DEVELOPMENT IN SECONDARY PRE-SERVICE MATHEMATICS TEACHERS' PRE-EXISTING BELIEFS DURING THE LAST 1.5 YEARS OF THE FIVE YEAR INTEGRATED PROGRAM

AYŞEGÜL ERYILMAZ

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Prof. Dr. Canan ÖZGEN
Director

I certify that this thesis satisfies all the requirements as a thesis for the degree of Master of Science.

Prof. Dr. Ömer GEBAN
Head of Department

This is to certify that we have read this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Science.

Assoc. Prof. Dr. Behiye UBUZ
Supervisor

Examining Committee Members

Prof. Dr. Ziya ARGÜN (Gazi Univ., SSME) _____

Assoc. Prof. Dr. Behiye UBUZ (METU, SSME) _____

Assoc. Prof. Dr. Ahmet ARIKAN (Gazi Univ., SSME) _____

Asst. Prof. Dr. Zülbiye TOLUK (Abant İzzet Baysal Univ., ELE) _____

Dr. Ayhan Kürşat ERBAŞ (METU, SSME) _____

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Name, Last name: Ayşegül ERYILMAZ

Signature :

ABSTRACT

DEVELOPMENT IN SECONDARY PRE-SERVICE MATHEMATICS TEACHERS' PRE-EXISTING BELIEFS DURING THE LAST 1.5 YEARS OF THE FIVE YEAR INTEGRATED PROGRAM

Eryılmaz, Ayşegül

M. S., Department of Secondary Science and Mathematics Education

Supervisor : Assoc. Prof. Dr. Behiye Ubuz

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The purpose of this study was to determine the fourteen pre-service mathematics teachers' beliefs about mathematics and teaching and learning of mathematics, and their expectations and acquisitions of the Five Year Integrated Program in the Department of Secondary Science and Mathematics Education at Gazi University, Turkey, and the development in their beliefs during the last three semesters of the program.

The data were collected through four longitudinal interviews from each participant. Data collection process began at the beginning of the spring semester of the 2002–2003 academic year and ended at the end of spring semester of the 2003–2004 academic year. The interviews were tape-recorded and transcribed verbatim to produce a complete record of the interviewees' conversation.

The findings that were gathered from analyses of individual interviews show that pre-service teachers came to teacher education programs with some beliefs about mathematics, and teaching and learning of it. The interviews have

provided evidence that pre-service teachers seemed to develop some new beliefs about mathematics during the first 3.5 years of program, and that the courses of the last 1.5 years of the program improved and consolidated pre-service teachers' attitudes towards and beliefs about mathematics, and beliefs about the teaching and learning of mathematics.

The research findings lead to the conclusion that OFD406, OFD408, OFD509 and OFD501 courses were perceived as the most effective courses and OFD402, OFD410 and OFD507 courses were considered as the least effective courses of the program.

Keywords: Pre-service teachers' beliefs, pre-service teacher education, secondary education

ÖZ

BEŞ YILLIK BÜTÜNLEŞİK TEZSİZ YÜKSEK LİSANS PROGRAMINI TAKİP EDEN ORTAÖĞRETİM MATEMATİK ÖĞRETMEN ADAYLARININ İNANÇLARININ SON 1,5 YILDAKİ GELİŞİMİ

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Bu çalışmanın amacı Gazi Üniversitesi Ortaöğretim Fen ve Matematik Alanları Eğitimi Bölümünde kayıtlı olan on dört matematik öğretmen adayının matematiğe ve matematik öğretimine ve öğrenimine yönelik inançlarını, Beş Yıllık Bütünleşik Programından beklentilerini ve kazanımlarını ve son üç dönem süresince bu inançların gelişimini belirlemektir.

Veriler dört boylamsal görüşme ile elde edilmiştir. Veri toplama süreci 2002–2003 akademik yılı bahar dönemi başında başlamış ve 2003-2004 akademik yılı bahar dönemi sonunda sonlanmıştır. Görüşmelerin tam kaydının oluşturulması için, konuşmalar ses kayıt cihazıyla kayıt edilmiş ve kelimesi kelimesine çözümlemesi yapılmıştır.

Bireysel görüşmelerin nitel analizleri aday öğretmenlerin öğretmen yetiştirme programlarına matematiğe ve matematik öğretimine ve öğrenimine yönelik bazı görüşlerle geldiğini göstermiştir. Görüşmeler programın ilk 3,5 yılında aday öğretmenlerin matematiğe yönelik yeni inançlara sahip olduğunu, ve son 1,5 yıldaki derslerin aday öğretmenlerin matematiğe yönelik tutum ve

inançlarını ve matematik öğretimi ve öğrenimine yönelik yeni bakış açıları ve inançlarını geliştirdiğini ve pekiştirdiğini gösteren kanıtlar sunmuştur.

Veriler OFD406, OFD408, OFD509 ve OFD501 derslerinin en etkili dersler olarak algılandığını, ve OFD402, OFD410 ve OFD507 derslerinin ise en az etkili dersler olarak düşünüldüğünü göstermektedir.

Anahtar Kelimeler: Aday öğretmenlerin inançları, aday öğretmen yetiştirme, ortaöğretim

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CHAPTER I

INTRODUCTION

The heyday of studies in psychology, social psychology and education that focused on teacher's attitudes towards students, teachers' democratic attitudes, relationship between teachers' attitudes and classroom behaviors, and the effect of teacher attitudes on teacher-student interactions occurred from 1950s through the early 1970s (Richardson, 1996). In late 1970s, the discipline of social psychology became more cognitively oriented. The shift of the social psychology studies from affective to cognitive orient affected the attitude concept; and attitudes (affective) and beliefs (cognitive) were separated. Several definitions for beliefs (see Goodenough, 1963; Green, 1971; Richardson, 1996; Rokeach, 1968) and attitude (see Bem, 1970; Fishbein, 1967; Richardson, 1996; Rokeach, 1968) have been made but the differences between beliefs and attitudes remained unclear. The definitions of the attitude and belief can differ depending on the discipline. For example, Fishbein (1967) defined the concept of attitude and belief as:

> Attitudes are learned predispositions to respond to and object or class of objects in a favorable or unfavorable way. Beliefs are hypotheses concerning the nature of these objects and types of actions that should be taken with respect to them. (p.257).

Since the late 1970s, teachers' beliefs (e.g. Alba, 2001; Bussiss, Chittenden & Amarel, 1976; Cimer & Cimer, 2002; Carter & Norwood, 1997; Nussbaum, 1998; Munby, 1984; Peterson, Fennema, Carpenter & Loef, 1989; Raths, 2001; Shavelson & Stern, 1981; Ubuz, 2001; Wilson & Cooney, 2002; Lloyd, 2002; Hart, 2002; Philipppou & Christou, 2002; Lerman, 2002), students' beliefs

(Hannula, 2002; Ponte, 1999; Carter & Norwood, 1997), and pre-service teachers' beliefs (Breen & Milroy, 1994; Campbell, 1998; Cimer & Cimer, 2002; Görgen & Deniz, 2003; Hart, 2002; Lasley, 1980; Raymond & Santos, 1995; Stuart & Thurlow, 2000; Turley & Nakai, 2000; Ubuz, 2002) have become an important research topics in education.

The researches on teachers'/pre-service teachers' beliefs have focused on teachers' roles (Munby, 1984), the effects of specific pedagogical courses (such as method course, and teaching practice course) on pre-service teachers' beliefs about nature of mathematics and teaching and learning of mathematics (Breen & Millroy, 1994; Campbell, 1998; Hart, 2002; Nussbaum, 1998; Raymond & Santos, 1995), teachers'/pre-service teachers' beliefs about mathematics and teaching and learning of mathematics, and the effects of these beliefs about classroom practice and their students' achievement, attitudes and interests (Alba, 2001; Archer, 1999; Carter & Norwood, 1997; Munby, 1984; Lasley, 1980; Peterson et al., 1989; Stuart & Thurlow, 2000; Waggett, 1999), the differences of beliefs of teachers who graduated from different undergraduate programs (Baydar, 2000; Görgen & Deniz, 2003), and teachers' momentary views about the teacher education programs from which they graduated (Cimer & Cimer, 2002; Ubuz, 2002).

Most of these studies were especially short term, but a few of them (Campbell, 1998; Hart, 2002; Nussbaum, 1998) were longitudinal studies. Campbell (1998) tried to identify and analyze the 30 elementary pre-service teachers' thoughts and beliefs about mathematics, perceptions about the nature or structure of mathematics, purposes for teaching mathematics and teacher's role in teaching and learning mathematics during the 12 or 16 weeks teaching experience by using pre-teaching and post-teaching survey results, observations and interviews. Beside that, 41 cooperative teachers completed the same survey at the beginning of pre-service teachers' school experience.

Results taken from surveys were analyzed in terms of total scores and subscale scores. In addition, pre-service teachers were observed in mathematics lessons to identify similarities and differences between the observed practices of pre-service teachers and their stated beliefs. The follow-up interviews with pre-service teachers were conducted to investigate beliefs and thoughts about mathematics and to determine whether the behaviors noted in the observation process were considered by pre-service teacher to be typical of most mathematics lessons. Findings of Campbell's study indicated that pre-service teachers' attitudes, thoughts and perceptions about mathematics did not change during the student teaching experience. Besides, statistical difference was found in the area of the role of teacher in teaching and learning environment. Pre-service teachers' perceptions about the role of teacher altered from viewing teacher as a facilitator to viewing teacher as an expert who shows or models. Nussbaum (1998) studied with six secondary pre-service teachers during their last two semesters. The study was conducted within mathematics method class in which the subjects were enrolled during the first semester, and secondary mathematics public school classrooms in which they enrolled during the second semester of an innovative teacher preparation program. She investigated the changes in their beliefs about mathematics and their teaching practices by using data collected from interviews, questionnaire, lessons, lesson plans, course syllabi, program descriptions and observations through mathematics method class and student teaching. Data was collected by weekly observations in method course and by four observations while pre-service teachers were teaching at public school classrooms. Interviews followed observations to gain insight about beliefs and belief changes. Two professors who had helped to design the secondary education certification program were interviewed to clarify the goals of the program. The document analysis was done to collect non-observable data while allowing participants time to think. Nussbaum found that pre-service teachers believed that students learned best by listening to teachers and through practicing repetitive exercises and these

beliefs were grounded from their high school and college experiences. Hart (2002) assessed the success of the Urban Alternative Preparation Program integrated math/methods sequence in changing the beliefs of 14 pre-service teachers in the program and the consistency of their teaching practices with their beliefs through four math-related courses. Pre-service teachers completed a 30 item mathematics belief instrument during the orientation of the program and at the end of their teaching experience (15 months later) to determine the consistency of an individual's beliefs with the philosophy of the National Council of Teachers of Mathematics Curriculum and Evaluation Standards; and to assess the change in teachers' beliefs about teaching and learning mathematics within and outside the school setting. In addition pre-service teachers wrote weekly logs in which they analyzed their experiences in teaching mathematics during the course of their student teaching. Results suggested that the program was successful in changing pre-service teachers' beliefs about their effectiveness in learning and teaching mathematics. These longitudinal studies analyzed the effects of some courses such as methods and teaching practices courses. There were, however, no longitudinal studies in Turkey about teachers' or pre-service teachers' beliefs.

There are several collected volumes (e.g. Calderhead, 1996; Ernest, 1989a; Ernest, 1989b; Thompson, 1992; Clark & Peterson, 1986; Kagan, 1992a; Kagan, 1992b; Pajares, 1992; Richardson, 1996) and books (e.g. Leder, Pehkonen, & Törner, 2002) published recently which features "beliefs". These summaries draw attention to the continuing interest in the field of beliefs in teacher education as well as to the increasing diversity of paradigms and methodologies used by researchers. Doing researches to determine teachers/pre-service teachers' beliefs about their subject and pedagogical knowledge, teacher training and classroom experiences; and to examine the development of these beliefs is important to understand the nature of teaching profession (Lasley, 1980; Pajares, 1992). Beliefs may be the best way to

predict how teachers behave in the classroom. Studies showed that teaching methods and instructional practices were influenced by teachers' beliefs about teaching and their profession, and it is clear that teachers' beliefs and the instructional practices influence their students' achievements, beliefs, and attitudes (Alba, 2001; Carter & Norwood, 1997; Ernest, 1989; Pajares 1992; Peterson et al., 1989; Thompson, 1984; Thompson, 1992).

Having established these facts, it seems necessary to examine the secondary pre-service teachers' beliefs about mathematics, teaching and learning of mathematics and teacher education program, and the development in their beliefs during the last three semesters of teacher education program, which was put into practice in the 1998-1999 academic year. In this study, the concept of "belief" is used in the sense Ponte (1994) defined. "Beliefs are the incontrovertible personal 'truths' held by everyone, deriving from experiences or from fantasy, with a strong affective and evaluative component." (p.169).

In 1994, The Council of Higher Education (YOK) and The Ministry of National Education (MONE) started studies to refresh teacher-training programs in education faculties. As mentioned above this new program was put into practice in 1998-1999 years. With this reorganization in the program, becoming a secondary school mathematics teacher was required to graduate level with two different programs: The Five Year Integrated Program (3.5+1.5) and Master Of Science Program without Thesis Program (4+1.5). This study was conducted with the pre-service teachers attending to The Five Year Integrated Program. Students entered to the five year integrated programs through the University Entrance Exam (ÖSS) results. The students are granted with a M.S. degree without thesis upon graduation. In this integrated program, students spend seven semesters by taking the major area courses, and in the remaining three semesters, they take courses related to the teaching profession.

1.1. The Purpose of the Study

The purpose of this study was to determine the pre-service mathematics teachers' beliefs about mathematics, teaching and learning of mathematics, and their expectations and acquisitions of The Five Year Integrated Program in the Department of Secondary Science and Mathematics Education at Gazi University, Turkey and the development in their beliefs during the last three semesters of their study.

Three research questions were proposed to facilitate the exploration of the problem in this study:

1. What beliefs do the pre-service teachers hold about mathematics? How pre-service teachers' beliefs on mathematics are changed/shaped during during the last three semesters of the program?

2. What beliefs do the pre-service teachers hold about learning and teaching mathematics? How pre-service teachers' beliefs on teaching and learning of mathematics are changed/shaped during the last three semesters of the program?

3. What expectations and acquisitions do the pre-service teachers have about the five year integrated program?

1.2. Significance of the Study

Studies about teachers' beliefs about teaching and learning (Peterson et al. 1989; Thompson, 1984) shows that teachers' beliefs have affect on their classroom management, their teaching activities, their instructional decisions and teaching methods. Thompson (1984) advised that if there is a relationship between instructional practices and beliefs, any effort to improve the quality of

mathematics teaching begin with the understanding of the beliefs of teachers and pre-service teachers.

Lortie found that beginning teachers are most likely to teach mathematics as they were taught (as cited in Richardson, 1996). In addition, researches indicate that a teacher's beliefs will be a factor in how he or she will teach (Thompson, 1984). It is important for mathematics educators to study the beliefs of teachers and pre-service teachers because some research indicates that beliefs are one factor guiding their instructional choices and actions (Thompson, 1992).

Teacher education programs develop and defend a set of belief statements about mathematics, teaching and learning of mathematics, teaching profession, and teacher training program (Lasley, 1980).

Neglecting identification of the pre-service teachers' beliefs "may be responsible for the perpetuation of antiquated and ineffectual teaching practices" (Pajares, 1992, p. 328). Knowing pre-service teachers' beliefs and how their beliefs change/develop can help teacher educators develop new strategies in their courses.

Teachers' beliefs affect the instructional practices (Alba, 2001, Carter & Norwood, 1997; Pajares, 1992; Thompson, 1992), and instructional practices effect the students' beliefs (Peterson et al., 1989). The students' beliefs can have a substantial impact on their interests and motivations in mathematics, and enjoyment of it (Kloosterman, 2002). The students' beliefs also affect their own achievements (Ball & McDiarmid, 1990; Grossman, Wilson, & Shulman, 1989).

Consequently, mathematics teachers' beliefs are the key issues for student success in mathematics (Peterson et al., 1989). Therefore, efforts to increase

students' achievements are partially dependent to pre-service teachers' beliefs. The results of this study should provide valuable data about pre-service teachers' beliefs about mathematics, teaching and learning of mathematics and development in those beliefs.

1.3. Assumptions of the study

Since a small group of participants was involved in this study, changes in beliefs may be thought as unique to these individuals. The study, however, is based on the assumption that behavior is universal and that similar studies with larger number of participants would produce similar results (Boglan & Biklen, 1992).

This study is based on the assumption that the participants answered interview questions truly, honestly and sincerely. To obtain such answers from these interviewees, the interviewer explained the importance and significance of the study, and participants were made to be sure about the confidentiality of the identifier and given information.

1.4. Limitations of the study

One of the limitations of the interview technique is the participants' likelihood of bias in reporting his/her ideas (Cannell & Kahn, 1953). Although it is commonly assumed that the individual possesses certain facts, he/she may withhold or distort them. In order to eliminate this problem, interviewees were told that no one else has access to the data, and all interviewees were assured that any data collected from or about them will be held confidential. As a matter of fact the researcher was a research assistant in a different university, and this provides participants to report their ideas easily about program, their instructors and themselves.

Memory bias is another limitation which makes the interviewees unable to provide accurate information. To overcome this factor, the interviews were conducted just after the courses at the end of semesters.

The participants were affected by many experiences, such as interactions with other pre-service teachers, cooperative teachers, teacher educators, parents, and high school students. In this research, I tried to clarify influencing factors, noting how each of interaction affected the participants and how each of them was addressed by the program. The effects of personal attributes were not considered in this study.

Although data collection procedures in some similar researches about beliefs are based on both interviews and observations, in this study data collection is based only on interviews. One limitation of this study was that no observation data were collected when the students were in the classroom during their field experience and student teaching assignments. This would have been an opportunity to expand this study to include some data about relationship between beliefs and actions and if any changes occurred as a result of their pedagogical education. However, participants did not have the opportunity to demonstrate their existing beliefs in realistic classroom environments as a result of University Entrance Exam (OSS) or their cooperating teachers/supervisory school teachers.

The major problems in interviewing are the inability and unwillingness of the respondent to communicate. These problems were surmounted by arranging interview day, time and place together with interviewee to get the appropriate time for volunteer participation.

CHAPTER II

REVIEW OF LITERATURE

This chapter focuses on the research literature relevant to the study. Sections are including importance of beliefs in education and the previous research studies about beliefs.

2.1. Importance of Beliefs in Teacher Education

Since the late 1970s, teachers', pre-service teachers' and students' beliefs have become an important research topic in education (Kagan, 1992). There are several collected volumes (e.g. Clark & Peterson, 1986; Ernest, 1989, Gess-Newsome, 1999; Kagan, 1992; Pajares, 1992; Richardson, 1996; Thompson, 1992) and books (e.g. Leder, Pehkonen & Törner, 2002) published which emphasize the importance of beliefs. As teachers' and pre-service teachers' beliefs about mathematics and teaching and learning of mathematics is a factor in the process of teaching and learning, doing researches to determine their beliefs about mathematics, teaching and learning of mathematics is important to predict the teachers'/pre-service teachers' behaviors and future classroom practices. Ernest (1989) suggested, "The powerful effect of beliefs is more useful in understanding and predicting how teachers make decisions". Waggett (2001), however, indicated that "Beliefs may be the best way in which to predict what teachers will do in the classroom, but verbalization of best practice does not guarantee that teachers will do as they say" (p.3).

In addition, there is a relationship between teachers' beliefs and students' achievement. Teachers' beliefs affect their instructional practices (e.g. Pajares,

1992; Thompson, 1992), and instructional practices affect the students' beliefs (e.g. Peterson et al., 1989). The students' beliefs influence their interests and motivations in mathematics, and enjoyment of it (e.g. Kloosterman, 2002). They also affect their achievements (Ball & McDiarmid, 1990; Grossman, Wilson, & Shulman, 1989). Consequently, mathematics teachers' beliefs are the key issues for students' achievements in mathematics (Peterson et al., 1989). Therefore, efforts to increase students' achievements are partially dependent to pre-service teachers' beliefs.

Pre-service teachers came to the teacher education programs with strong educational beliefs which were shaped during years of being student (Kagan, 1992; Pajares, 1992). Beliefs held prior to a program are resistant to change and education students leave programs with the same beliefs they had when they started the program (Shaw & Cronin-Jones, 1989). In his widespread research, Kagan (1992) concluded about pre-service teachers' beliefs about mathematics and mathematics teaching:

> … the personal beliefs and images that pre-service candidates bring to programs of teacher education usually remain inflexible. Candidates tend to use the information provided in coursework to confirm rather than confront and correct their pre-existing beliefs. Thus, a candidate's personal beliefs and images determine how much knowledge the candidate acquires from a pre-service program and how it is interpreted. (p.154)

This view questions the effect of teacher education programs. Lasley (1980) proposed that determining beliefs about teaching, learning and teacher education, and detailing reasons for these beliefs were necessities in the world of pre-service teacher education.

