson, A. G. (1992). Teachers' beliefs and conceptions: A synthesis of the research. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 127-146). New York: Macmillan.
- Treffers, A., & De Moor, E. (1990). Proeve van een nationaal programma van het reken-wiskundeonderwijs op de basisschool. Deel 2: Basisvaardigheden en cijferen [Specimen of a national program for primary mathematics teaching. Part 2: Basic mental strategies and written computation]. Tilburg, The Netherlands: Zwijsen.
- Underhill, R. G. (1988). Focus on research into practice in diagnostic and prescriptive mathematics. *Focus on Learning Problems in Mathematics*, 10(3), 43-58.
- Verschaffel, L., De Corte, E., & Borghart, I. (1997). Pre-service teachers' conceptions and beliefs about the role of real-world knowledge in mathematical modelling of school word problems. *Learning and Instruction*, 7(4), 339-359.
- Verschaffel, L., De Corte E., & Lausure, S. (1994). Realistic considerations in mathematical modelling of school arithmetic word problems. *Learning and Instruction*. 4, 273-294.
- Wallace, C. S., & Kang, N. H. (2004). An investigation of experienced secondary science teachers' beliefs about inquiry: An examination of competing belief sets. *Journal of Research in Science Teaching*, 41(9), 936-960.
- Yıldırım, A., & Şimşek, H. (2005). *Qualitative research methods in social sciences*. Ankara: Seçkin Publishing.
- Yin, R. K. (2009). *Case study research: Design and methods*. London: Sage
- Yoshida, H., Verschaffel, L., & De Corte, E. (1997). Realistic considerations in solving problematic word problems: Do Japanese and Belgian children have the same difficulties. *Learning and Instruction*, 7(4), 329-338.