2.2. Beliefs about Mathematics

Beliefs about the nature of mathematics are part of a system of beliefs about teaching and learning mathematics (Greer, Verschaffel, & De Corte, 2002).

The previous researches (Ernest, 1991; Manouchehri, 1997; Richardson, 1996; Thompson, 1992) suggest that teachers' beliefs about mathematics have considerable impact on how they teach and determination of teaching method. There is a range of perspectives or beliefs in the philosophy of mathematics. According to Cope (as cited in Thompson, 1992), there are four beliefs (conceptions): Absolutism, Multiplism, Relativism and Dynamism.

> From absolutist view, mathematics was thought as a collection of facts whose truth is verifiable in the physical world. Multiplism emerged with the advent of than Euclidian geometrics. The advent of relativism was marked by the abandonment of efforts to prove the logical consistency of the different systems and the concomitant acceptance of their coexistence as equally valid systems. Dynamism is characterized by commitment to a particular system or approach within context of relativism. (p.133).

Davis, Hersh and Marchisotto (1995) considered three perspectives: Platonism, Formalism and Constructivism. They put these perspectives this way:

> According to Platonism, mathematical objects are real. Their existence is an objective fact, quite independent of our knowledge of them. … On the other hand, according to formalism, there are no mathematical objects. Mathematics just consists of axioms, definitions and theorems, in other words, formulas. … Constructivists regard as genuine mathematics only what can be obtained by a finite construction. (p.356, p. 357).

Lerman (1990; as cited in Thompson, 1992) considered that Logicism, Formalism, Intuitionism (earlier term of constructivism) and Lakatosian perspectives on mathematics could be set out as two alternative beliefs: Absolutist or Euclidean and Fallibilist or Lakatosian views. Absolutists think mathematics is based on universal, absolute foundations. "Mathematics is a steadily accumulated body of knowledge, linear, hierarchical, dependable, reliable, and value-free. Conceptions do not develop, they are discovered." (p.132). Absolutists want to maintain that mathematics is "objective, absolute, certain and incorrigible body of knowledge, which rests on the firm foundations of deductive logic." (Ernest, 1991). Absolutists view mathematical

knowledge as timeless, although new theories and trusts may be discovered; it is superhuman and historical; history of mathematics is irrelevant to the nature and justification of mathematical knowledge; it is pure isolated, value-free, culture-free knowledge just for its absolutist features (Ernest, 1996). Fallibilists think "mathematics develops through conjectures, proofs and refutations, and certainty is accepted as inherent the discipline." (Lerman, as cited in Thompson 1992; p.132). Fallibilists have been arguing that mathematics is historical and social. They view mathematics as the outcome of social processes (Ernest, 1996). According to fallibilists, mathematics is "experienced as warm, human, personal, intuitive, active, collaborative, creative, investigational, cultural, historical, living, related to human situation, enjoyable, full of joy, wonder, beauty." (Ernest, 1996).

During the last decade, there has been growing interest in researching teachers' (Lindgren, 2000; Perkkilä, 2003; Thompson, 1984), and pre-service teachers' (Benbow, 1996; Camacho, Socas & Hernandez, 1998; Pietila, 2002; Raymond & Santos, 1995; Steele & Widman, 1997) beliefs about mathematics.

Thompson (1984) conducted case studies with three junior high school teachers (Kay, Jeanne and Lynn). Kay held problem solving view of mathematics that allows for the discovery of properties through personal inquiry; Jeanne saw mathematics as unorganized and logical system of symbols and procedures; and Lynn believed that mathematics was a static collection of facts and rules necessary for finding answers to specific tasks and it was free of ambiguity and interpretation. Jeanne and Lynn perceived mathematics as rather static body of knowledge; in contrast, Kay believed mathematics is a challenging subject including essential process with discovery and verification.

Perkkilä's (2003) study attempted to describe and understand the primary school teachers' mathematics-related beliefs. She used both qualitative and

quantitative data. At first, seventy item Likert-scale belief questionnaire was administered to 230 first and second grade teachers. Then, six teachers were observed and interviewed. Results show that 140 of 230 teachers had traditional beliefs, which are near instrumentalist view of mathematics. Observations and interviews exposed the inconsistencies between beliefs and teaching practices. She suggests that it is important to make connections between learning theories and mathematics teaching in mathematics teacher education programs.

Lindgren (2000) explored the content and the epistemology of primary teachers' practical theories in teaching mathematics. Thirty-two teachers filled the questionnaires, and she made a follow-up study with six teachers by interviewing and observing. The results of the study indicated:

> Memories from childhood and early school years have influenced the teachers' beliefs about the nature of mathematics and about the way it should be taught properly and the in-service courses have widened the teachers' understanding of the nature of mathematics. (Parag. 25)

Raymond and Santos's (1995) study focused on the pre-service elementary teachers' beliefs about mathematics. They tried to identify beliefs during the T104 Mathematics for Elementary Teachers via Problem Solving course which was designed to challenge students to question their beliefs about themselves as mathematics learners. Data was collected through observations, document analysis from two classes of 24 students, and interviews with eight female volunteers. One of the three thematic categories was beliefs about self as a doer of mathematics. Raymond and Santos, however, focused on two teachers' interviews and document analysis. The results revealed that, Kate, one of the pre-service teachers in their study, acquired new perspectives about mathematics through the course since her experiences in high school. It is found that all of the pre-service teachers had associated their like and dislike of mathematics with the level of success and understanding they experienced in

mathematics classes. Another subject, Helen, saw mathematics in most everyday occurrences, but she perceived it taught in schools to be distinct from mathematics she encountered in everyday life.

Pietila (2002) purposed to examine pre-service elementary teachers' views and beliefs about mathematics and the experiences that influence their development. She used a research material that was gathered from 80 pre-service teachers in the form of written homework. Participants wrote five different letters about their experiences of mathematics at school and methods course during their mathematics studies. She concluded that while approximately half of the students were interested in mathematics, some were afraid of it. She determined that mathematics studies helped students to question and redefine their views of mathematics. In her study students expressed that their view of mathematics became more organized. Thus, it was possible to influence students' views of mathematics during their studies.

In a study by Camacho, Socas and Hernandez (1998), involving 54 pre-service teachers from different subject areas, six categories were established to describe beliefs. Three scale Likert-type questionnaire was used to determine the beliefs, similarities between groups. It was found that the participants held different beliefs (conceptions) on mathematics. The 67% of participants believe mathematics to be a means for understanding their environment; 72% admitted that they enjoy themselves when dealing with mathematics and all participants agree that mathematics is important in the life of all citizens (65%) and in culture (69%).

Benbow (1996) investigated the relationship between mathematics beliefs of 25 pre-service teachers, who were attending the mathematics content-methods course and its additional field experience, and their initial mathematics classroom teaching experience. Participants' beliefs about mathematics were

assessed by three questionnaires, written reports, observations and follow-up interviews. The results revealed that pre-service teachers' existing beliefs had an effect on their teaching practices and no changes were detected in participants' beliefs about mathematics.

Steele and Widman (1997) seeked to find out whether or not exposing pre-service teachers to alternative models of teaching changed their conceptions about mathematics; and wanted to find out conceptual changes if there are. They used several methods of data collection such as interviews, observations, and artifact collection. Five participants were randomly selected from total number of 19 and interviewed at the beginning and at the end of the mathematics method course based upon constructivist learning principles. Before the course, all of the participants' responses reflect to a traditional view of mathematics. According to Steele and Widman (1997), the participants were becoming mathematical thinkers and in doing so, they were changing their conceptions about the nature of mathematics.

2. 3. Beliefs about Teaching and Learning of Mathematics

In mathematics education literature, there is a body of research on teachers' (Carter & Norwood, 1997; Chuene, Lubben & Newson, 1999; Peterson et al., 1989; Thompson, 1984) and pre-service teachers' (Brown, Cooney & Jones, as cited in Alba, 2001; Chuene, Lubben & Newson, 1999; Hart, 2002; Lasley, 1980) beliefs about teaching and learning of mathematics. The role of student or teacher, appropriate classroom activities, methods outcomes of instruction, and internal and external factors that affect teaching are all part of one's belief system on mathematics learning and teaching. Many studies show that not only teachers' beliefs about mathematics but also their beliefs about teaching and learning of mathematics influence their instructional practices, pedagogical decisions, classroom behaviors and consequently influence their students'

attitudes, interest, and achievement (e.g. Campbell, 1998; Kagan, 1992, McLeod, 1994; Pajares, 1992; Peterson et al., 1989; Thompson, 1992; Thompson, 1984). Personal experiences that are shaped by family, religious background, gender, ethnicity, schooling, informal observations, folklore of culture, socioeconomic status influence in relation to a person's mental construct shape biases, attitudes, and beliefs (Knowles, 1990, Lasley, 1980; Nespor, 1987; Pajares, 1992 Richardson, 1996). Many years of being student and educational experiences shape beliefs about teaching (Bookhart & Freeman, 1992; Lasley, 1980).

Many research studies have been conducted about pre-service teachers' entering beliefs about teaching and learning of mathematics, and the changes in their beliefs. Brown, Cooney and Jones (as cited in Alba, 2001) have found that pre-service teachers hold beliefs about teaching and learning of mathematics before teacher preparation coursework. The results about belief changes are complex. Some programs lead to changes and others not, certain types of students change their beliefs, others not; some beliefs are more difficult to change than others (Richardson, 1996).

Lasley (1980) states that pre-service teachers' beliefs about teaching gather around mainly three aspects: teaching is a fulfilling career, teacher education courses do little to prepare teachers for the real classroom, and people who like children are effective teachers.

Peterson et al. (1989) investigated the pedagogical beliefs about mathematics of 39 first grade teachers by 48-item questionnaire and structured interview. They drew five important conclusions. First, teachers vary widely in their pedagogical beliefs. Second, teachers' pedagogical content beliefs affect their approaches to teaching, and their goals for instruction. Third, teachers' pedagogical content beliefs are related to students' mathematics learning and

achievement. Fourth, teachers' pedagogical content beliefs and their pedagogical content knowledge are interrelated. Fifth teachers' pedagogical content beliefs are related to their classroom actions.

Chuene, Lubben and Newson (1999) studied the pre-service and novice teachers' views on mathematics teaching and the influence of school experience on their beliefs. Data gathered from the semi-structured interviews conducted with 17 pre-service and 17 novice teachers. Responses to the question what pre-service teachers expected to learn from college in relation to mathematics teaching were analyzed. Three of the 17 interviewees expected 'mathematics content taught during teacher education to be the same as what they did at high school'. On the other hand, one interviewee expected to learn more about the mind of the child and development of a child to enable herself to understand children's abilities. Another interviewee expected to learn nothing from college because he considered himself already a competent teacher. One of the clusters about views on teaching experience focused on the conflicting guidance provided by lecturers and supervisory school teachers. While some of the pre-service teachers valued the teaching practice as an opportunity to interact with youngers, some of them did not take practice teaching seriously. One of the suggestions of pre-service teachers was doing teaching practice instead of classroom observations. Besides, three novice teachers talked about the method course, and theory learned during these classes were found to be irrelevant to real classroom situations. All the pre-service teachers complained about the method of teaching during their education. They wished for a more student centered method of teaching during lectures instead of textbook method or overhead projectors. In addition to the pre-service teachers' comments on education program, their perceptions on teaching styles were determined. Since most of the pre-service teachers focused on active involvement of students, discussions group work was preferred for this purpose. A few interviewees focused on making mathematics

applicable to everyday situations. In another category pre-service teachers commented that some characteristics of a teachers' personality have effect on teaching and learning of mathematics. Chuene et al. suggested that strong links between schools and teacher education institutions should be developed, and the role of a tutor at supervisory schools should be clearly defined.

Carter and Norwood (1997) studied the relationship between teachers' and students' beliefs about mathematics, and teaching and learning of it. They studied with seven fourth and fifth grade teachers and their 158 students. The research question of this study was "are the beliefs held by elementary teachers about teaching and learning mathematics reflected in their students' beliefs about mathematics?" The data were collected through two instruments specifically designed to measure belief systems about mathematics. The results of this study suggest that teachers' beliefs about the teaching and the learning of mathematics influence the way in which their students are likely to view the learning of mathematics. As Carter and Norwood (1997) stated, it is evident that students' beliefs about learning and the nature of the subject matter affect their learning, and how they perceive mathematics are based on what they do in the classroom. Beside this, it was found that what teachers believe about mathematics and the teaching of mathematics influence what they do in the classroom.

Carter and Norwood (1997) determined:

> It is evident that what the teacher does in the classroom influences students' beliefs about mathematics. It is also evident that what teachers believe about mathematics and the teaching of mathematics influence, what they do in the classroom and that their beliefs may be translated into students' beliefs. (p.63)

Pajares' (1992) study supported the results of Carter and Norwood (1997). According to Pajares (1992), beliefs are "far more influential than knowledge

in determining how individuals organize and define tasks and problems and [beliefs] are stronger predictors of behavior" (p 311). Thus, students' learning is affected by teachers' beliefs, more than behaviors (Pajares, 1992).

Hart (2002) explored how well teacher education programs nurture beliefs about teaching and learning mathematics that are consistent with their philosophy of learning and teaching. This study was conducted with 14 pre-service elementary teachers participating in an alternative certification program. Pre-service teachers completed a 30-item Mathematics Belief Instrument before and after the program. The instrument consists of three parts. Part A determines how consistent an individual's beliefs are with the philosophy of the National Council of Teachers of Mathematics Curriculum and Evaluation Standard. Part B was used to assess change in teachers' beliefs about teaching and learning mathematics within and outside the school setting. In Part C, pre-service teachers were asked to indicate their beliefs about their effectiveness in learning and teaching mathematics. The result of the study showed that in the beginning of the year mean scores on Part A and B indicate a more traditional perspective on teaching and learning mathematics, as well as on the subject of mathematics. Pre-service teachers believed that "to be a good at math you need to memorize the formulas." At the end of the year, the higher mean scores demonstrate that more students disagreed with those statements and held beliefs more consistent with the National Council of Teachers of Mathematics Standards (1989). The increase in the mean score of Part C can be interpreted as enhancement of the teacher efficacy. Results suggested that the program was successful in changing pre-service teacher beliefs.

Thompson (1984) examined the relationship between teachers' conceptions (an alias for beliefs in his study) of mathematics and mathematics teaching and instructional practices. The findings of this study showed that teachers' beliefs about mathematics teaching, regardless whether they are consciously or

unconsciously held, play a significant role in shaping the teachers characteristic patterns of instructional behavior. He advised that if the relationship between instructional practices and beliefs exist, any effort to improve the quality of mathematics teaching begin with the understanding of the beliefs of teachers and their relation with teachers' instructional practices.

CHAPTER III

METHODOLOGY

This chapter contains the methodology and overall design of the study. The context of the study, participants and the instruments are described first. The data collection procedure of the study follows. Then, the data analysis process are explained in detail.

3.1. Context

The study was conducted with 14 pre-service teachers attending the Five Year (3.5+1.5) Integrated Program at Gazi University towards degree in secondary school. Gazi University is one of the two public universities in Ankara that has Five Year Integrated Secondary Mathematics Teacher Education Program. Students entered The Five-Year Integrated Programs through the University Entrance Exam (OSS) results to be a secondary school mathematics teacher. The students are granted a M.S. degree without thesis upon graduation. Of this program, the first 3.5 years are spent on taking the mathematics courses and the last 1.5 years on pedagogical courses. Each year consists of two semesters. There are 37 must courses (25 mathematics, 2 physics, 2 Principles of Kemal Atatürk, 2 Turkish Language, 4 technology related, and 2 foreign language) and three elective courses in first seven semesters. There are 12 must courses and two pedagogical related elective courses in the last three semesters. (The courses and the descriptions of the courses are given in Appendix A and Appendix B)

3.2. Participants

Fourteen volunteers from a total size of 15 secondary school pre-service teachers who had just completed their 7th semester of program and had just started to take the courses related to the educational science and subject education courses participated in the study (see Appendix F). Eight were female and six were male. Nine graduated from Teacher Anatolian High Schools, and the rest graduated from other high schools such as Anatolian High Schools, public high schools. Compared to Public High Schools, Anatolian High Schools and Teacher Anatolian High School students were selected through the standardized national exam (LGS, High School Entrance Exam) and spent their first year in the English preparatory courses and the following three years for the high school curriculum covered by all types of schools. In addition, Teacher Anatolian High Schools also have some additional must pedagogical courses specific to teacher education. These pedagogical courses spread to Teacher Anatolian High Schools curriculum. These must pedagogical courses are 'Introduction to Teaching Profession', 'Psychology of Learning', and 'Teaching Methods and Strategies'. Eleven of participants had some previous teaching experience, either as a private tutor or a teacher in "dershane" (private institutions preparing students for the exams, especially for the University Entrance Exam), ranging in duration from two weeks to one year. The age of the participants ranged from 21 to 23, with the mean 22. Mothers of six participants graduated from primary school (1-5 grades), one graduated from middle school (6-8 grades), three graduated from high school (9-11 or 12), and one did not know reading-writing. I do not have any information about other three's mother education levels. Twelve of the participants' mothers are housewives, other two are civil servants. Fathers of six participants graduated from primary school, one graduated from middle school, four graduated from high school, three graduated from vocational

school of higher education. Five of the participants' fathers are retired; others work in different business sectors.

Although the quotes given in the following section are verbatim, names have been changed to ensure confidentiality. Secondary pre-service teachers' pseudonyms used during the study were P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, P11, P12, P13, and P14. The first eight were female and last six were male.

3.3. Data Collection Instruments

In this study, two instruments were used. One was Demographic Data Instrument (DI) and the other was Belief Instrument (BI). Detailed information about instruments is presented below.

3.3.1. Demographic Data Instrument (DI)

This instrument was prepared to get the demographic information about pre-service teachers (Appendix C). The instrument includes 15 questions on pre-service teachers' personal information (Q1, Q2, Q14 and Q15), parental information (Q8, Q9, Q10, and Q11), and educational background (Q3, Q4, Q5, Q6, Q7, Q8, Q12 and Q13).

3.3.2. Belief Instrument (BI)

This instrument (Appendix D) consists of two parts. First part was developed to investigate pre-service teachers' beliefs about mathematics and teaching and learning of mathematics, and to investigate their expectations and acquisitions of last three semesters' pedagogical courses prior and after taking them. This part consists of 22 questions, seven (Q1, Q2, Q3, Q4, Q14, Q15 and Q22) of which is about beliefs about mathematics, one (Q7) is about their general

expectations and acquisitions of mathematics courses that they had taken past 3.5 years, nine (Q5, Q6, Q15, Q16, Q17, Q18, Q19, Q20 and Q22) is about beliefs about teaching and learning of mathematics, seven (Q8, Q9, Q10, Q11, Q12, Q13 and Q21) is about teaching profession. Second part was developed to determine the pre-service teachers' expectations and acquisitions of the last three semester courses of the five year integrated teacher education program. This part includes one question (23). The question in this part differed from semester to semester according to courses taken but there was no difference in content. The question asks either the pre-service teachers' expectations or acquisitions from the semester courses, depending on the time of the interviews.

3.4. Data Collection Procedures

The purpose of this study was to investigate the development in secondary school pre-service teachers' beliefs about mathematics, teaching and learning of mathematics and to investigate their expectations or acquisitions about the pedagogical courses before and after taking them.

The researcher prepared a prototype of the interview protocol considering the related literature on teachers', students' and pre-service teachers' beliefs about mathematics and teaching and learning of mathematics, and teaching profession (Benbow, 1996; Mitchell, 1998; Nussbaum, 1998; Waggett, 1999).

The first draft of the interview protocol including 32 questions about pre-service teachers' demographic information such as age, educational background, family background, measures of socio-economic status, their beliefs about mathematics, teaching and learning of mathematics, and teaching profession, and their expectations and acquisitions of last three semesters' courses, were submitted to a two member validation panel composed of a

research assistant in the mathematics education and the advisor (mathematics educator) respectively. Their judgments regarding the extent to which the questions were spread to cover the topics mentioned before, language level, clarity and content-specificity were used to select the final questions for pilot study interviews. Some questions were revised, changed or dropped. The 22 interview questions were piloted with four pre-service teachers at the Middle East Technical University (METU). Details about piloting were given below.

3.4.1. Pilot Study

The pilot study was conducted with four secondary pre-service teachers attending to The Non-Thesis Masters Program (4+1.5) in Secondary Science and Mathematics Education Department at METU in fall semester of the 2002-2003 academic year. In order to determine the method of data collection, to make sure that the data collection instrument was appropriate to collect the relevant data in terms of pre-service teachers' beliefs about mathematics, teaching and learning of mathematics, and to investigate their expectations and acquisitions of last three semesters' courses. In addition, the researcher had a chance to practice conducting interviews and analyzing data. Training of the interviewer is one of the important points in qualitative open-ended interview (Gall, Borg, & Gall, 1996). The researcher was the interviewer in this study.

The non-thesis masters program is designed for the students who already have mathematics, or some engineering (Electrical Engineering, Electrical and Electronic Engineering, Electronic Engineering etc.) graduate degrees, but have returned to the university to get a masters' degree; to work as secondary school mathematics teachers. This program aims to give them relevant information, training, and practical skills about teaching and learning required for being secondary mathematics teacher. The program seemed a particularly appropriate program for piloting, as 1.5 years period of the 4+1.5 program was

exactly the same program of 1.5 years period of 3.5+1.5 program. That is, the courses of the last three semesters in a five year integrated program and the non- thesis master program are the same in all universities.

The pilot instrument (Appendix E) consists of 7 demographic questions about personal information (Q1 and Q2), educational background (Q3) and parents' educational background and occupation (Q4, Q5, Q6, and Q7); 15 belief questions about mathematics (Q8, Q9, Q16, and Q18), mathematics teaching (Q10 and Q17), teaching profession (Q11, Q12, Q13, Q14, Q15, Q19 and Q20); and thoughts about the first semester courses of the non-thesis master program (Q21 and Q22).

One participant was interviewed, and written responses to the same questions were taken from the other three participants. The difference in methods grows out of the aim of determining the method of data collection. Following issues were also checked during the piloting: (i) whether the questions focused on issues and topics were relevant to the questions; (ii) whether the questions made sense to the interviewees; (iii) whether the questions were related to their circumstances and experiences; (iv) whether the flow of the questions was appropriate; (v) whether the questions created any ethical issues; (vi) whether the timing was appropriate; (vii) whether the method of data collection was appropriate.

In this pilot study interview took approximately 30 minutes, and written responses took approximately 40 minutes. Time difference between two methods may occur from their possible lack of writing abilities in order to express their feelings or attitudes and it takes longer to write than to speak. Moreover, written responses were not clear enough to understand the participants' beliefs. Furthermore, during interview the researcher had chance to add some extra questions, if needed, in order to ask the interviewee to clear

some points. Although the interviews for this study were primarily structured by preparing interviewing questions in advance, some complementary questions were imposed on the interviewer spontaneously reacting to students' descriptions of their beliefs. As a result semi-structured interview format was appropriate to be used in the main study. Semi structured interviews has the advantage of providing plausibly standard data across respondents, and greater depth data can be obtained than structured interview (Gall et al., 1996).

An interview is a purposeful conversation that is directed by one in order to get information from the other (Bogdan & Biklen, 1998; p. 93). In order to see and understand how people organize their world and their thoughts about the world through the 'eyes' of the participants one have to ask some questions. The researcher used interviewing since interviewing increases the probability of learning about one's experiences, thoughts, feelings and perceptions better.

After piloting, the instrument was divided into two parts: the demographic data instrument (see Appendix C) and belief instrument (see Appendix D). To the demographic data instrument, some questions were added for the following reasons. Forth, 5^{th}, 6^{th}, 7^{th} questions were added to get the information about their future intentions and about their intended occupation before OSS. Twelfth and 13^{th} questions were added to select the participants who did not obtained the pedagogical courses at the university and who regularly continued their education. Fourteenth question was added to get information about their teaching experience and 15^{th} question was added to get their addresses for further communication. As a result, the number of the demographic data instrument's questions raised 15 from seven. Belief instrument questions were decided to be considered under two subtitles: (1) beliefs about mathematics, mathematics teaching and (2) expectations and acquisitions of the last three semesters of the five year integrated program. To the beliefs part of the belief instrument three new questions (Q4, Q6, Q7) were added to get the pre-service

teachers' thoughts on the curriculum in the first 3.5 years (Q7), and its effect on their mathematics (Q4) and mathematics teaching (Q6) beliefs. The question that asks how a teacher could teach mathematics more effectively (Q7) was expanded and revised to determine their beliefs about mathematics teaching deeply and asked as seven different questions (13^{th}, 15^{th},16^{th}, 17^{th}, 18^{th}, 19^{th} and 20^{th}). In such case, the first part of BI consisted of 22 questions. The questions about the beliefs/thoughts on pedagogical courses of program (Q21, Q22) were combined as question 23 and this question formed the second part of BI.

3.4.2 Main Study

After implementing the necessary revisions to the instrument, the researcher started actual data collection procedure. The participants for the study were selected from the five year (3.5+1.5) integrated program on secondary school mathematics teacher education at Gazi University.

Data collection process began at the beginning of the spring semester of the 2002 – 2003 academic year and ended at the end of spring semester of the 2003 – 2004 academic year. Prior to conducting the interviews Demographic Data Instrument (DI) was administered to 39 pre-service teachers enrolled in OFD408 course (The Methods of Science and Mathematics Teaching I) given at the beginning of their eighth semester. Data collected through DI was used to gather the demographic information from the pre-service teachers and then to select the pre-service teachers, who have not previously taken any pedagogical courses at the university. According to these data, fifteen pre-service teachers were asked to participate in the study. Only one of them did not want to participate. So, these 14 pre-service teachers were considered as the sample of the study and participated in a sequence of four in-depth interviews. Belief instrument and optional probes (pertinent follow-up questions) were

used to structure the interviews at Time1 (March-April, 2003, at the beginning of the eighth semester); Time2 (May-June, 2003 at the end of eighth semester); Time3 (December, 2003-January, 2004 at the end of the ninth semester); Time4 (May, 2004 at the end of the tenth semester, just before graduation from the program). In addition, at Time4 stimulated recall technique was used to access any development in their previously stated beliefs. The interviews were conducted by the researcher. The in-depth interviews elicited their accounts of beliefs and their perceptions of development in them, if any.

An interview calendar was prepared with the participants of the study in order to use their and researcher's time economically. Prior to conducting the interviews, each time the researcher explained the purpose of the interview, where the interview data was to be used, the time needed, and the confidentiality of their names. Besides, researcher wanted from all the pre-service teachers to say what they thought, even if it was said before. All the interviews were audio-recorded with the permission of the participants. Recording provides a complete verbal record, and it can be studied much more thoroughly than data in the form of interview notes. During the interview, the researcher took notes on nonverbal information such as looks, body postures, and long silences to remember the mood of the interviewee since all are significant in the interactional interview situation (Fontana & Ferey, 1994). Also researcher tried to maintain eye contact as it is evident that eye contact plays a crucial role in communication. Listening with eye contact makes the interviewees feel more comfortable and creates trustworthy atmosphere. Gaining trust is essential to an interviewers' success (Fontana & Ferey, 1994). The tone of the interview was amiable and non-threatening, and efforts were made to make students feel comfortable to provide candid responses. During the interviews, the participants had expressed an interest and willingness to participate in the study. At the end of all interviews, the researcher thanked for time and effort.

At Time1, it was observed that pre-service teachers got excited at the beginning of the interviews. After the friendly atmosphere and relationships created, this excitement turned into enjoyment and other times of interviews they enjoyed being interviewed. Upon the completion of each interview, the researcher transcribed it in two weeks. All the interviews were mainly conducted in a classroom at the Faculty of Education at Gazi University. Rarely were they conducted in participants home. At Time1, three pre-service teachers, at Time4 one pre-service teacher were interviewed at their homes because of their limited time. Each interview took approximately 30, 20, 20, and 40 minutes subsequently.

3.5 Researcher's Qualifications and Roles in the Study

Qualitative inquiry utilizes the researcher as an instrument. Creswell (2003) suggested that, "data are mediated through this human instrument, rather than through inventories, questionnaires, or machines" (p. 145). In addition to some advantages of this approach, researchers bring biases to their studies (Marshall & Rossman, 1995). Researcher as an instrument indicates the significant role that the researcher plays in collecting and analyzing data. Therefore, researcher's background and ideas about mathematics, mathematics teaching may have influenced the efforts to understand and interpret the research.

Researcher graduated from program of mathematics teacher education in 2000; and then she officiated as 6-8 grade mathematics and English teacher in a village between September 2000 and December 2001. Moreover, her main research interest has been secondary level teaching and learning of mathematics. After her teaching experience, she became a research assistant in mathematics education field at a university on December 2001. At the time of the data collection, she had completed the courses for the degree of M. S. prior to the beginning of this study she was informed about both qualitative and

quantitative research methods. Prior to actual data collection, during fall 2003 semester she conducted a pilot study to develop data instruments and to determine the data collection method. The pilot study gave the researcher a chance to practice interviewing and test herself as a data collector.

Researcher played a basic role –interviewer, transcriber, and analyzer- during the semesters in which the main study took place, and her relationship with participants was limited. For all of them, she was a researcher interested in their perspective on teaching and learning mathematics and in their opinions on teacher education courses. She was not an evaluator for them. Since the researchers' position, that has no authority and power, pre-service teachers' ability to be honest and forthright with her in interviews was not affected by any external factor arise from researcher. In addition, after conducting the first interviews a relationship like friendship occurred between the researcher and participants. In addition, this relationship provides additional honesty and informality to the interviews and make the interviewing process more of a conversation than a one way process of receiving information.

As the method of data collection was interviewing, the researcher interviewed with participants. She recorded and transcribed the data, and then analyzed and interpreted. The researcher, in effect, tried to find out what it is like to be a member of that culture. The researcher tried to understand the case's language, beliefs and experiences by being around the site and having relationships with both participants and other pre-service teachers at the stated university. For example, pre-service teachers do not use the codes of the courses during their speech about course; they always use the abbreviations of courses such as ÖMG for "Introduction to Teaching Profession" ("Öğretmenlik Mesleğine Giriş", in Turkish).

Many methods in psychology, sociology and education aim to minimize or exclude the subjective influences, in order to reach "objectivity." A distinction between the researcher and the researched case made interactions minimal. As the researcher was a research assistant at a different university, she was not an instructor or an assistant for any course that participants of this study took. The researcher was only important data collector and interpreter not a tutor, or research assistant at the same university. As a result of this limited interaction, participants could express their beliefs more easily.

3.6. Data Analysis Process

Data analysis is the process of systematically searching and arranging the interview transcripts, field notes and other materials that the researcher accumulate to increase his/her understanding of them and also enable the researcher to present what he/she has discovered to others (Bogdan & Biklen, 1998). Moreover, data analysis process involves “working with data, organizing them, breaking them into manageable units, synthesizing them, searching for patterns, discovering what is important and what is to be learned and deciding what to tell others” (Bogdan & Biklen, 1998; p. 157).

According to Cresswell (2003), the process of data analysis in qualitative research involves making sense out of open ended data. As the research method is case study, the data analyses involve detailed description of the setting and individuals. The data analysis steps, which were developed by Cresswell (2003) and followed by the researcher of this study, were as follows:

3.6.1. Organization and Preparation of the Data for Analysis

This step involves transcribing each interview, sorting and arranging the data into two different types: arranging the data across members, and across interview Times.

The researcher transcribed interviews that she recorded during the interview word by word by using a word processing program through which 360 pages of single spaced word-processed raw data were generated. Transcribing the data herself made the researcher become thoroughly acquainted with the content of the interviews, a critical aspect for the process of analysis, and provided an additional opportunity to review and connect with the data (Tutty, Rothery & Grinnell, 1996)

The transcripts were formatted by leaving the right margin as wide as 5 centimeters in order to allow for easy reading and writing comments, taking notes for further analysis. Two different types of arrangement were used. For each interview of each interviewee two copies of transcripts were printed. At first, the hard copy of each interview was filed in four groups according to interview times. Secondly, the hard copy of each interview was filed in 14 groups according to the interviewee. Moreover, each interview time was numbered as Time1, Time2, Time3, and Time4, and each interviewee (pre-service teacher) was numbered as P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, P11, P12, P13, and P14.

3.6.2. Obtaining General Sense

In this step researcher repeated readings of transcriptions, analyzed the text data, highlighted all sections and sentences and labeled them with a term relevant to the research questions and responses. This step led to obtain a general sense of the information. General thought about the data and general

information about the participants, general ideas of participants, general information about credibility and the use of information were gathered in this step. The organization of the data into categories and clusters, which will be used to summarize the researcher's interpretation of the data, was done in this step. In this step, codes were formed based on the actual language of the participants.

At first, two interviews of the Time1 were transcribed. Transcriptions were read carefully several times and the list of all codes was written. Then, similar codes were grouped together and categories were constituted by keeping the prior review on the relevant literature, the focus of the research and the research questions, inferences from the actual data, researcher's imagination, previous knowledge and experiences in mind. The list of categories, which emerged after the first two interviews were analyzed, was as follows:

1. What is mathematics?
2. How mathematics can be learned?
3. Mathematics teaching
4. Teaching environment
5. Factors affecting mathematics teaching
6. Teaching profession
7. Properties of a good teacher
8. Opinions about the five year integrated teacher education program
9. Recent problems at high schools
10. Expectations from 8th semester courses
    a. OFD402-Introduction to Teaching Profession
    b. OFD404-Development and Learning
    c. OFD406-Instructional Planning and Evaluation in Secondary Education
    d. OFD408-Methods of Science/Mathematics Teaching I
    e. OFD410-School Experience in Secondary Education I

In this process, the researcher classified and grouped the data into meaningful units, in which the researcher makes decisions about the pieces of data that fit together.

3.6.3. Coding the Data

After the first draft version of the categories was constituted, all the first interviews were analyzed through these categories and codes. During the procedure when the same issue was repeated by any of the participants, this was inserted to the analysis table by giving the participant number (Table 3-1).

Table 3-1: Example of the analyzed data

	P2	
What is mathematics?	**Time 1**	**Time2**
I like mathematics	+	
Mathematics is a philosophy	+	
Reflection of natural events on papers	+	
...		
How mathematics can be learned?		
Doing exercises	+	
Thinking on mathematics	+	
Being curious	+	
...		
Mathematics Teaching		
Daily life examples should be given	+	
Teachers should concretize mathematics	+	
...		
Effective teaching environment		
Using materials	+	
Size of the class	+	
Silence	+	
...		
Factors affecting mathematics teaching		
Students' fear of mathematics	+	
Students' dislike of mathematics	+	
Teachers' pedagogical knowledge	+	
Teachers' personal characteristics	+	
University Entrance Exam (OSS)	+	

	P2	
...		
Teaching profession		
I want to be a teacher	+	
Requires big responsibility	+	
Low salary	+	
...		
Properties of a good teacher		
Content knowledge should be enough	+	
Relationships between teacher and student should be good	+	
A good teacher should be patient	+	
...		
Opinions about five year integrated program	**Time 1**	**Time 2**
We took unnecessary mathematics courses	+	
High school content should be given	+	
We gained different perspective towards mathematics	+	
Recent problems at high schools		
Noise	+	
Teachers' insufficient subject knowledge	+	
Monotony	+	
Week classroom management	+	
…		
Last 1.5 year courses of the program		
OFD402		
Properties of a good teacher	+	
OFD404		
Children development	+	
OFD406		
Lesson planning	+	
OFD408		
Teaching mathematics	+	
OFD410		
Observation of lessons	+	

3.6.4. Refining and Reorganizing the Categories

Analyses were done for each interviewee and each Time. The researcher worked back and forth between data collected from the participants to verify the meaningfulness and accuracy of the categories and the placement of data in those categories. This process went on until data analysis for each interviewee

of fourth interviews was completed. Categories remained the same until the last analysis was done.

After the data integration to the tables was finished, researcher worked on the repeated codes, categories, and clusters. The data collected were analyzed by categorizing the data under the three heading drawn from the framework of the study: mathematics, teaching and learning of mathematics, and program. These categorizations formed a two dimensional table that was used to summarize the collected data. One dimension was codes and the other one was participants and the interview Time. The codes and responses were placed on a chart for each theme and were reviewed to find out the common patterns, similar responses and deviant responses. With this form, it is easy to check the development/change of the participants' beliefs from interview to interview. After having completed all the interviews, the researchers' next step was grouping the codes into clusters in their categories. Data analysis was qualitative. Similar responses were identified to form clusters in categories of responses with similar themes. Themes were identified emerging from the interviews and synthesized common themes leading to the refinement and reorganization of table of responses. The following tables show the clusters and categories of data that were used to interpret the data and to report the findings of this study.

Data about the beliefs about mathematics and attitudes towards mathematics were interpreted according to two categories and six clusters in total.

Beliefs about Mathematics

Absolutist

Fallibilist

Both absolutist and fallibilist

Attitudes on mathematics and factors affecting attitudes towards mathematics

External factors

Affective domain

Cognitive domain

Data about beliefs about teaching and learning mathematics were grouped into two categories and six clusters.

How mathematics can be learned?

Mathematics study skills

Ability

Affective domain

Mathematics Teaching

Mathematical content

Instruction

Teachers Responsibilities

Factors Affecting Mathematics Teaching

Students

Teachers

Conditions of school and classroom

System

Parents

Mathematics itself

For the pre-service teachers' expectations and acquisitions of last three semesters' courses, each course was thought as a category and clusters were as follows:

Effectiveness

Content

Content need to be covered

Methodology

Applicability

Teacher

Feeling

3.7. Reliability and Validity Issues

The researcher took the following measures in order to address the reliability and validity concerns during data collection stage.

Interview questions were submitted to a two-member validation panel composed of a research assistant in mathematics education and the lecturer in mathematics education, respectively. Their judgments regarding the extent to which the questions were spread to cover the topics mentioned above, language level, clarity and content-specificity were used to select the final questions for the pilot study. Pilot study created an opportunity to check if there is any misunderstanding due to wording.

Interview was chosen as a data collection method as interview is generally considered to be suitable for capturing the beliefs, views and opinions (Maxwell, 1996). Open-ended questions were used. The value of open ended questions is explained by Patton (1990) "for purposes of qualitative evaluation, good questions should, at a minimum, be open ended, neutral, sensitive, and clear" (p.295). Therefore, the researcher prepared an interview form with open-ended questions and tried not to ask any leading questions so that the interviewees would be able to express themselves freely. The researcher paid care to go through the same sequence before, during and after interview in order to create same conditions during the interviews such as seating arrangement, no interruptions so on. This allowed the researcher to collect valid data on research questions.

According to Maxwell (1996), validity refers to the correctness or credibility of description, conclusion, explanation, interpretation, or other sort of account. He describes the three main types of understanding -description, interpretation, and theory- has distinct threats to validity.

Since the inaccuracy or incompleteness of the data is a threat for valid description (Maxwell, 1996), the entire interview was recorded with the permission of the subjects in this study. This also provided researcher to listen interviews again and again, which prevented the loss any information and which helped them to be analyzed them in detail. The researcher transcribed all the interviews by herself and this enabled her to indulge in the data more.

According to Maxwell (1996, p. 89) "Imposing one's own framework or meaning, rather than understanding the perspective of the people studied and the meanings they attack to their words and actions" can be considered as a threat to validity (interpretation). Therefore, the researcher prepared an interview protocol with open-ended questions and tried not to ask any leading questions so that the interviewees would be able to express themselves freely. Member checks are the main ways of avoiding this treat (Maxwell, 1996). Member check means taking back a summary of your findings and conclusions back to key informants in the field for a reality check. In this study designated changes of beliefs especially on mathematics, asked to the participants again to get the accurate data for particular participants. Beside this, data analyses for random chosen transcriptions of two participants were done by a research assistant in the same field to examine the chain of evidence. When the analysis of random chosen transcriptions were compared, it was seen that they were 85% consistent. The concensus of different results was to go ahead. After this collaboration, the results were discussed with the mathematics teacher educator and agreement in the results reached by group. Collaborative research and feedback provide to decrease analysis error and improve the credibility of the study.

In order to make the replicate of the study possible, the researcher described all the steps taken before and during the data collection and analysis stages explicitly and in detail.

The concept of transferability corresponds to the notion of generalizability. It is concerned with the extent to which findings of a study can be applied to other situations. However, in contrast to most quantitative study, a qualitative study is preferred by the researchers because of the desire to achieve in-depth understanding of one situation. Thus, to address generalization issues in qualitative research, the researcher must provide "thick description" (see Geertz, 1973) so readers will be able to determine how closely their own situations reflect the research situation and the transferability of findings (Merriam, 1998).

CHAPTER 4

RESULTS

The purpose of this study was to study the pre-service mathematics teachers' beliefs about mathematics and teaching and learning of mathematics; and expectations and acquisitions of The Five Year Integrated Program in Secondary Science and Mathematics Education Department at Gazi University, and the development in their beliefs during the last three semesters.

In this chapter, pre-service teachers' responses to beliefs instrument (BI) questions were presented under certain clusters and categories. Similar responses were identified to form clusters and categories of responses with similar themes. Frequencies of different clusters and categories were used for interpreting and reporting the findings. Responses given by a participant may fall into different clusters of the same category, which causes the sum of the total of category frequency to exceed the sample size.

4.1. Pre-service Teachers' Beliefs about Mathematics

Although pre-service mathematics teachers constituted their beliefs and attitudes since primary schools, they seemed to have new perspectives on mathematics during the five year integrated program. As the mathematics-related questions were asked only in Time1 and Time4, the summary table consisted of only two response frequencies.

When the pre-service mathematics teachers were asked, what mathematics was, many of them responded that they had never thought before what mathematics was.

At Time 1, nine pre-service teachers (P1, P2, P4, P6, P7, P9, P11, P12, and P13) mentioned that the university mathematics was different from the mathematics that was taught at schools. Not only scope of the high school mathematics and university mathematics but also teaching methods were different. At high school, just formulas, drill and practice, solving mathematics questions as quickly as possible and finding the right choice by clues were taught; in contrast, at university, theorems, axioms, and logical systems were taught. Pre-service teachers stated that they realized mathematics was not just solving questions; it was in life and all around; it had a logical structure and philosophy. Seven (P1, P6, P8, P9, P11, P12, and P13) of them expressed that their beliefs about mathematics had taken shape during their first 3.5 years of university education. Most of the pre-service teachers talked about this difference in the first interview. P6 commented his realization of this difference as follows:

"I like mathematics much. But when we were in high school, we did not feel that mathematics is in nature. We realized that mathematics was more beautiful. … At high school, we did exercises, solved multiple choice questions, learned methods of solving questions quickly but here [at university], how I can say, we saw different dimensions and we have realized it is more beautiful, it is much more different from high school" (P6-Time1)

P11 explained the effect of university mathematics somewhat differently:

"At university, I saw the relationship between life and mathematics. It is too peculiar. Look, algebra or other branches, it seems too incoherent. But I have realized it is not. Maybe, for me, that is the greatest benefit of the first 3.5 years. At last, I think to

myself that mathematics is so related to real life. I don't know how I can tell but I believe my thought system has changed and developed." (P11-Time1)

At Time 4, three pre-service teachers (P6, P8, and P10) also indicated that pedagogical courses had effect on their beliefs about mathematics in terms of seeing mathematics in life. P8 put it in the following way:

"Especially my beliefs about mathematics were affected a lot by Methods of Mathematics Teaching courses; namely, [these courses] showed the mathematics around us. The other times [during his first 3.5 years], we did not have the opportunity to consider that mathematics was in our lives because we kept studying lessons. We copied the notes from the board to the notebook; we studied our notes, and then passed the courses. Afterwards, we did not think about the things we learned in those courses." (P8- Time4)

At Time1, half of the pre-service teachers (P1, P2, P3, P9, P11, P12, and P13) expressed their beliefs about mathematical knowledge. They believed that having mathematical knowledge increases one's imagination and thought power. However, at Time4, only three pre-service teachers (P1, P2, and P10) mentioned this theme. As a representative example, P2 said:

"I think it [mathematics] is a philosophy and it develops our thought power. I realized that as I work on mathematics, I could look at events from different aspects… Mathematics develops thought power. One can see one way of the problem and you [if you think mathematically] can see the other ways." (P2-Time1)

"I think learning mathematics is very important. … We had asked our teachers that why we were learning mathematics. I see that it is useful and mathematics develops thought power and imagination. Therefore learning and teaching mathematics is very important." (P12-Time1)

The interviews conducted at Time1 and Time4 revealed that the pre-service teachers' beliefs about mathematics could be grouped into two categories: Absolutist and Fallibilist.

According to Table 4-1, half of the pre-service teachers (P6, P7, P8, P9, P11, P12, and P13) did not change their beliefs and perspectives on mathematics during the last 1.5 year of the program. Beside, three (P2, P3, P10) pre-service teachers who had both absolutist and fallibilist beliefs at Time1 changed their beliefs to absolutist. Inversely other three (P1, P4, P5) added fallibilist beliefs to their absolutist beliefs. Only one (P14) showed fallibilist perspective at Time 1, but he added absolutist beliefs to his beliefs.

Table 4-1: Beliefs about mathematics

	Codes from Time 1	**freq**	**Codes from Time 4**	**freq**
Absolutist	P1, P4, P5, **P6, P7, P8, P9, P11, P12**	9	P2, P3, **P6, P7, P8, P9,** P10, **P11, P12**	9
Fallibilist	P14	1		
Both	P2, P3, P10, **P13**	4	P1, P4, P5, **P13**, P14	5

Note: Bolds indicate the pre-service teachers who did not change their beliefs

One of the most used absolutistic expressions was "mathematics is everything in life" in interviews. Absolutists thought that mathematics was logical and existed in nature. Mathematics has absolute truths and explains nature by using numbers, operations, theorems and proofs. P8 stated her absolutist belief with these words: *"Mathematics is everything in the world. Everything that we are connected to deals with mathematics somehow."* (P8-Time1)

After the pedagogical courses, Time1, P8 echoed similar sentiment saying, *"Once, everything is true, clear, absolute and not relative. I like this [property]."* (P8- Time4)

Fallibilist expression codes in our analysis are mostly about problem solving, philosophical, investigational perspective of mathematics. Most used expressions for problem solving perspective was “mathematics is problem solving”, for philosophical perspective was “mathematics has a philosophy”, and investigational perspective included such expressions: “mathematics is constructed by people” belief. P13 stated his fallibilist belief as follows:

“I know that mathematics has a philosophy and a logical side; all things spliced. One thing has been found and then another has been added to it, in this way the whole is formed ...” (P13-Time4).

P1, P4 and P5’s absolutist beliefs about mathematics seemed to be influenced by the last 1.5 years. While they had absolutist beliefs at Time1, they believed that it has both absolutist and fallibilist properties at Time4. P1 and P5 explained their beliefs at Time1 as “*Explanation of the whole world with numbers, functions, formulas and it is always definite and sharp.” (P1-Time1).* At Time 4, they echoed these beliefs and in addition to these beliefs they talked about the living, developmental and investigational side of mathematics. P4 believed that mathematics was numbers, formulas and theorems at Time1, but at Time4, she emphasized that mathematics was everywhere and it has a philosophical side. It helps us to understand world.

As fallibilist and absolutist believers, P2 and P10 stressed the philosophic side of mathematics and P3 stressed the problem solving based mathematics at Time1, but both three do not mentioned this properties of mathematics at Time4.

“I think mathematics is a philosophy. I think it improves our thought power. I realized that I can look at an event from different perspectives, when I grapple with mathematics.” (P2-Time1).

P14 thought mathematics is problem solving (Time1), then he added mathematics has a systematic and thinking patterns. Other students echoed their fallibilist beliefs similar sentiments saying:

"I haven't thought before what mathematics is, but recently I have discovered it is methods and techniques for solving problems." (P14-Time1).

As a result, nine of 14 pre-service teachers had absolutist beliefs and five had both fallibilist beliefs about mathematics at the end of five year integrated program.

The beliefs about mathematics that pre-service teachers have are important because literature (e.g. Ernest, 1999; Pajares, 1992) concluded that the teachers' beliefs about mathematics affect the teaching methods of teacher and the classroom atmosphere.

4.2. Pre-service Teachers' Attitudes towards Mathematics

Pre-service teachers have been coming face to face with mathematics since primary school. All experiences effect beliefs and attitudes. Interviews conducted at Time1 and Time4 revealed that almost all pre-service teachers had a positive attitude towards mathematics by mentioning, "*I have liked [mathematics] since I was at middle school because of my teachers, and I didn't have the ability to do other social courses anyway. I strived to be successful in mathematics in all probability.*" (P7-Time1). However, this positive attitude was not towards all topics, branches or levels of mathematics. At Time1, three pre-service teachers (P1, P3, and P4) indicated that they love middle school and high school mathematics much. P3 commented on this issue as follows:

"I like mathematics but not the university mathematics. I like high school mathematics more. I don't know, maybe I don't really understand, maybe I think I won't use it. I am considering the teaching profession as my first career choice. But I think I won't use most of the things I was taught." (P3-Time1)

When the origins of their attitudes and beliefs towards mathematics were asked, their responses showed that origin of attitudes vary. Even, thirteen of 14 pre-service teachers (except P13) constituted their attitudes about mathematics before university.

For example, P1, P8, and P11 began to like mathematics since they were at high school. Teachers, high school mathematics content and enjoying studying and being successful were the origins of their attitudes.

P1 expressed origins of her attitudes with these words:

"Mathematics was amusing, and problems were not tiresome, at high school. For example, I found history or geography boring, and solving problems as boring. Actually, I did not think what mathematics was. Teacher gave a question and we solved it. How I can say, it was like a play." (P1-Time1)

P8 mentioned her dislike and fear of mathematics, which existed during middle school, in first interview. She said "*I was afraid of [mathematics] at middle school. It was very bad ... I got rid of this fear during high school. At university, this feeling transformed to love."* When the reason for this change was asked, she said:

"My high school mathematics teacher led me to love not only teaching profession but also mathematics. Understanding transformed fear to love, and understanding that 'I can do it'… The reason for my fear was being unsuccessful. … At that time, I thought it was my fault; that I could not do, I could not understand. But it was not. I realize

that it was due to my teachers and their teaching methods inappropriate for me." (P8-Time1).

As another example, P11 loves mathematics since high school because he likes to study mathematics. He depicted his love as follows:

"I can say clearly, the reason of my love is not teachers. I do not believe my high school teachers were affective. If you ask me the reason of my love, at first, I like studying mathematics, and I can do it. Being successful. For example, I did not like physics because I can not do it." (P14-Time1).

P14 is an extreme example in this view he decided to be a mathematics professor, not a mathematics teacher, when he was a child. Thus, his attitude was intrinsic and based on his childhood. He does not know the reason of his attitude. As P14"explained, *"I have thought 'I will be a mathematics professor' since I was six or seven. Because of this, if what I like most were put in one side and the mathematics on the other, I would choose mathematics. I like it." (P14-Time1)*

Seven of 14 pre-service teachers mentioned the positive effects of university on their attitudes either at Time1 and/or at Time4 (Table 4-2).

Positive attitude in P8's Time1 interview reiterated at Time4. She said that *"After I settled down my life and I looked [mathematics] as a life style, I began to like mathematics much more [at university]."* (P8-Time4).

P13, however, mentioned that he began to like mathematics when he started to look at mathematics as a philosophy. P13 put it this way,

"When we [I] examine our experiences in terms of mathematics, I didn't like mathematics much until I came here [university]; likewise, I tried to learn geometry in

the last one month [of the 11th grade] because of the exam (OSS). I had recourse to mathematics when I need it. After coming to university and believing that mathematics is a philosophy, I began to like mathematics." (P13-Time4)

Table 4-2: Factors affecting attitudes towards mathematics

	Time1		*Time4*	
	Code	***f***	***Code***	***f***
External factors				
Primary school	P9, P6, P14	3		
Middle school	P2, P4, P5, P7, P9, P12, P10	6		
High school	P1, P2, P5,P8, P11	5	P8	1
University	P1, P6, P8, P9, P11, P12, P13	7	P6, P13	2
Family	P2	1		
Teachers	P12	1		
Difference of university mathematics	P1, P2, P4, P6, P7, P9, P1,1 P12, P13	9	P13	1
Affective domain				
Feel pleased when I deal with mathematics	P2, P4	2	P4, P5, P9, P13	4
Interest and curious about mathematics	P5, P9	2		
Love of mathematics (understanding and success increased it)	P3, P12, P8, P5, P11	5	P14	1
Afraid of mathematics (e.g. because I think I cannot do math)	P8	1		
Cognitive domain				
Knowledge of mathematics increases self confidence	P1, P10	2	P14	1

Some of the pre-service teachers mentioned about the relationship between knowledge and self-confidence. P1, P10 (at Time1) and P14 (at Time4) expressed that their self-confidences increase with the knowledge of

mathematics. This association was explained by P10 as, "*When one's knowledge of mathematics increases, his/her self confidence increases." (P10-Time1)*. At Time1, five (P3, P5, P8, P11, P12), at Time4, one (P14) pre-service teachers indicated that there is a relationship between the attitude towards mathematics and level of success and understanding. P8 explained this obstacle by giving her own experience as mentioned before. P14 explained the same relationship somewhat differently, *"... There are not any obstacles to being unsuccessful if you have an average intelligence and don't have any fears or dislikes." (P14-Time2).*

4.3. Pre-service Teachers' Beliefs about Teaching and Learning of Mathematics

The pre-service teachers beliefs about teaching and learning of mathematics can be grouped and analyzed into three groups:

1. How mathematics can be learned?
2. Mathematics teaching
3. Factors affecting mathematics teaching

4.3.1. How Mathematics can be Learned?

Most of the pre-service teachers believe that learning and studying type depends on student and may change student to student. When we clustered the responses of pre-service teachers' beliefs about mathematics learning, five main clusters can be constituted (see Table 4-3):

Table: How mathematics can be learned?

	TIME1 (n=14)	f	TIME2 (n=14)	f	TIME3 (n=13)	f	TIME4 (n=14)	f
Mathematics study skills								
solve different types of questions			P6, P9	2	P2, P3	2		
studying with writing	P1	1	P1	1	P1	1	P1	1
Thinking on mathematics								
pay attention to terms and definitions	P12	1	P3	1	P3, P9, P12	3	P9	1
repeat what has been learned (by studying regularly)	P1, P2, P3, P4, P10, P11	6	P1, P4, P5, P9, P10	5	P1, P2, P6, P7, P11	5	P2, P3, P6, P10, P12	5
Ability								
make connections to previous and developing knowledge	P1, P10	2	P1, P11	2	P1, P3, P6, P8, P9, P11	6	P1, P6, P7, P9	4
comprehend systematic, and ropes	P9	1	P13	1	P9	1	P5, P9, P13	3
comprehend the way of solution	P1	1			P6, P7, P11	3	P7	1
establishing the relationship between mathematics and life	P3, P5, P8, P10, P11, P14	6	P2, P5, P7, P11, P12, P13	6	P3, P7, P8, P9, P11, P12, P13, P14	8	P1, P2, P4, P5, P7, P11, P12, P13	8
self-directed learning	P7	1	P5	1	P3, P8, P11	3	P1, P2, P3, P5, P6, P7, P8, P11	8
mathematical intelligence	P8, P10	2	P5	1			P3, P9	2
abstract thinking	P10	1	P6	1			P13	1
self-awareness	P3, P11	2					P7	1
Affective Domain								
must like mathematics	P8, P9, P14	3	P1, P3, P4, P7, P8, P10, P11	7	P3, P4, P7, P11	4	P1, P3, P4, P6, P7, P8, P9, P10, P11, P14	10
not to be afraid of mathematics	P2, P7, P8, P13	4	P2, P4, P7, P8	4	P1, P2, P3, P9	4	P2, P5, P7, P8, P10	5
willingness and enjoy of studying mathematics, instead of necessity	P3, P10, P11	3	P2, P8	2	P3, P4, P5, P6, P7, P9, P11, P13	8	P1, P4, P10	3
searching and be curious about mathematics	P2, P3, P4, P6, P7	5	P4, P5, P6, P8, P13, P14	6	P2, P3	2	P2, P3, P6, P7, P10, P11	6

4.3.1.1. Mathematics study skills

Of the approximately seven or eight pre-service teachers mentioned the importance of study skills in learning, only one participant's belief seemed to be changed. However, P8, P13 and P14 did not point out the importance of study skills in any interviews. In other cases, beliefs remained unchanged as their responses depended on their self study skills. P1 admitted this as follows:

"One cannot learn mathematics by reading. For example, you [students] should do and prove the theorems by yourself. If I only read, I cannot do whether the same question was asked. If I do it by myself and solve the questions by writing, I learned and I don't forget it." (P1-Time2)

P9 seemed to add the belief about the importance of the understanding of definitions after taking OFD509 Textbook Analysis course. He expressed his beliefs by these words:

"I have never thought them [using materials, giving definitions] before. Being dershane teacher, here you have to solve a lot of questions and you have to solve them as quickly as you can. But this was changed for me. Now, we begin with definitions, and then start to questions. Sometimes we could spend one hour in lesson on one definition. … At the beginning, students confused and flustered about time, questions. But later they have realized that they were not seeing subjects such complex anymore. Students see benefits of definitions in time" (P9-Time3).

4.3.1.2. Ability

Ability refers to the being able to perform in here. All of the pre-service teachers emphasized the importance of ability in different interviews.

When we investigated the interview results, we saw that all of the pre-service teachers mentioned, in both of them or in one of them, the importance of ability. Most emphasized ability was establishment of the relationships between life and mathematics. Six participants believed that ability to establish the relationship between life and mathematics was important for learning mathematics before the pedagogical courses. The reason of this belief might be their experiences or their own studying habits. Four pre-service teachers seemed to add the belief about this issue after eighth semester. The importance of the daily life examples highlighted in OFD408 and OFD 505 Special Teaching Methods courses and OFD 501 Instructional Technology and Material Development course. According to data, pre-service teachers, who mentioned the importance of establishing the relationship between life and mathematics, consolidated their beliefs during the last semesters. For example, P11 believe the importance of establishing the relationship at Time1, later at Time4 his belief was continuing *"Are the students aware of the relationship between life and mathematics? ... I think students should know this relationship to learn mathematics."* (P11-Time3). P4 emphasized this importance in different way. She said, "*Love of mathematics and knowing the usage of mathematics is important to learn mathematics. Students could do this*" (P4-Time4).

Only P6 did not give importance to this issue. She believed that ability to make connections to previous and developing knowledge and comprehend the way of solution were more important.

Pre-service teachers did not change these beliefs but they developed their beliefs with new terms into their pedagogical knowledge. Before the pedagogical courses, they do not have any beliefs about self-directed learning. Self directed learning is a learning environment in which students are responsible for their own learning. The role of the teacher becomes to facilitate

learning rather than direct it. While P5 and P7 consolidated their beliefs with pedagogical courses, at Time3 and/or Time4 six pre-service teachers realized the importance of self-directed learning. P8 mentioned the self-directed learning as follows:

"In mathematics, everything is formulas anyway. Nevertheless, I will not force to memorize these formulas. … There won't be strict rules. Child constructs her/hisself pattern." (P8-Time3)

A few of the pre-service teachers mentioned the importance of students learning mathematics such as mathematical intelligence, abstract thinking or self-awareness. Responses of interviewees seemed to be scattered, as the change or development was not determined.

The five pre-service teachers expressed the importance of mathematical intelligence at different times. For example, P9 said:

"Mathematics learning depends on mathematical intelligence. I think intelligence is stable but it can be used in different ways. When you make an intensive study of a subject continually, the power of perceiving, learning and understanding become appearent." (P9-Time4)

In this cluster, at first, the participants attached importance to establishing the relationships between life and mathematics, but later, the importance of self-directed learning became appear. At Time4, all pre-service teachers articulated the importance of ability.

4.3.1.3. Affective domain

This affective domain term here refers to how individuals feel emotionally and physically such as fatigue, and illness, willingness, persistence and attention

abilities, emotions and attitudes while learning (Herod & Ed, 2002). It can be easily seen from Table 4-2; pre-service teachers gave more importance to the affective domain in learning with eighth semester educational courses. Of the approximately 11 or 12 participants mentioning the importance of affective domain in learning, however, data shows that P12 did not believe the importance of affective domain.

When we investigate Table 4-3 and the transcripts, we see that pre-service teachers, who mentioned affective domain in both interviews or either in one of them, their beliefs about the importance of affective domain did not change. For example, P14 admitted, "*Their [students'] prerequisites are important; in addition to this their love of mathematics is important too. If he/she likes mathematics, he/she will do it by himself/herself*" (P14-Time1 and Time4).

4.3.2. Mathematics Teaching

This section contains the main beliefs of pre-service teachers on mathematics teaching. There are three clusters explaining the pre-service teachers' beliefs about important points of mathematics teaching (see Table 4-4).

Table 4-4 : Mathematics teaching

	TIME1 (n=14)	f	TIME2 (n=14)	f	TIME3 (n=13)	f	TIME4 (n=14)	f
Mathematical content within an emphasis on								
history of mathematics			P2, P13	2	P3, P6	2	P6	1
the importance of mathematics	P3, P10	2	P3, P11, P13	3	P2, P8, P13	3	P2, P7	2
concretization of mathematics (e.g. daily life examples)	P1, P2, P3, P5, P6, P7, P9, P10, P11, P12, P13	11	P2, P3, P5, P6, P7, P10, P11, P12, P13	9	P1, P3, P6, P7, P8, P9, P11, P12, P14	9	P1, P2, P6, P7, P9, P10, P11, P12, P13, P14	10
connections to previous and developing knowledge	P9	1					P7, P8, P9	3
definitions					P3, P9, P12	3	P3, P9	2
Instruction within an emphasis on								
planning of instruction is important	P7	1			P3, P12	2		
variety of teaching methods	P3, P6, P7, P11	4	P2, P3, P10, P13	4	P3, P11, P14	3	P2, P3, P5, P7, P10, P11	6
taking students' attention	P2, P5, P7, P9	4	P5, P10	2	P9	1	P2, P4, P6, P9, P10, P12, P14	7
Teacher's responsibilities within an emphasis on								
removing math fear of child, and shifting from fear to love	P1, P2, P7, P8, P9, P10, P11, P12, P13, P14	10	P1, P2, P4, P9, P11	5	P1, P3, P5, P7, P8, P9	6	P1, P2, P4, P6, P7, P9, P10, P12, P13, P14	10

4.3.2.1. Mathematical content

Table 4-4 shows that, either in one of the interviews or in both; almost all of the pre-service teachers mentioned the importance of concretization of mathematics with daily life examples.

P5 mentioned the daily life examples at Time1 and but she did not talk about this after ninth semester. When we investigated the interview of P5, we saw that she began to believe the importance of practice and drill and similar examples. She said that "*At first, teacher should lead them to love teacher and then teacher can teach mathematics with examples and questions from books"* (P5-Time4)

P8 and P14 realized the importance of concretization of mathematics and daily life examples particularly after the ninth semester. When their beliefs about courses examined, it can be said that they began to believe on the importance of concretization of mathematics with OFD505 Special Teaching Methods CourseII.

Furthermore, P4 did not believe on the importance of content in teaching mathematics. She did not say anything on this cluster. She gave the importance to teachers' responsibilities and taking students' attention during instruction.

Another point in this cluster is definitions. P9 began to talk about definitions after the tenth semester specifically after OFD509 Textbook Analysis. This course led pre-service teachers to think about the importance of definitions. Pre-service teachers' beliefs about this course explained more detailed in Beliefs about Program section.

Only four of the pre-service teachers mentioned about the history of mathematics during whole study. According to interview results, it can be said that because of the Special Teaching Methods courses, pre-service teachers recognized telling history of mathematics as useful in making sense of teaching mathematics. P2 stated her belief about importance of history of mathematics during teaching at Time2 with these words:

"We did group work in Special Teaching Method course. We made activities for subjects. We learned that it was important to mention the history of mathematics. … Students were not curious, but we can tell it." (P2-Time2)

4.3.2.2. Instruction

Instruction is a process that includes the activities dealing with the teaching of pupils such as planning, teaching, methods of teaching and assessment; and that facilitates learning.

When we examined the interviews and Table 4-4, we saw that P1 and P8 did not mention about instruction process. Comparing the results of Time1 which was conducted prior to the pedagogical courses and the results of Time 2 and Time 3, we see that five (P2, P5, P10, P13, P14) pre-service teachers included new beliefs to their beliefs system about the usage of variety of teaching methods.

"Constructivism, concept maps and different approaches were taught us in Special Teaching Methods course. We learned to teach mathematics by using different methods... We can concretize the mathematics and teach mathematics with different methods." (P10-Time1)

Four interviewees mentioned the importance of taking students' attention at Time1. After first interview, five pre-service teachers realized the importance

of taking students' attention. Half of participants believed that taking students' attention was an important issue in mathematics teaching at the end of pedagogical courses. Interestingly P4, P6, P12, and P14 valued students' attention only at Time4; and according to interviews, we can say that they developed their beliefs with the affect of tenth semester courses.

"I thought to teach mathematics like my teachers by using question and answer technique; and to prepare them to OSS before pedagogical courses. With pedagogical courses, I learned to capturing students' interest and taking students' attention, and the importance of them." (P6-Time4)

Integration of new participants to this cluster at different times might be arising from the Special Teaching Methods courses, School Experience courses and Teaching Experience course. Pre-service teachers saw the real classroom environment in School Experience courses and Teaching Experience course. They mentioned about the discipline problem and the lack of students' attention in classrooms. This may led pre-service teachers to add new beliefs about instructional process.

A few pre-service teachers valued the planning of instruction on mathematics teaching. The reason of this small amount was interviewees who believe planning on paper is not necessary. For example, P14 expressed his beliefs in second interview.

"Our instructor said that we have to do lesson plan for every lesson. But I am not agreeing with him. I believe that we should constitute plans in our mind. It is enough. For example, today in two hours I will teach functions. What I am going to tell in first two hours, blabla…. I planned these two hours in my mind, it is not necessary to write." (P14-Time2)

Although planning was an important subject of OFD406 Instructional Planning and Instruction, OFD408 and OFD505 Special Teaching Methods courses, these courses did not have a contribution in teachers' beliefs about planning.

4.3.2.3. Teachers Responsibilities

All of the pre-service teachers stated their beliefs about teachers' responsibility of removing math fear of child and shifting from this fear to love at different times of the interviews. As an example, only P3 and P5 mentioned at Time3. They realized that teacher was responsible for removing negative attitudes of child after ninth semester courses. P6, however, had not mentioned before but mentioned at Time 4.

"I led my students learn fundamentals of mathematics. I think, I can make them love mathematics. It is important. A teacher should do this. At first, I will respect them, and then they will respect me and my lesson." (P5-Time4)

When codes of ninth semesters' courses examined, it was found that P3 and P5 valued OFD505 Special Teaching Methods Course. Similar to the concretization of mathematics code, the reason of development in this beliefs can bee seen as OFD505 course, and the presentations in this course.

4.3.3. Factors Affecting Mathematics Teaching

The answers of the question "What are the factors affecting mathematics teaching?" were constituted this category. Either in one of the interviews or in both of them, all pre-service teachers' mentioned students, teachers, conditions of school and classroom and system as a factor that were affecting mathematics teaching on these factors vary. Table 4.5 gives brief summary beliefs of pre-service teachers with six clusters on factors affecting mathematics teaching.

Table 4-5 : Factors affecting mathematics teaching

	TIME1 (n=14)	f	TIME2 (n=14)	f	TIME3 (n=13)	f	TIME4 (n=14)	f
Student'								
attitude towards mathematics	P7, P8, P10, P13	4	P5, P6, P9	3	P14	1	P9, P10, P13	3
prejudice towards mathematics	P3, P7, P8, P10, P13	5	P3, P5, P6, P9	4	P3, P6, P13, P14	4	P6, P7, P10, P14	4
fear of mathematics	P2, P3, P7, P8, P9, P10, P11, P13	8	P2, P4, P6, P7, P8	5	P1, P4, P5, P6, P7, P9, P14	7	P1, P2, P4, P5, P6, P7, P8, P10, P14	9
dislike towards mathematics	P1, P2, P11	3	P1, P2, P4, P5, P7, P10, P11	7	P1, P4, P6, P11	4	P1, P4, P5, P6, P7, P8, P9, P10, P11, P14	10
disinterestedness towards mathematics	P2, P4, P8, P9, P10, P11	6	P2, P4, P8, P9, P10, P12	6	P4, P5, P8, P11	4	P2, P4, P5, P8, P10, P11	6
prerequisite subject knowledge	P1, P3, P14	3	P1, P7, P10, P13	4	P1, P3, P5	3	P1, P3, P4, P10, P12, P13, P14	7
awareness of necessity of mathematics	P9	1	P7, P9	2	P5, P9, P11, P12	4	P9	1
development level	P2, P5, P7, P8	4	P2, P5, P10	3	P8	1	P2, P8	2
willingness of students to usage of different methods			P3	1				
values given to the education	P3, P5, P6	2	P5	1	P3, P5, P7, P12, P14	5	P1	1
liking for teacher	P1, P3, P6, P8, P10, P11, P12, P14	8	P1, P3, P7	3	P1, P5, P7, P8, P14	5	P5, P8	2
Teachers'								
pedagogical content knowledge	P1, P5, P8, P9, P11, P13, P14	7	P3, P4, P5, P6, P9, P10, P14	7	P3, P8, P9	3	P2, P3, P5, P8, P9, P11	6
teaching ability	P1, P3, P5, P7, P8, P9, P10, P13	8	P1, P2, P4, P5, P6, P9, P10, P14	8	P1, P2, P4, P9	4	P3, P4, P6, P10	4
tiredness of teaching	P1, P4, P12	3	P5	1	P4, P11	2	P4	1
subject knowledge	P1, P2, P4, P5, P6, P7, P9, P11, P12, P13, P14	11	P1, P3, P4, P5, P6, P8, P9, P10, P12, P13, P14	11	P1, P2, P3, P4, P6, P7, P8, P9, P12	9	P2, P3, P4, P5, P6, P8, P9, P10, P11, P12, P13	11
personal characteristics	P1, P2, P3, P5, P6, P7, P11, P12	8	P3, P4, P5, P6, P8, P11, P14	7	P1, P2, P6, P8, P11, P12	6	P2, P4, P5, P6, P8, P10, P11, P14	8
knowing students characteristics	P6, P9, P14	3	P9	1			P4, P12	2
methods of teaching	P14	1	P5, P6, P10, P11, P13	5	P1, P11, P14	3	P1, P4, P5, P6, P13	5
planning courses according to students' needs	P3	1			P3, P4	2	P1	1

Table 4-5 : Factors affecting mathematics teaching

	TIME1 (n=14)	f	TIME2 (n=14)	f	TIME3 (n=13)	f	TIME4 (n=14)	f
Conditions of school and classroom								
physical conditions of school and classroom	P3, P6, P8, P11, P12, P13, P14	7	P1, P2, P3, P6, P7, P8, P10, P13, P14	9	P4, P8, P11	3	P1, P2, P5, P6, P9, P10, P11, P13	8
size of classroom	P1, P5, P7, P9, P12, P13,	6	P1, P4, P5, P7, P10	5	P1, P2, P3, P5, P7, P12,	6	P2, P4, P7, P9, P10, P11, P13	7
discipline problems	P1, P2, P4, P5, P6	5	P2, P4, P5, P8, P11, P12, P13	7	P1, P2, P4, P5, P6, P7, P8,	7	P2, P9, P6, P10,	4
System								
University Entrance Exam (OSS)	P1, P2, P4, P6, P7, P9, P10, P12, P13	8	P1, P5, P6, P7, P9, P10, P11	7	P3, P5, P6, P7, P8, P11, P12, P13	8	P1, P2, P3, P5, P6, P7, P8, P11, P12	9
curriculum	P4, P5, P6, P9, P10, P11, P13	7	P4, P5, P6, P7, P9, P13	6	P5, P8, P9, P11, P12, P13, P14	7	P5, P9, P13	3
application of the passing system			P8	1				
Parents'								
values given to the education	P4, P8, P13, P14	4	P3, P9	2	P6, P8, P11	3	P8	1
socioeconomic status	P2, P11, P12, P13	4			P4, P13	2	P13	1
Mathematics Itself								
abstractness of mathematics	P2, P5, P8, P10	4	P2, P11	2	P6, P12	2	P13	1

4.3.3.1. Students

The main factor that affects the mathematics teaching was designated as student. According to Table 4-5, affective factors were sticked out such as students' dislike, fear, disinterestedness, prejudice and attitude towards mathematics etc. All of the participants mentioned about student factor either in one of the interviews, or in both of them. Dislike towards mathematics, fear of mathematics and the prerequisite subject knowledge were the most valued codes. Pre-service teachers recognized the importance of students' affective factors mostly at Time2 and/or at Time3, and added these beliefs to their belief system. Notwithstanding the oscillating of frequencies were seen, the difference between first and the last time frequencies were explicit. The responses show that pre-service teachers saw students' negative thoughts and attitudes towards mathematics as the most important factor. P13 expressed his beliefs with these words:

"At first, prejudices; students' prejudices towards mathematics. Students come to classes with prejudices like 'mathematics is difficult' and 'I cannot do mathematics'. For this reason, we [mathematics teachers] begin from the negative" (P13-Time1)

P10 mentioned this factor at another interview as follow:

"There are prejudices, deficiencies in motivation and prerequisite subject knowledge. At the beginning, students' love was needed. Students have to leave their prejudices and fears. Teachers have to show that mathematics is not difficult." (P10-Time4)

Unlike these, P3 stressed an interesting factoring mathematics teaching at Time3. She asserted that willingness of students to usage of different methods affects mathematics teaching. She stated:

"I want to use student centered teaching methods but students have not been used to different teaching methods. I may confront difficulties when I intend to change their habitual environment. Students may confuse; I may cause a loss of time. Students' habits are important, too. I have to be careful; I cannot use these [different teaching methods] directly." (P3-Time2)

4.3.3.2. Teachers

Similar to students, teachers were seen as an important factor that affects mathematics teaching, and all pre-service teachers mentioned about this importance either in one or in both of the interviews. It is commonly accepted that an effective teacher should have sufficient subject knowledge and pedagogical content knowledge. In addition, a good teacher should have good personal characteristics such as attractiveness, objectivity, judicious, cheerfulness, and patience; and also teachers should have ability to teach. All these common properties of good and effective teacher were rated as a factor that affect mathematics teaching. The general framework of these codes shows that the beliefs of pre-service teachers for this cluster were consistent with the properties of good teacher. Approximately seven or eight pre-service teachers mentioned the teachers as an important factor in teaching mathematics at Time1. However, these pre-service teachers consolidate their existing beliefs with eight semester courses; pre-service teachers rated some new codes at Time2. Some codes were rated at Time3 and Time4 by new pre-service teachers but they are not much. As a result of interviews and Table 4-5 we can say that pre-service teacher recognized the importance of teachers and students in mathematics teaching, and add new beliefs to their belief systems with eight semester pedagogical courses.

"At first students dislike towards mathematics is a factor. Teachers' behaviors may influence the instruction. For example, teacher is being thought teacher centered

methods such as lecturing. He/she do not answer the questions or do not make the subject simple."(P10-Time2) .

Besides, three different codes were identified. A few pre-service teachers mentioned about teachers' tiredness of teaching. Especially P4 were defending her beliefs in both interviews:

"Teachers are experienced but this experience causes tiredness and weariness. He/she comes, lectures and then goes. He/she do not have luxury in terms of inject students with a favorable attitude towards mathematics or give right students to speak about lesson. He/she just tells the subject and go" (P4- Time1)

Hence, pre-service teachers took courses on development and learning, planning and evaluation, and methods of teaching during their last 1.5 years; it was expected to get responses about these issues. However, there were few beliefs about the factor code 'knowing students characteristics' and 'planning courses according to students' needs'. Vis-à-vis these two codes, 'methods of teaching code' was more rated. At Time1, only P4 designated the teachers' teaching method as a factor affecting mathematics teaching. After completing the eighth semester's pedagogical courses, the frequency in this code increased. Representing the sentiment P13 expressed his beliefs about the factors affecting teaching mathematics: "*Students' background and their teachers [affect the mathematics teaching] of course. Teachers' teaching methods, questioning, lecturing, and their democratic behaviors are important topics.* " (P13- Time2)

Consequently, the change in beliefs about this cluster can be determined only methods of teaching code. It can be said that the reason of this change was Methods of Teaching 1 course.

4.3.3.3. Conditions of school and classroom

Another important cluster that all pre-service teachers rated at different times was conditions of school and classroom. This cluster includes physical conditions of classroom and school such as warming, lightening, noise control of school and location and type of board, desks, windows, curtains, lightening etc., size of the classroom and discipline problems in classes.

Most rated code was physical conditions of school and classroom. Most of the pre-service teachers addressed many points in this code at different times and the change in their beliefs can not be seen from the data. Hence, the size of the classrooms is the main problem in the public high schools in Turkey, the size of the classroom and discipline were expected factors. Almost half of the participants were stated their prior beliefs, those based on their experiences, on this cluster at Time1. Nine pre-service teachers at Time2 accepted conditions of school and classroom as a factor affecting mathematics teaching. School experiences and the discussions on the school conditions and discipline might have an impact on pre-service teachers' beliefs. Nonetheless, changelessness of the beliefs about discipline after Classroom Management course was unpredicted. As a representative example, P1 stated about the conditions of school and classroom the following:

"There should not be any noise absolutely. This is the most important thing for me. The classroom should not be much crowded; there should be a suitable teaching environment, suitable desks, and a board." (P1-Time1).

4.3.3.4. System

Almost all of the pre-service teachers believe that the existence of University Entrance Exam influence mathematics teaching in high schools, due to their existing beliefs. Besides, the high school curriculum was determined as a factor

by nearly half of the pre-service teachers. Interviewees also expressed consolidation of these factors with school experiences. Curriculum is not coinciding with the OSS content, as a result of this situation high school teachers, especially grade two and grade three teachers, cannot teach content, and the students were receiving report for last their last semester. Thus, OSS system and the curriculum system were determined as a factor that affects teaching and learning. P12 mentioned this factor briefly; *"OSS affects mathematics teaching too much. No one interested in mathematics learning, because of OSS."* (P12-Time3). P5 put it this way *"As the University Entrance Exam is one level, some subjects removed from the exam content. Thus, teachers are not teaching lots of important subjects in mathematics."* (P5-Time2).

P11 mentioned this problem from the view of students' willingness.

"Students are not motivated. Even teachers try; maybe student interests only that time or if there is an exam he/she interests for it. If the subject was an OSS subject, student would interest differently. … He/she would not interest in mathematics because of his/her love." (P11-Time3).

P6 gave herself as an example and tried to understand students. She expressed the situation as following:

"Width of curriculum and the existence of OSS affect mathematics teaching. Students said 'Let's solve questions; these were not beneficial for us.' We had said the same to our teachers. Students think they do not need mathematical knowledge and that they only need to pass the exam. They see other things except for solving questions as a waste of time." (P5- Time2).

4.3.3.5. Parents

Parents' socioeconomic status and their values of education are the main points of this cluster. A most of the pre-service teachers believed that parents were affected mathematics teaching, but they mentioned at different times. Pre-service teachers' thoughts were based on their own experiences. P1 mentioned:

"My sister is a teacher at a public high school. She is concerning only one or two students who are interested in education. There are some extreme students in her class. For example, two of the students do nothing. They don't solve exam questions. They trust their parents, and at the end parents come to school and they pass the class." (P1-Time2).

P3 considered the same theme from another point. She emphasized the guarantees that were given from parents. She commented that with following words:

"Students think that teacher can not teach enough in schools, and that they can learn more effectively in private courses or at dershane. They said if we were not learned, we would take private courses. Parents gave this guarantee anyway. If parents' socioeconomic status was good and they had possibility to take private course, students could easily neglect the school and learning." (P3-Time2).

"Not only teachers' but also students' socioeconomic status is one of the most important factors. …For example, when you are in comfortable situation, teaching will be easier. Reaching the materials and tools won't be a problem." (P13-Time1).

4.3.3.6. Mathematics itself

Different pre-service teachers, in total nine, in every Time stated the abstractness of the mathematics is one of the factors. As a representative example, P8 said her beliefs as:

"Mathematics teaching is teaching abstract things to students. I am giving private science lessons for elementary students. They were really easy to teach. For example, when you are on simple machines and levers subject, you can show pincers. But one (1) or two (2) or, 'x', I can not have the chance to show. It is hard to construct that in students' minds. From this point of view, when I think about mathematics teaching, I remember the complicatedness of the process." (P8-Time1).

4.4. Pre-service Teachers' Expectations and Acquisitions of Five Year Integrated Program

Pre-service teachers' general views about the mathematics courses of first 3.5 year of the five year integrated program were asked at Time1 and Time4. Participants' expectations and acquisitions of the each course of last 1.5 year of the five year integrated program were asked through the interviews based on the time the courses taken. Responses were identified emerging from the interviews and then documented, synthesized common responses leading to the development of table of codes about courses and presented under two subtitles: First 3.5 Year of Five Year Integrated Program and Last 1.5 Year of Five Year Integrated Program

4.4.1. First 3.5 Years of Five Year Integrated Program

During the first 3.5 year of the program pre-service teachers took 37 must courses (25 mathematics, 2 physics, 2 Principles of Kemal Atatürk, 2 Turkish, 4 technology related, and 2 foreign language) and two pedagogical and one mathematics related elective courses (the descriptions of the courses and the curriculum are given in Appendix B).

When the pre-service teachers asked what they thought about first 3.5 year of the program, as mentioned before, nine pre-service teachers stated that university mathematics was different from the mathematics that was taught at

schools. At Time1, 10 of 14 pre-service teachers (P1, P2, P3, P4, P5, P6, P9, P10, P12, and P13) expressed that some of the mathematics courses as topology, differential geometry, and linear algebra taken during the first 3.5 year of the program were unnecessary. Five pre-service teachers (P2, P4, P5, P8, and P9) at Time1 and four pre-service teachers (P1, P4, P5, and P7) at Time4 thought that these courses were more advanced and therefore do not contribute to their teaching profession. In other words, subjects learned in these courses found not to be necessary to be able to teach high school curriculum. At time 1, almost all of the pre-service teachers (except P9, P14) mentioned about the lack of high school content during the 3.5 years of the program and the necessity for covering the high school mathematics and geometry curriculum. These pre-service teachers expected to learn the high school mathematics curriculum but at a more detailed way in teacher education program. They emphasized that this could have been deepen their high school mathematics knowledge. P1 commented on the importance of the teaching high school mathematics in her perspective:

"I am not pleased. It is very important to be taught high school mathematics. While I am teaching at dershane, I use my high school mathematics knowledge. University mathematics is more abstract than high school mathematics and I won't use university mathematics during my teaching profession." (P1-Time1)

P11 echoed the deficiency of the program:

"The topics, that I will teach, were not taught. This is the most deficiency of the program. All of us took and passed algebra, linear algebra, topology, but I will not teach these to my students. Yes, I have to be superior to students and these provide me a different perspective. ... Four or five years passed over my graduation from high school and my knowledge worn away." (P11-Time1).

P9 and P14, however, stated that high school curriculum and university curriculum were well integrated.

P9 argued the teaching of high school mathematics content in mathematics teacher education programs. As he put it:

"I am not in favor of teaching high school mathematics, it is not necessary, because they are simple and easy subjects. Some instructions could be given [including how to teach]. We have already known them. For example, complex numbers. We took complex analysis, and they were included anyway." (P9-Time1)

At Time 4, three pre-service teachers (P4, P5, and P7) still mentioned about the teaching of high school mathematics curriculum as they feel themselves insufficient for teaching high school mathematics. Other interviewees thought that the deficiency of knowledge about the high school curriculum removed in pedagogical courses such as Analysis of Secondary Education Textbooks (OFD502), Special Teaching MethodsII (OFD505), and Elective I (OFD 509) (Textbook Analysis). Especially, pre-service teachers mentioned about the benefits of Elective I (OFD 509) (Textbook Analysis). The details about these courses were mentioned individually in related sections.

4.4.2. Last 1.5 Year of Five Year Integrated Program

Pre-service teachers' first and formal familiarization with a professional model of teacher and action about teaching is in teacher education programs (Chuene, 1999). During the last 1.5 years of the program, pre-service teachers took 12 must courses and two pedagogical elective courses (the descriptions of the courses and the curriculum were given in Appendix A and Appendix B).

At first interviews, four pre-service teachers (P1, P8, P9, and P12) mentioned about their adaptation problems. They said they faltered at the beginning of the

eighth semester because they just finished mathematical courses and then suddenly their courses became too verbal. Representing the sentiment P8 said:

"Actually as I said before, courses bore me. We don't keep notes in lessons now. During mathematics courses something was written on the blackboard, we tried to understand the subject and we copied notes to our books. May be these courses were better than pedagogical courses. We kept notes during mathematics lessons. As we got used to continuous operations and numerical studies I don't enjoy sitting like this and doing nothing" (P8-Time1)

Pre-service teachers' expectations and acquisitions of the courses were asked at the beginning and at the end of each course. For example, pre-service teachers' expectations from eighth semesters' courses OFD402, OFD404, PFD406, OFD408 and OFD410 were asked at Time1. Acquisitions from these courses were asked at Time2; at the same time, expectations from ninth semester courses OFD501, OFD503, OFD505, OFD507, and OFD509 courses were asked.

Table 4-6 below gives the distribution of the opinions about the effectiveness of the courses before to and after taking them. Responses given by a participant may fall into both effective and ineffective categories which result into category frequencies exceeds the sample size. Although it was found that the courses did not change the pre-service teachers' initial opinions, there was clear distinction between effective and ineffective ones from point of view of the students.

Table 4-6 : The distribution of the opinions about effectiveness of the courses

		Before course		After course	
		effective	**ineffective**	**effective**	**ineffective**
Eight semester courses of program	Introduction to Teaching Profession (OFD402)	6	8	3	12
	Development and Learning (OFD404)	10	5	10	6
	Instructional Planning and Evaluation in Secondary Education (OFD406)	*11*	*3*	*12*	*2*
	Special Teaching Methods I (OFD408)	*12*	*2*	*11*	*3*
	School Experience I(OFD410)	6	8	7	10
Ninth semester courses of program	*Instructional Technology and Material Development (OFD501)*	*12*	*2*	*11*	*5*
	Classroom Management (OFD503)	11	3	9	5
	Special Teaching Methods II (OFD505)	9	5	10	5
	School Experience II (OFD507)	7	7	4	10
	Elective I (OFD 509) (Textbook Analysis in Mathematics Education-I)	-	-	*12*	*2*
Tenth semester courses of program	Analysis of Secondary Education Textbooks (OFD502)	7	6	10	4
	Guidance (OFD504)	10	4	9	5
	Practice Teaching in Secondary Education (OFD506)	14	1	10	5
	Elective II (OFD 508) (Algebraic Concepts and Equations)	-	-	5	5
	Elective II (Computer Assisted Instruction)	-	-	4	-

This data led to the conclusion that OFD406, OFD408, OFD509 and OFD501 courses were perceived as the most effective courses at the beginning of the term, and this belief did not change much through the term or there was little change. The participants valued these courses mainly because of the necessity and the applicability of the knowledge learned in these courses to the teaching profession.

OFD406 “Instructional Planning and Evaluation” was one of the most valued courses. The responses of participants for this course can be seen in Table 4-7. The OFD406 course is about basic concepts in curriculum development and its processes, development of lesson plan, annual and daily plan, teaching methods and strategies, assessment and evaluation. The requirements of the course were reading articles, writing discussion reports about them, making lesson plans etc. This course seems to be efficient; hence, pre-service teachers

reported that they acquired the skills necessary for their teaching profession. Representing this sentiment, a pre-service teacher (P7) said that *"We made presentations about articles (in OFD406 course). Becoming efficient teacher and teaching of mathematics were discussed. [This course was] Very beneficial for us… Each teacher should know how to evaluate students" (P7-Time 2)*

OFD 408 "Special Teaching Methods I" course and OFD505 "Special Teaching Methods II" were also valued by most of the participants (see Table 4-8 and 4-9). Even OFD505 course was not valued as much as OFD408 course, the courses covered similar contents such as learning-teaching process, application of general teaching strategies on subject matter, special teaching methods and strategies. There were two sections for the course OFD408 and OFD505. The first group studied lessons by making discussions in the classroom. Besides that, students were asked to prepare project related to teaching high school curriculum subject. In the second section, the course content was taught by a student each time to the whole class. At the beginning of the course, groups were formed and the each course content was assigned to a group. So each group was responsible for their subject. One member of a group was also responsible to present their topics in the classroom. First group students expressed that they experienced the varieties of interesting, new and different teaching approaches. Participants attending to the second section of the course given by different lecturer expressed that student teaching was not impressive and everybody learned their own subject that they worked on P3 complained about this situation by saying, *"Nothing changed for me. I just learned what I presented." (P3-Time 2 (Section-2))*

Table 4-7: Instructional Planning and Evaluation in Secondary Education (OFD406)

	before course (n=14)		after course (n=14)	
	code	**f**	**code**	**f**
Effectiveness		14		14
Effective	P1, P2, P3, P4, P7, P8, P9, P10, P11, P13, P14	11	P1, P2, P3, P4, P6, P7, P8, P9, P10, P11, P13, P14	12
Ineffective	P5, P6, P12	3	P5, P12	2
Content				
Methods of teaching and appropriate plans for methods	P7, P8, P9, P10, P11	5	P2, P3, P6, P7, P10	5
Assessment and evaluation	P8, P10	2	P1, P3, P4, P7, P8, P9	6
Lesson planning	P1, P4, P5, P6, P8, P12	6	P6, P8, P9, P11, P12	5
Methodology				
Planning of the lesson is bad			P13	1
Studying with papers is good			P11	1
Applicability				
The knowledge learned from this course can be applied in teaching profession	P1, P7, P11, P13	4	P1, P4, P7, P8, P9, P10, P11, P13	8
Making plan on paper is not necessary, planning in mind is enough			P5, P9, P14	3

Table 4-8: Special Teaching Methods I (OFD408)

	before course (n=14)		after course (n=14)	
	code	**f**	**code**	**F**
Effectiveness		14		14
Effective	P1, P2, P4, P5, P6, P7, P8, P9, P11, P12, P13, P14	12	P2, P3, P4, P5, P7, P8, P9, P11, P12, P13, P14	11
Ineffective	P3, P10	2	P1, P6, P10	3
Content				
Methods of teaching specifically mathematics	P1, P2, P4, P5, P6, P7, P8, P9, P10, P11, P13, P14	12	P1, P2, P4, P7, P8, P9, P11, P10, P12, P13, P14	11
Importance of materials' use in teaching and learning	P4	1	P3, P5, P7, P11, P13, P14	6
Content need to be covered				
Practicing of the theory	P3	1	P6	1
It is necessary to focus on which topics in mathematics is appropriate to teach which methods of teaching			P6	1
Methodology				
Ineffective student teaching			P3, P5, P6, P7	4
Teacher				
Teacher is not tactful	P1, P10	2	P1, P10	2
Applicability				
The knowledge learned from this course can be applied in teaching profession	P9, P13	2	P8, P11	2

Table 4-9:Special Teaching Methods II (OFD505)

	before course (n=14)		after course (n=14)	
	code	**f**	**code**	**f**
Effectiveness				
Effective	P1, P5, P6, P8, P9, P11, P12, P13, P14	9	P2, P3, P5, P7, P8, P9, P11, P12, P13, P14	10
Ineffective	P2, P4, P3, P7, P10,	5	P1, P2, P4, P6, P10	5
Content				
Methods of teaching specifically mathematics	P1, P5, P6, P9, P12, P14	6	P2, P4, P7, P8, P9, P10, P11, P14	8
Using material in classroom			P7	1
Assessment and evaluation			P7	1
Similar topics covered in OFD408	P2, P3, P4, P5, P7, P8, P9, P10, P11, P13	10	P7, P8, P9, P13, P14	5
Methodology				
Effective student teaching			P7, P8,	2
Discussions were beneficial			P9	1
Presentations by students were beneficial			P3, P5, P6, P7, P8, P13, P14	7
Presentations were not beneficial			P9, P10	2
Applicability				
The knowledge learned from this course can not be applied in schools in Turkey			P4, P8, P11	3
Teacher				
Teacher is not tactful			P2, P6, P10	3

The other most valued courses were OFD 501 “Instructional Technology and Material Development”, OFD509 “Textbook Analysis in Mathematics Education-I” and OFD502 “Analysis of Secondary Education Textbooks II” (see Table 4-10, Table 4-11 and Table 1 and 4-12).

Both OFD509 and OFD502 were similar courses in terms of content. Examination of subject matter course books and educational programs, content, language, format, and contribution to meaningful learning and the appropriateness to the students’ level were covered in these courses. In addition, this high school-I mathematics subjects were repeated in OFD509 and high school-2 subjects in OFD502. At Time1, seven pre-service teachers (P1, P2, P6, P9, P10, P11, and P13) complained about the lack of any courses related to high school mathematics curriculum and they felt themselves insufficient in teaching high school mathematics. Most of the pre-service teachers (P1, P3, P4, P6, P7, P8, P9, P10, P11, P12, P13, P14), however, expressed at Time3 and/or Time4 that the essential high school curriculum contents was covered through these courses.

Representing the sentiment P11 mentioned:

“We found opportunity to compensate our weakness especially in high school mathematical concepts” (P11- Time 4)

Table 4-10: Instructional Technology and Material Development (OFD501)

	before course (n=14)		after course (n=14)	
	code	**f**	**code**	**f**
Effectiveness		14		16
Effective	P1, P2, P3, P4, P5, P6, P8, P10, P11, P12, P13, P14	12	P1, P2, P3, P4, P6, P7, P8, P10, P12, P13, P14	11
Ineffective	P7, P9,	2	P3, P4, P5, P9, P11	5
Content				
Developing visual materials for teaching mathematics	P3, P2, P7, P8, P10, P11, P12	7	P1, P3, P7, P8, P10, P11, P12, P13	8
Flash program			P7, P8	2
Similar topics covered at OFD408	P4, P14	2		
Teaching mathematics	P3, P6, P7, P8, P12	5	P9	1
Content need to be covered				
Preparing concrete materials should be more beneficial	P8	1	P3, P4, P5, P7, P11	5
Methodology				
Too much assignments			P2, P7, P11	3
Usage of technology was good			P1, P4, P5, P6, P8, P10, P12, P13	8
Usage of technology was bad			P3, P7, P11	3
Working with materials was enjoyable	P2, P10, P13, P14	4	P6	1
Applicability				
The knowledge learned from this course can not be applied in schools in Turkey			P1, P3, P9	3

Table 4-11: Analysis of Secondary Education Textbooks (OFD502)

	before course (n=13)		**after course (n=14)**	
	code	**f**	**code**	**f**
Effectiveness		13		14
Effective	P2, P3, P6, P7, P8, P11, P14	7	P1, P2, P3, P4, P6, P8, P10, P11, P13, P14	10
Ineffective	P1, P4, P5, P9, P12, P13	6	P2, P4, P5, P7	4
Content				
Examine high school 2 curriculum	P2, P3, P4, P5, P6, P7, P9, P11	8	P2, P4, P6, P8, P9, P10	6
Properties of a good book	P7, P8	2	P8, P9, P10, P13	4
Covering of high school content			P4, P8, P9, P10, P14	5
Importance of definitions	P3	1	P6, P11, P13, P14	4
Methodology				
Copying instructors notes to board			P4, P5, P7,	3
Ineffective student teaching			P1, P3,	2
Presentation are insufficient			P4	1
Presentation are beneficial			P2, P8, P10, P13, P14	5

Note: P10 cannot be interviewed before the course

Table 4-12: Elective (OFD 509) (Textbook Analysis)

	before course (n=14)		after course (n=14)	
	code	**f**	**code**	**f**
Effectiveness				14
Effective			P1, P2, P3, P6, P7, P8, P9, P10, P11, P12, P13, P14	12
Ineffective			P4, P5,	2
Content				
Properties of a good book			P7, P8	2
Examine lycee1 curriculum			P1, P3, P4, P6, P7, P8, P9, P11, P13, P14	10
Criticizing of the high school 1 books			P2, P7, P8, P9, P12, P13, P14	7
How to select a book			P1, P7, P8, P9, P14	5
Methodology				
Using instructors notes in presentations was bad			P4, P5	2
Teacher				
Instructors knowledge is impressive			P3, P10, P13	3

In another valued course OFD501 “Instructional Technology and Material Development” the characteristics of various instructional technologies, the place and the use of technologies in instructional process, development of teaching materials through instructional technologies were covered (see Table 4-10). Even visual materials learned during OFD 501 were found to be inapplicable in schools in Turkey; all of the pre-service teachers thought that visual materials could attract students’ attentions. P1 expressed her beliefs about this course as follows:

“In Material Development course, we worked on Flash program, it was very different. Students can learn everything by using computer. But I do not believe it is effective. Teacher might have a computer and can use it with flash program. However, I believe we cannot use this method in real classrooms of Turkey. Conditions of classrooms and schools are restrictive.” (P1-Time3).

P3 put this issue with these words:

“We need to have a computer, flash program etc… it is difficult to see them in the classrooms [in Turkey]. Beside that, I do not know how whether we could capable of using them in the classroom. Instead of these, it could have been very beneficial if we had prepared materials by ourselves.” (P3-Time3)

In contrast, OFD402 “Introduction to Teaching profession”, OFD410 “School Experience in Secondary Education I” and OFD507 “School Experience in Secondary Education II “ courses were considered to be least effective courses of the program (see, Table 4-13, Table 4-14, and Table 4-15). The OFD402 course included characteristics and principles of teaching profession, philosophical and historical foundations of education, Turkish education system, status of teaching profession, school and classroom contexts, teacher development. In OFD 402, participants expect the content of the course such as properties of effective teaching and good teacher to be more related with the

mathematics teaching but the historical principals took up much time. Also, they mentioned the ineffectiveness of the student teaching. P5 mentioned her expectations with these words: *"I had expected to learn about being mathematics teacher. But we learned history of teacher education and relation with other disciplines [such as psychology, sociology]" (P5-Time 2)*

Both the OFD410 and OFD507 courses were school experience courses. The purposes of these courses were to introduce the school environments to the pre-service teacher. Pre-service teachers observed classrooms including teacher, student, classroom management etc…, and school including organization and management of school, daily activities in the school, problems of school, and materials and written sources of school. Later, they wrote reports about their observations. Nine of the pre-service teachers attended to 6-8 grade classes in elementary schools rather than 9-11 grade classes. Most the pre-service teachers mentioned that doing observations in the classrooms, not attending to the appropriate schools (attending to the elementary schools rather than secondary schools), not having enough solidarity between teacher educators and the supervisor school teachers, and unwillingness of the supervisor school teachers to be observed were the main problems in these courses. Pre-service teachers' expressions about these courses were as follows:

"We gained little from this [OFD410]. Just we observed" (P13- Time 2)

"We went to primary school. It was for seeing the school atmosphere. We observed the class and wrote something to our reports. We did not give importance. Neither supervisory teachers nor our instructors deal with us." (P10-Time2).

"We took the course. Our supervisory teacher was good. It was our luck, our classes were naughtiness and problematic. It passes with observing, sitting at the back. It was useless." (P12-Time2).

"Actually, we want to teach. ... but our group was crowded and teaching for each of us was impossible ... This course (OFD507) was very similar to prior one (OFD410) , we just observed." (P5- Time3)

In general, pre-service teachers' complaint focused on the point of inadequate practice opportunities.

Pre-service teachers thought both OFD404 "Development and Learning", OFD503 "Classroom Management", OFD504 "Guidance", OFD506 "Practice Teaching" were effective but not effective as much as OFD406, OFD408, OFD501.

OFD404 "Development and Learning" course included theories and principles of child development, factors, affecting development, prenatal and post-natal periods, birth cognitive development, approaches of learning styles, learning process and individual differences (Table 4-16). During this course classical classroom environment occurred. Instructor taught and pre-service teachers listened. Most of the pre-service teachers valued this course because of its content. They thought that the content taught in this course could be used during their teaching profession. Besides, some pre-service teachers (P2, P4, P6, P10, P13, and P14) found this course ineffective because of the teaching method that the instructor used. Rather practicing of the theory and discussions could have been done.

P4 expressed her beliefs with these words:

"I think this course [OFD404] was boring, maybe the reason is the teacher or general structure of the course… the content knowledge is for primary teachers, children development etc. Development and psychology properties of teenagers were not taught us. For this reason, I don't think it was efficient. Course covers 0-6 level of age and compulsory education period. Higher education is passed over lightly." (P4-Time2).

Table 4-13: Introduction to Teaching Profession (OFD402)

	before course (n=14)		after course (n=14)	
	code	**f**	**code**	**f**
Effectiveness		14		15
Effective	P1, P5, P9, P12, P13, P14	6	P2, P9, P13	3
Ineffective	P2, P3, P4, P6, P7, P8, P10, P11	8	P1, P3, P4, P5, P6, P7, P8, P10, P11, P12, P13, P14	12
Content				
Relationship among education, philosophy, and psychology	P3, P8, P13,	3	P1, P3, P8, P9, P12	5
Properties of effective teaching and good teacher	P1, P2, P4, P5, P6, P7, P9, P10, P12, P13, P14	11	P2, P4, P7, P8, P10, P11, P12, P13	8
History of education and teaching profession	P2, P3, P4, P7, P10, P11	6	P4, P5, P7, P8, P10	5
Introduction to teaching profession	P2, P4, P5, P7, P8, P10, P11	7	P3, P4, P9	3
Methods of teaching	P2, P5, P7, P10, P12, P13, P14	7	P13, P14	2
Similar topic covered at OFD406			P6	
Content need/not need to be covered				
Content should be more related to mathematics teaching			P1, P5, P8	3
Methodology				
Student teaching like traditional teaching is ineffective			P1, P3, P6, P7, P8, P11, P12, P13, P14	9
Studying journal papers is beneficial			P2, P13	2
Practicing of the theory must be done			P4, P8, P9, P10, P11	5
Inviting experienced persons to share their experiences could be done			P3	1

Table 4-14: School Experience in Secondary Education I (OFD410)

	before course		after course	
	code	**f**	**code**	**f**
Effectiveness				
Effective	P1, P2, P3, P4, P6, P7,	6	P1, P2, P3, P6, P8, P9, P10	7
Ineffective	P5, P8, P9, P10, P11, P12, P13, P14	8	P4, P5, P6, P7, P8, P10, P11, P12, P13, P14	10
Content				
Experiencing to real classroom environment as teacher	P3	1	P1, P8, P12	3
Content need to be covered				
Strong solidarity must be established between instructors and schools	P1, P4, P5, P6, P13, P12	6	P4, P5, P6, P10, P11, P12, P13	7
Much importance must be given	P4, P11, P13	3	P1, P3, P4, P8, P10, P11, P13, P14	8
Methodology				
Making only observation is boring	P1, P2, P10	3	P7, P8, P10, P12	4
Attending to primary schools rather than secondary schools is not good	P1, P2, P5, P7, P8, P1	6	P1, P3, P4, P5, P6, P7, P8, P10	8
Feelings				
Real situation scared us			P2, P8	2

Table 4-15: School Experience in Secondary Education II (OFD507)

	before course (n=14)		after course (n=14)	
	code	**f**	**code**	**f**
Effectiveness		14		14
Effective	P1, P2, P3, P4, P5, P8, P10,	7	P2, P6, P7, P8,	4
Ineffective	P6, P7, P9, P11, P12, P13, P14	7	P1, P3, P4, P5, P9, P10, P11, P12, P13, P14	10
Content				
Teaching practice one or two times			P7	1
Experiencing real classroom environment	P4, P8, P9, P10	4	P7, P8	
Similar topics covered in OFD410	P1, P7,	2	P1, P7, P12	
Methodology				
Observation in schools	P3, P6, P7, P8, P9, P10, P12, P14	8	P1, P5, P8, P9	4
Same as previous				
Just report writing			P3, P10, P13	3
Teaching practice in schools	P1, P2, P5,	3		
Cooperative teacher should show more interest			P2, P4, P13,	3
Activities could be done in classrooms			P2, P3, P6, P7, P14	5
Feeling				
This course will be more difficult than OFD 410	P8	1		
Theory and reality was different			P8	1

P7 mentioned about the OFD 404 course as follows:

"It [OFD404] is about development properties of students. While we are teaching we have to know the stage of student and if s/he can understand the subject. It is important to remember perceptions of students. We have to know developmental properties of students to assure more effective learning." (P7 – Time2)

The content of the OFD503 "Classroom Management" course included classroom environment, development and application of classroom management rules, discipline, classroom organization, motivation, communication, formation of positive and suitable environment, behavioral problems in classroom and development of dispositions for this situation. Most of the pre-service teachers valued this course because of the teaching method used by the instructor. Most of the pre-service teachers thought working on papers, discussions about papers and making presentations were beneficial and made OFD503 course effective. However, P5, P6, P11, P13, and P14 thought this course as ineffective. Before the course they believed that this course was one of the most important courses they would take but at the end of the course they complained about the lack of real life examples notwithstanding discussions about papers and content matching with OFD402 "Introduction to Teaching profession" and OFD404 "Development and Learning".

"I didn't understand the purpose of this course, meaningless course. Classroom management is important but the same things told us (in OFD402, OFD404). I didn't find that I expected. … I expected to learn the use of scepter that makes everything ideal in classroom. … How the teachers provide silence? Knock the board, designate the classroom rules etc. We all learned these last semesters in OFD404 or OFD402. There was nothing different." (P13-Time 3)

"We learned not to be panic when we confronted unexpected situation or behavioral problems, ways of coping with these unexpected situations… We maintain an opinion about classroom management. I believe [this course] is very useful for us."(P7-Time3)

The OFD504 course covered children's development properties, role of these properties in education, general principals of guidance and types of guidance, and supervising. Most of the pre-service teachers (9/14) valued this course because of the course content. They believed that knowledge learned from this course makes easy to help students in their lives and learning with appropriate response for their development properties. On the contrary, two pre-service teachers thought that the OFD504 course content was inappropriate for teachers because teachers do not do counseling that described way in course, and three thought ineffective because of the teaching method used by instructor such as asking students to write course notes to board by a pre-service teacher.

"We learned much about guidance, but I think we learned too much. I mean, like a guidance specialist we learned principles of guiding and all about guiding. I believe I won't use [this knowledge]. I don't know if I will do counseling, but I think this course is not effective for me and I did not acquire much for my future teaching profession career." (P1-Time4)

"I benefited from OFD504 at dershane. It is necessary to think person like dough. You should make ready the right moment or stage in development before teaching mathematics. At this point guidance is beneficial. The person who you are going to teach can be plunged in thought or thinking something else or have a problem. When you talk to hem/her just ten minutes, you can easily communicate and also he/she saw you like a friend. It is easier to teach something to someone that you have closer relationship." (P13-Time4)

Table 4-16: Development and Learning (OFD404)

	before course (n=14)		after course (n=14)	
	code	**f**	**code**	**f**
Effectiveness		15		16
Effective	P1, P2, P5, P7, P8, P9, P10, P11, P12, P14	10	P1, P2, P3, P5, P7, P8, P9, P11, P10, P12	10
Ineffective	P2, P3, P4, P6, P13	5	P2, P4, P6, P10, P13, P14	6
Content				
General knowledge about family and children	P1, P4, P5, P6, P7, P9, P11	7	P4, P11	2
Learning types	P5	1	P9, P10, P12	3
Guide future responses	P1, P2, P5, P7, P8, P9, P10, P12	8	P1, P2, P3, P5, P7, P8, P10, P12	8
Knowledge for primary teachers	P4, P13	2	P2, P4, P13	3
Children development properties	P1, P2, P3, P5, P6, P7, P8, P9, P10, P12	10	P2, P3, P5, P7, P8, P11, P12	7
Methodology				
Traditional teaching (lecturing) is not good			P1, P2, P3, P4, P6, P7, P8, P10, P11, P13, P14	10
Practicing of the theory and discussions must be done			P10, P13	2
Inviting experienced persons to share their experiences could be done			P3	1
Applicability				
The knowledge learned from this course can be applied in teaching profession	P1, P2, P3, P7, P5, P9, P10, P11, P12	9	P1, P3, P7, P10, P11	5

Table 4-17: Classroom Management (OFD503)

	before course (n=14)		after course (n=14)	
	code	**f**	**code**	**f**
Effectiveness				
Effective	P1, P2, P3, P4, P5, P8, P9, P10, P11, P13, P14	11	P1, P2, P3, P4, P7, P8, P9, P10, P12	9
Ineffective	P6, P7, P12	3	P5, P6, P11, P13, P14	5
Content				
Discipline in the classroom/school	P7	1	P7, P8	2
Management of classroom	P1, P2, P3, P4, P5, P6, P7, P8, P10	9	P3, P7, P8, P9	4
Ways of coping with the unexpected situations	P1, P3, P5, P7, P9, P14	6	P4, P7, P10	3
Similar topics covered in OFD 402, OFD 404			P11, P12, P13, P14	4
Content need to be covered				
Real life examples should be given			P5, P6, P11, P13	4
Methodology				
Questioning technique was good			P7	1
Paper presentation was beneficial			P8	1
Discussions were beneficial			P3, P4, P6, P7, P8, P9, P10, P12, P13	9

Table 4-18: Guidance (OFD504)

	before course (n=13)		after course (n=14)	
	code	**f**	**code**	**f**
Effectiveness		10		14
Effective	P1, P2, P4, P5, P6, P7, P8, P9, P13, P14	10	P2, P4, P5, P7, P8, P10, P11, P12, P13,	9
Ineffective			P1, P3, P4, P6, P14	5
Content				
Students properties and relationship between student and teacher	P1, P4, P7, P8, P11	5	P1, P2, P4, P5, P7, P8, P10, P14	8
How to help students with learning difficulties, and personal problems	P1, P2, P3, P4, P5, P6, P7, P8, P9, P14	10	P1, P4, P7, P8, P11, P12, P13	7
Guidance and types of guidance			P7, P8,	2
Psychological development of children	P1, P2, P6, P10, P13	5	P5	1
Content need to be covered				
Not appropriate for teachers			P1, P14	2
Real life examples should be given			P3	1
Methodology				
Writing notes to board by students is not good			P3, P4, P6	3
Use of traditional teaching based on memorization and lecturing is bad			P3	1
Discussions, question answer method was good			P5, P11	2

Note: P10 cannot be interviewed before the course

Table 5-19: Practice Teaching in Secondary Education (OFD506)

	before course (n=13)		after course (n=14)	
	code	**f**	**code**	**f**
Effectiveness		15		15
Effective	P1, P2, P3, P4, P5, P6, P7, P8, P9, P11, P12, P13, P14	14	P1, P3, P4, P5, P7, P8, P9, P10, P11, P12,	10
Ineffective	P13	1	P2, P6, P9, P13, P14	5
Content				
Teaching practice				
Classroom management	P7	1	P1, P8	2
Interaction with students	P3, P7, P8, P13, P14	5	P2, P3, P4, P5, P7, P8	6
Presentations of topics	P1, P2, P3, P4, P5, P7, P8, P13, P14	9	P2, P3, P4, P5, P6, P7, P8, P10, P11, P12,	10
Effectiveness				
Overcome excitement of presentation	P2, P3, P4, P8	4	P2, P6, P7, P8,P11	5
Amusing	P1, P2, P3, P7, P8,	5	P3, P5, P7, P8,	4
I am already a teacher, it is ineffective for me			P2, P9, P14	3
Feeling				
Being observed is stressful			P8	1

Note: P10 cannot be interviewed before the course

Table 4-20: Elective – II (OFD 508 Algebraic Concepts and Equations)

	before course		after course (n=10)	
	code	**f**	**code**	**f**
Effectiveness				10
Effective			P6, P7, P12, P13, P14	5
Unnecessary			P1, P3, P4, P8, P11	5
Content				
Too complex and hard to understand		3	P1, P3, P4, P6, P7, P8, P11, P14	8
Irrelevant for teaching secondary mathematics content education			P3, P8, P11	3

Table 4-21: Elective – II (309 Computer Assisted Instruction)

	before course		after course (n=4)	
	code	**f**	**code**	**f**
Effectiveness				4
Effective			P2, P5, P9, P10	4
Ineffective				
Content				
Technology based activities and animations			P2, P5, P9, P10	3
Not applicable in Turkey recently			P5, P9	2

"We learned what the guidance is, types of guidance. For example, when we were appointed schools as teachers, teaching is not the unique function of us. We are responsible to know the problems of students, sources of these problems, the ways of deliverance, and the psychological counseling and guidance foundations around. We can help children." (P7, Time4)

The main topics of OFD506 (Practice Teaching).were teaching practice in a classroom environment including classroom observation, teaching of a course in a planned way, and planning and preparation for teaching. The majority of the pre-service teachers thought that practice teaching course was effective because of the content covered. Especially, the interaction with students and presentations of subjects were beneficial. Being with students and teaching them amused pre-service teachers. Although presentations provided opportunities to overcome excitement of presentation, P8 mentioned about the stress of being observed by the supervisory school teacher and the instructor.

"Actually, we have to go during all semester, but I went only two weeks. But as a result, I teach like an experienced teacher. I am already a teacher. ... I experienced real classroom environment once more. Nonetheless, thought of my supervisory school teacher was important for me. He asked his students about me, and students asked why he [P14] doesn't always come." (P4-Time4)

"We lecture two hours and observe two hours in a week. We experienced entirely. In the first instance I get excited, I have never lectured before. I felt happy when I see their eyes and appreciated they understood the subject." (P6- Time4)

OFD508 "Algebraic Concepts and Equations" and 309 "Computer Assisted Instruction" (CAI) elective courses were taken by the ten pre-service teachers and four pre-service teachers, respectively.

In the CAI course pre-service teachers were required to prepare technology based activities and animations by using MAPLE. Despite the inapplicability of technology in real life classrooms, all pre-service teachers, who took this course, valued this course because of the technology.

"This course was very effective. We prepared derivative subject by using MAPLE. We put different animations, activities, and hyperlinks to another websites. Usage of computer makes mathematics more enjoyable, and calls students attentions. Strictly speaking, this course was amusing, enjoyable and struggling. (P2- Time3)

OFD 508 Algebraic Concepts and Equations course content includes simple groups, series of groups, solvable groups, composition series and such mathematics topics. Half of the pre-service teachers thought that this course was effective. Eight of ten pre-service teachers thought it was too complex and hard to understand, and three of them believed that the content was irrelevant for teaching secondary school mathematics education. P6 and P7 thought that it was hard to understand but they valued this course. P12, P13, and P14 were extreme students that want to learn much about mathematics and they believe this kind of courses grant required content knowledge for teachers.

"I believe this course make no contribution. It was an obligatory elective course; I never think it was one of the necessary courses. It would be better if more related, with mathematics education, course were given. It was hard to understand and complex." (P 4- Time4)

CHAPTER 5

DISCUSSIONS, CONCLUSION AND IMPLICATIONS

This chapter consists of four sections. The first section presents the summary of the results, and then discussions follow. Implications are given in the third section and the fourth section includes recommendations.

5.1. Summary of Results

This study was designed to determine 14 pre-service mathematics teachers' beliefs about mathematics and teaching and learning of mathematics, and expectations and acquisitions of the Five Year Integrated Program in Secondary Science and Mathematics Education department at Gazi University, and the development in their beliefs during the last three semesters of the program.

Data were analyzed in four domains: pre-service teachers' beliefs about mathematics, pre-service teachers' attitudes towards mathematics, pre-service teachers' beliefs about mathematics teaching and pre-service teachers' expectations and acquisitions of the Five Year Integrated Program.

5.1.1. Pre-service Teachers' Beliefs about Mathematics

Most of the pre-service teachers mentioned that the university mathematics was different from the mathematics that was taught at schools. Pre-service teachers saw mathematics just as formulas, drill and practice, solving mathematics questions as

quickly as possible and finding the right choice by clues were taught at high school; in contrast, at university, they began to see it as theorems, axioms, and logical systems. Pre-service teachers realized that it was in life and all around and that it had a logical structure and philosophy. Half of the pre-service teachers expressed that their beliefs about mathematics had taken shape during their first 3.5 years of university education. Three of these pre-service teachers, however, mentioned about the consolidation of their beliefs with the pedagogical courses.

Besides these, during the last 1.5 years of the program, half of the pre-service teachers did not change their beliefs towards mathematics and the changes of other pre-service teachers took place in different ways. Some pre-service teachers added fallibilist beliefs to their belief systems, while some of them changed such beliefs. On the other hand, one of them added absolutist beliefs. The differences across cases indicated that the process of change was personal and that they were grounded in their experiences.

As a result, it can be said, almost all of the pre-service mathematics teachers constituted some beliefs about mathematics before entering teacher education programs and the analysis revealed that pre-service teachers' beliefs about mathematics continued to be shaped during the five year integrated program.

5.1.2. Pre-Service Teachers' Attitudes towards Mathematics

Pre-service teachers have been coming face to face with mathematics since primary school. The data analysis revealed that almost all pre-service teachers had a positive attitude towards mathematics and the origins of attitudes varied. However, the interviews in this study showed that pre-service teachers' positive attitude towards mathematics was not towards all mathematics topics, branches or levels. In fact, some pre-service teachers love high school mathematics much more than university mathematics, whereas some love algebra more than calculus or vice versa.

Since almost all of the pre-service teachers formed their attitudes before the university, in the present study, interviews provided evidence that courses both during the first 3.5 years and the last 1.5 years of the program improved and consolidated most of the pre-service teachers' attitudes towards mathematics. Only one of the pre-service teachers changed his attitude and began to love mathematics through mathematics courses offered in the first 3.5 years at university.

5.1.3. Pre-Service Teachers' Beliefs about Teaching and Learning of Mathematics

The case studies presented in this study suggested that beliefs about teaching and learning mathematics could be grouped under three different categories: how mathematics can be learned, teaching and learning of mathematics, and factors affecting mathematics teaching.

The interviews revealed that all pre-service teachers' beliefs about learning mathematics have been constituted since the primary school and each pre-service teacher has his/her own learning habits. Pre-service teachers' beliefs were scattered through the clusters of this category. However, interviewees valued students' repetition of the learned subject, students' positive attitude towards mathematics, and students' ability to establish the relationships between mathematics and life as regards learning mathematics. The most important development in pre-service teachers' beliefs about learning was in the cluster of ability. Before the pedagogical courses, only one of the participants mentioned self-directed learning. While two participants consolidated their beliefs, six pre-service teachers realized the importance of self-directed learning through pedagogical courses.

Pre-service teachers began teacher education programs with beliefs about teaching and learning of mathematics. Almost all of the pre-service teachers were taught by the traditional methods through their school life and pre-service teachers showed a tendency of teaching the way they have been taught. Especially, the method courses

gave an opportunity to pre-service teachers to be aware of different teaching methods, and teaching techniques. In addition, these courses also developed favorable beliefs towards the use of materials and student centered teaching methods. Consequently, new beliefs challenge pre-service teachers' prior beliefs and pre-service teachers changed their beliefs about mathematics teaching. Pre-service teachers attached importance to concretization of mathematics, removing the math fear of the child and shifting from fear to love in teaching mathematics.

Pre-service teachers believed that the most important factors affecting mathematics teaching were students and teachers. In particular, they believed that students positive/negative attitude towards mathematics, teachers' subject knowledge, personal characteristics and pedagogical knowledge affected more to mathematics teaching. Apart from these, interviews revealed that conditions of the school and the classroom, the size of classroom, the OSS system and the curriculum were determined as important factors affecting the teaching of mathematics. The only outstanding change in pre-service teachers' beliefs in this category was in the teachers cluster of this category. Only one teacher considered the teachers' teaching methods as a factor before the courses, but after the eighth semester of courses, especially after the methods courses, half of the pre-service teachers realized the importance of the teaching method.

Pre-service teachers in this study have different beliefs about these three categories, which were shaped in early school years. Participants developed some new perspectives and beliefs about teaching and learning of mathematics, and consolidated/changed some of their existing beliefs during the last 1.5 years of the program. The process of change or development is ongoing.

Consequently, pre-service teachers came to teacher education programs with beliefs about teaching and learning which were constructed through the school years as a student. The qualitative analysis displayed that the first 3.5 years of the Five Year Integrated Teacher Education Program had an effect on pre-service teachers' beliefs

about mathematics, and the pedagogical courses of the last 1.5 years of the program had an effect on pre-service teachers' beliefs about both mathematics and teaching and learning of mathematics. Some pre-service teachers changed their beliefs, other did not; some beliefs were more difficult to change than others were. Thus, while teacher education programs developed the pre-service teachers' beliefs about teaching and learning, with adequate education, their beliefs and perspectives could continue to develop, grow and motivate throughout their teaching career.

5.1.4. Pre-Service Teachers' Expectations and Acquisitions of the Five Year Integrated Program

The analyses led to the conclusion that OFD406, OFD408, OFD509 and OFD501 courses were perceived as the most effective courses. The participants valued the first two courses mainly because of the necessity and the applicability of the knowledge learned in these courses to the teaching profession. The last two courses were valued because of the content of the courses. For example, repeating 9^{th} grade curriculum in OFD509 (Textbook Analysis) helped them to revise the topics covered at that level. In the first interviews, half of the pre-service teachers' complained about the lack of courses related to high school mathematics curriculum and they felt themselves insufficient in teaching high school mathematics. In the last interviews most of the pre-service teachers stated that OFD509 and OFD502 (Analysis of Secondary Education Textbooks) courses filled this gap. Even visual materials learned during OFD 501 were found to be inapplicable in schools in Turkey; they thought that visual materials could attract students' attention and these courses were valued by the participants. In contrast, OFD402, OFD410 and OFD507 courses were considered as the least effective courses of the program. The reasons expressed by most of the pre-service teachers for the school experience courses (OFD410 and OFD 507) were making only observations, not attending to the appropriate schools (attending to the elementary schools rather than secondary schools), not having enough solidarity between teacher educators and the supervisor school teachers, and the unwillingness of the supervisor school teachers to be observed.

The pre-service teachers expected to gain more practical knowledge that can be useful for their future teaching career. In addition to this, pre-service teachers complained about the method of teaching during their education. They mentioned that there was a contradiction between the teaching methods they were taught and the teaching methods they were asked to use. In general, pre-service teachers' complaint focused on the point of too much emphasis on theoretical sides but inadequate practice opportunities

5.2. Discussion

In this study, it was determined that pre-service teachers came to the teacher education programs with deeply grounded beliefs about mathematics and teaching and learning of mathematics. In addition, it was found that teacher education program affected their beliefs. Findings of the study supported previous studies (Bookhart & Freeman, 1992; Lasley, 1980; Lindgren, 2000; Pajares, 1992; Richardson, 1996), which provided evidence that teacher education programs lead to a change in pre-service teachers' beliefs' on teaching and learning, and beliefs are flexible.

Interviews showed that pre-service teachers viewed mathematics just as formulas, drill, practice, and solving questions before the university. However, they realized that it was in life and all around, and that it has a logical structure and philosophy during the first 3.5 years of the five year integrated program. Results show that pre service teachers' beliefs were affected and changed during the mathematics courses in first 3.5 years of the program. Till the university, pre-service teachers' beliefs and attitudes on mathematics were constructed; nevertheless, university mathematics courses challenged their beliefs, and pre-service teachers' beliefs and attitudes towards mathematics continued developing in line with their experiences. These findings of the study supported the findings of the Raymond and Santos's (1995) study. In their study, they tried to identify beliefs during the "T104 Mathematics for Elementary Teachers via Problem Solving" course and found that this course

challenged the pre-service teachers' beliefs and changed their beleifs towards mathematics. In my study, half of the pre-service teachers did not change their beliefs towards mathematics and the changes of other pre-service teachers that occurred in different ways with pedagogical courses in the last 1.5 years. Previous researchers (Benbow, 1996; Campbell, 1998) stated that the student teaching experience courses and method courses did not affect pre-service teachers' attitudes, thoughts and beliefs about mathematics. The results of our study contradicted these previous researches. Results revealed that pre-service teachers' beliefs about mathematics continued to be shaped during the five year integrated program.

Almost all of the pre-service teachers came to the mathematics teacher education program with positive attitudes towards mathematics and the origins of these attitudes showed variations. In addition, when the factors affecting attitudes were investigated, it was found that some pre-service teachers in this study believed that there is a connection among likes and dislikes of mathematics, the level of success and the understanding of it. This relationship was emphasized in previous researches (e.g. Raymond & Santos, 1995).

Pre-service teachers' prior beliefs about teaching and learning mathematics depend on their past experiences. All of the pre-service teachers in the study were taught by traditional methods or direct learning through their school life. In our study, before the pedagogical courses, most of the participants thought that they would teach as they were taught by high school teachers. Nonetheless, at the end of the courses, they tended to use more student centered methods, and were likely to use visual materials and technology in their teaching process. This is supported by the findings of the previous studies (Hart 2002; Nussbaum, 1998; Raymond & Santos, 1995). The findings also confirmed that pre-service teachers' prior beliefs would change with teacher education programs. Most of the pre-service teachers in this study believed that concretization of mathematics with materials and everyday life examples was important in teaching mathematics.

If the courses were to be constructed towards the real life classrooms, with and appropriate content for educational conditions of Turkey, courses might have a more significant effect in pre-service teacher's beliefs about teaching and learning of mathematics.

When the expectations of the pre-service teachers from the teaching experience courses were asked, a few of the pre-service teachers said that they expected to learn nothing because they considered themselves already competent teachers. Some other participants complained about the monotony and the boredom of the observations in school experience courses. They did not take school practice courses and teaching experience courses seriously. These findings were validated with the findings of the study of Chuene et al. (1999). Like their participants, interviewees of this study suggested it was more beneficial to do teaching practice instead of classroom observations.

Participants of this study believed that some courses of the program were irrelevant to secondary mathematics teaching profession, real life classroom situations and they thought that mathematics taught at university was distinct from mathematics at schools. Some of the pre-service teachers expected to learn parallel mathematics content with the high school curriculum content. The distinction between the learned theory and the real life situations were emphasized by the participants of different studies (Chuene et al. 1999; Raymond & Santos, 1995). Pre-service teachers' complaints about program were poorly planned, irrelevant to the day to day realities of working in schools, unconnected to teaching profession, badly aligned with other courses. Despite the complaints about the lack of high school curriculum, irrelevance of subjects to teaching profession, not only did the program compensate these deficiencies but also it led to change/develop pre-service teachers' beliefs about mathematics and teaching and learning of it. From this point of view, the program preserved its importance.

Pre-service teachers found some courses ineffective because of their theory based content. The most important reasons that made the courses ineffective were the excessively theoretical properties of the course, overlaps among the courses and the teaching methods of the course. Besides, if a course had applicable content to their future teaching profession, and if the teaching methods used in lessons led them to participate the lesson; pre-service teachers would be likely to think that course was effective. From this point of view, teacher educators could make their courses more effective to increase the effectiveness of the teacher education program.

5.3. Implications

This study holds the following implications:

- Pedagogical courses of teacher training programs should integrate paper discussions into their instruction. This provides pre-service teachers the opportunity to express their beliefs and ideas, and to have new knowledge about the subject.

- It might be better to investigate the attitudes in terms of subjects, topics or branches than investigate the general attitude towards mathematics.

- To prevent the overlaps of course contents and to provide the integration of the contents, teacher educators who are giving different courses should plan the courses with greater coordination.

- Just teaching theoretical information is not enough for pre-service teachers to be able to use them use them in their classes more effectively. Teacher educators should not only focus on the theory of the content, but also focus on the connections between real life and theoretical knowledge in classes.

- Teacher training programs should involve a course that gives the pre-service teachers an opportunity to repeat high school mathematics curriculum.

- Teacher educators should reflect and modify their classroom to provide the consistency between the knowledge they give and their practice.

- Teacher education programs should aim to strengthen the beliefs about mathematics and mathematics teaching of pre-service teachers for the consolidation of the enthusiasm for mathematics as a subject and carrying this love into classroom environment and instructions (Chuene, 1999).

- The role of the supervisory school teachers where the pre-service teachers school practices and teaching practice take place should be clearly defined, including his/her position and responsibility.

5.4. Recommendations for Further Research

Based on the results of this study, the following recommendations are made for further researchers:

- More longitudinal qualitative studies should be conducted with beginning teachers and novice teachers in order to determine the continuity of the changed/developed beliefs.

- This study revealed that teacher education programs had an effect on pre-service teachers' beliefs. The investigation of which course affects which beliefs of pre-service teachers are likely to be illuminating.

- Quantitative studies to provide more generalizable findings about pre-service teachers' beliefs in mathematics teacher education programs may be fruitful for further researchers.

- Further research is recommended to study/investigate the relationship between teacher educators' beliefs and pre-service teachers' beliefs.

- The replication of this study on different teacher education programs are recommended to provide more results that help to determine whether all the teacher education programs are effective on pre-service teachers' beliefs.

- A study can be conducted to determine the relationship between instructional practices and beliefs.

- As the sample size of the study was small, the beliefs comparison among pre-service teachers who graduated from different high schools could not be done. A further study is recommended to determine the differences of beliefs among pre-service teachers who graduated from different high schools.

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APPENDIX A

THE FIVE YEAR INTEGRATED SECONDARY TEACHER EDUCATION PROGRAM COURSES AT GAZI UNIVERSITY

MATEMATİK EĞİTİMİ ANABİLİM DALI

1. SINIF 1. YARIYIL

OPTİK KOD	*DER.KOD*	*DERSİN ADI*	*T*	*U*	*L*	*K*
561011	AİT 101	Atatürk İlkeleri ve İnkılap Tarihi	2	0	0	2
561021	TDL 101	Türk Dili-I	2	0	0	2
561031	MAT 101	Soyut Matematik	2	2	0	3
561041	MAT 103	Anlitik Geometri	2	2	0	3
561051	MAT 105	Genel Matematik	4	2	0	5
561061	FİZ 101	Temel Fizik	4	0	0	4
561071	FİZ 103	Temel Fizik Lab	0	0	2	1
		TOPLAM	16	6	2	20

1. SINIF 2. YARIYIL

562011	AİT 102	Atatürk İlkeleri ve İnkılap Tarihi	2	0	0	2
562021	TDL 102	Türk Dili-II	2	0	0	2
562031	MAT 102	Soyut Matematik	2	2	0	3
562041	MAT 104	Elementer Geometri	2	2	0	3
562051	MAT 106	Genel Matematik	4	2	0	5
562061	FİZ 102	Temel Fizik	4	0	0	4
562071	FİZ 104	Temel Fizik Lab	0	0	2	1
		TOPLAM	16	6	2	20

2. SINIF 1. YARIYIL

563011	MAT 201	Lineer Cebir	3	2	0	4
563021	MAT 203	Diferansiyel Denklemler	2	2	0	3
563041	MAT 205	Analiz	3	2	0	4
563051	MAT 207	Bilgisayar Bilimine Giriş	2	2	0	3
563061	MAT 209	Olasılık ve İstatistik	2	2	0	3
		TOPLAM	12	10	0	17

2. SINIF 2. YARIYIL

564011	MAT 202	Lineer Cebir	3	2	0	4
564021	MAT 204	Diferansiyel Denklemler	2	2	0	3
564031	MAT 206	Analiz	3	2	0	4
564041	MAT 208	Bilgisayar Bilimine Giriş	2	2	0	3
564051	MAT 210	Olasılık ve İstatistik	2	2	0	3
		TOPLAM	12	10	0	17

3. SINIF 1. YARIYIL

OPTİK KOD	*DER.KOD*	*DERSİN ADI*	*T*	*U*	*L*	*K*
565011	YDL 301	Yabancı Dil-I (İngilizce)	2	0	0	2
565021	YDL 301	Yabancı Dil-I (Fransızca)	2	0	0	2
565031	YDL 301	Yabancı Dil-I (Almanca)	2	0	0	2
565041	MAT 301	Cebire Giriş	2	2	0	3
565051	MAT 303	Diferansiyel Geometri	2	2	0	3
565061	MAT 305	Topoloji	2	2	0	3
565071	MAT 307	Bilgisayar Programlama	2	2	0	3
565081	MAT 309	Seçmeli (Matematiğe Bilgisayarla Yaklaşım)	2	2	0	3
565091	MAT 311	Seçmeli (C Programlama)	2	2	0	3
565101	MAT 313	Seçmeli (Nümerik Analiz)	2	2	0	3
565111	MAT 315	Seçmeli (Matematik Tarihi)	2	2	0	3
565121	MAT 317	Seçmeli (Matematikte Seçme Konular)	2	2	0	3
565131	MAT 319	Seçmeli (Matematiksel Yazılım Tasarımı)	2	2	0	3
565141	MAT 321	Seçmeli (Fraktal Geometri)	2	2	0	3
565151	MAT 323	Seçmeli (Fonksiyonel Analiz)	2	2	0	3
565161	MAT 325	Seçmeli (Sonlu Yansıma Grupları)	2	2	0	3
		TOPLAM	14	12	0	20

* Seçmeli derslerden sadece ikisi seçilecektir

3. SINIF 2. YARIYIL

566011	YDL 302	Yabancı Dil-II (İngilizce)	2	0	0	2
566021	YDL 302	Yabancı Dil-II (Fransızca)	2	0	0	2
566031	YDL 302	Yabancı Dil-II (Almanca)	2	0	0	2
566041	MAT 302	Cebire Giriş	2	2	0	3
566051	MAT 304	Diferansiyel Geometri	2	2	0	3
566061	MAT 306	Topoloji	2	2	0	3
566071	MAT 308	Bilgisayar Programlama	2	2	0	3
566081	MAT 310	Sayılar Teorisi	2	2	0	3
566091	MAT 312	Seçmeli (Kümeler Teorisi)	2	2	0	3
566101	MAT 314	Seçmeli (Real Analiz)	2	2	0	3
566111	MAT 316	Seçmeli (C Programlama)	2	2	0	3
566121	MAT 318	Seçmeli (Uygulamalı Matematik)	2	2	0	3
566131	MAT 320	Seçmeli (Veri Analizi)	2	2	0	3
566141	MAT 322	Seçmeli (Matematikte Seçme Konular)	2	2	0	3
566151	MAT 324	Seçmeli (Matematiksel Yaz.Tasarımı)	2	2	0	3
566161	MAT 326	Seçmeli (Diskret Matematik)	2	2	0	3
566171	MAT 328	Seçmeli (Gruplar ve Geometriler)	2	2	0	3
566181	MAT 330	Seçmeli (Cebirsel Sayılar Teorisi)	2	2	0	3
		TOPLAM	14	12	0	20

* Seçmeli derslerden sadece biri seçilecektir

4. SINIF 1. YARIYIL

567011	MAT 401	Soyut Cebir	3	2	0	4
567021	MAT 403	Dönüşümler ve Geometriler	3	2	0	4
567031	MAT 405	Kompleks Değişkenli Fonksiyonlar	3	2	0	4
567041	MAT 407	Bilgisayar Cebiri	2	2	0	3
		TOPLAM	11	8	0	15

4. SINIF 2. YARIYIL						
OPTİK KOD	***DER.KOD***	***DERSİN ADI***	***T***	***U***	***L***	***K***
568011	ÖFD 402	Öğretmenlik Mesliğine Giriş	3	0	0	3
568021	ÖFD 404	Gelişim ve Öğrenme	3	0	0	3
568031	ÖFD 406	Öğretimde Planlama ve Değerlendirme	3	2	0	4
568041	ÖFD 408	Özel Öğretim Yöntemleri-I	2	2	0	3
568051	ÖFD 410	Okul Deneyimi-I	1	4	0	3
		TOPLAM	12	8	0	16
5. SINIF 1. YARIYIL						
568511	ÖFD 501	Öğretim Teknolojileri ve Materyal Geliştirme	2	2	0	3
568521	ÖFD 503	Sınıf Yönetimi	2	2	0	3
568531	ÖFD 505	Özel Öğretim Yöntemleri-II	2	2	0	3
568541	ÖFD 507	Okul Deneyimi-II	1	4	0	3
568551	ÖFD 509	Seçmeli Ders-I (Geometri Öğretiminde Yeni Yaklaşımlar)	3	0	0	3
		TOPLAM	10	10	0	15
5. SINIF 2. YARIYIL						
568611	ÖFD 502	Konu Alanı Ders Kitabı İncelemesi	2	2	0	3
568621	ÖFD 504	Rehberlik	3	0	0	3
568631	ÖFD 506	Öğretmenlik Uygulaması	2	6	0	5
568641	ÖFD 508	Seçmeli-II (Cebirsel Kav. ve Cebirsel Denk. Çöz.)	3	0	0	3
		TOPLAM	10	8	0	14
		GENEL TOPLAM	127	90	4	174

APPENDIX B

DESCRIPTIONS OF THE PROGRAM COURSES

Matematik Öğretmenliği Programı

103 Analitik Geometri (2203)

Düzlem ve uzayda vektörler. Vektör uzayı. Vektörlerin lineer bağımlılığı ve bağımsızlığı. İç çarpım uzayları. İki nokta arasındaki uzaklık. Bir vektörün uzunluğu. İki vektör arasındaki açı. Alan ve hacim hesaplamaları. Afin uzay ve Afin çatı. Afin koordinat sistemi. Euclid uzayı ve Euclid koordinat sistemi. Doğru denklemleri. İki doğrunun birbirine göre durumları. Noktanın bir doğruya göre durumu. Düzlemin denklemi. Doğrunun bir düzleme göre durumu. İki düzlemin birbirine göre durumu. Konikler. Çember, elips, parabol ve hiperbolün denklemleri. Genel ikinci derece denkleminin incelenmesi. Kuadratikler. Küre yüzeyi, silindir, koni, dönel yüzeyler, elipsoid, paraboloid, hiperboloid denklemleri, regle yüzeyler.

105 Genel Matematik (4205)

Temel kavramlar. Limit ve özellikleri, fonksiyon, fonksiyonların sürekliliği ve sürekli fonksiyonların özellikleri. Türev, türev alma kuralları ve genel teoremler. Konvekslik, maksimum ve minimum. Kapalı fonksiyonların türevleri. Geometrik uygulamalar. İntegral, genel teoremler. Alan hesapları, dönel yüzeylerin hacimlerinin hesabı, dilimleme yoluyla hacim hesabı.

101 Soyut Matematik (2203)

Önermeler Cebiri, Bağlaçlar, Boole Polinomları, Matematiksel Kanıt, Niceleyiciler, Teoremler İçin İspat Yolları, Küme Kavramı ve Kümeler Cebiri,

Küme Aileleri, Çarpım Kümeler, Küme Dizileri, Kartezyen Çarpımlar, Grafikler, İzdüşümler, Bağıntılar, Bağıntıların Bileşkeleri, Bağıntı Türleri, Denklik bağıntıları, Sıralama Bağıntıları, Fonksiyon Kavramı, Örten, Bire-bir Fonksiyonlar, Fonksiyonların Bileşkesi, Ters Fonksiyonlar, Kısmi Sıralı Kümeler, Tam sıralı Kümeler, Kümeler Ailesinin Kartezyen Çarpımı, Sıra korur Fonksiyonlar, Sırasal Eşyapı Dönüşümler, Grup, Halka, Cisim, İzomorfizmler.

104 Elementer Geometri (2203)

Aksiyomatik sistemler; aksiyomatik yöntem, modeller, aksiyomatik sistemlerin özellikleri. Sonlu geometriler; dört-nokta, Fano ve Young geometrileri. Konum geometrisi ve aksiyomları. Euclid'in geometrisi ve Euclid'in "Elemanlar"ı. Modern Euclidyen geometriler. Euclidyen geometrisi için Hilbert'in Birkhoff'un ve Okul Matematiği Çalışma Grubu'nun modelleri. Euclidyen olmayan geometriler. Nötral (mutlak) geometri; Eşlik şartları, paralellerin konumu, Hayyam dörtgeni, Saccheri-Legendre Teoremi, dikdörtgenin varlığı. Euclidyen geometri; paralellik postulatı ve ilgili amaçları, eşlik ve alan, benzerlik, çemberlik hakkında Euclidyen sonuçlar, üçgenler hakkında Euclidyen sonuçlar, dokuz-nokta çemberi, Euclidyen inşalar.

106 Genel Matematik (4205)

İntegral yardımıyla tanımlanan fonksiyonlar; üstel, logaritmik, hiperbolik fonksiyonlar.Ters trigonometrik ve hiperbolik fonksiyonlar ve bunlarla ilgili türev ve integral formülleri. İntegrasyon teknikleri. Kutupsal koordinatlar, kutupsal koordinatlarda alan ve yay uzunluğu hesabı. Genelleştirilmiş integraller. L'Hospital kuralı.

102 Soyut Matematik (2203)

Doğal sayılar, tam sayılar, rasyonel sayılar, gerçel sayılar, eşgüçlü kümeler, sonlu kümeler, sonsuz kümeler, sayılamaz kümeler, nicelik sayıları, iyi sıralanmış kümeler, eş sıralı kümeler, sıra sayıları, bir halka üzerinde polinomlar, bir cisim üzerinde polinomlar.

201 Lineer Cebir (3204)

Lineer denklem sistemleri. Matrisler, matris işlemleri, özel tip matrisler. Bir matrisin eşelon formu, Gauss eliminasyonu. Elementer matrisler ve bir matrisin tersi. Denk matrisler. Vektör uzayları; alt uzaylar, lineer bağımsızlık, lineer kombinasyonlar; baz ve boyut; kordinatlar ve izomorfizmalar; bir matrisin rankı. İç çarpım uzayları.

203 Diferansiyel Denklemler (2203)

Diferansiyel denklemler ve çözümleri. Birinci mertebeden ve birinci dereceden diferansiyel denklemler. Geometrik ve Fiziksel Uygulamalar. Birinci mertebeden doğrusal olmayan denklemler. n inci mertebeden doğrusal denklemler.

205 Analiz (3204)

Çok değişkenli fonksiyonlar. Limit ve süreklilik. Kısmi türevler ve n değişkenli fonksiyonların diferansiyeli ve Jacobien matris. Kapalı fonksiyonlar. Ters fonksiyonlar. Geometrik uygulamalar.Yöne göre türev.Çok değişkenli fonksiyonların maksimum ve minimumları. Lagrange çarpanları. Vektör alanları, vektör alanının gradienti, divergencesi ve curlu.

207 Bilgisayar Bilimlerine Giriş (2203)

Bilişim sistemi, Bilgisayarların gelişimi, Donanım ve yazılım sistemleri. Algoritma ve problem çözme teknikleri, akış çizeneği, Programlama kavramı ve programlama dilleri, işletim sistemleri.

MAT-209 Olasılık ve İstatistik (2203)

Olasılık ve İstatistiğin Dünyası, Permütasyonlar ve Kombinasyonlar, Olasılık Kuralları, Koşullu Olasılık, Bayes Teoremi, Rastgele Değişkenler ve Beklenen Değerler, Bazı Önemli Kesikli Olasılık Dağılımları (Bernoulli, Binom, Çok Terimli, Geometrik, Negatif Binom, Hipergeometrik, Poisson, Düzgün Dağılımlar), Bazı Önemli Sürekli Olasılık Dağılımları (Normal, Düzgün, Üstel, Gama, Beta, Cauchy Dağılımları), Moment Üreten Fonksiyonlar, Karakteristik Fonksiyonlar.

202 Lineer Cebir (3204)

Lineer dönüşümler ve matrisler, bir lineer dönüşümün matrisi. Lineer dönüşümlerin vektör uzayı ve matrislerin vektör uzayı, benzerlik. Determinantlar ve özellikleri, kofaktör açılımları, bir matrisin tersi, determinantların diğer uygulamaları. Öz değer ve öz vektörler, köşegenleştirme, simetrik matrislerin köşegenleştirilmesi, reel kuadratik formlar.

204 Diferansiyel Denklemler (2203)

Değişken katsayılı doğrusal denklemler. Legendre, Bessel ve Gauss denklemleri. Serilerle çözüm. Diferansiyel denklem sistemleri. Laplace dönüşümleri ve diferansiyel denklemlere uygulanması.

206 Analiz (3204)

Belirli integral, çok katlı integraller. Vektör değerli fonksiyonların integralleri. Değişken değiştirme. Yay uzunluğu ve yüzey alanının hesabı. Düzlemde eğrisel integral. Vektör integrali olarak eğrisel integral. Green teoremi. İntegralin yoldan bağımsızlığı.Diziler ve seriler.Alt ve üst limitler.Yakınsaklık ve ıraksaklık testleri.Fonksiyon dizileri ve fonksiyon serileri. Düzgün yakınsaklık ve Weierstrass M- testi. Düzgün yakınsak dizi ve serilerin özellikleri. Taylor ve Maclaurin serileri.

208 Bilgisayar Bilimlerine Giriş (2203)

Visual BASIC programlama dilinde program tasarımı ve uygulama yöntemleri. İnternet Ortamında temel Web sayfasının tasarımı, geliştirilmesi ve eğitimde uygulamaları.

MAT 210 Olasılık ve İstatistik (2203)

Örnek Seçimi, Verilerin Düzenlenmesi ve Analizi(Merkezi Eğilim ve Yayılma Ölçüleri), Örnekleme Dağılımları ve Tahmin(Nokta ve Aralık Tahminleri), Hipotez Testleri, Ki-Kareye Dayanan Anlamlılık Testleri, Regresyon ve Korelâsyon.

301 Cebire Giriş (2203)

Kümeler, denklik bağıntısı, ikili işlemler, fonksiyonlar. Asal sayılar. Aritmetiğin Temel teoremi. Grup tanımı ve örnekler. Alt gruplar. Permütasyon grupları; yörünge, devirli permütasyonlar, tek ve çift permütasyonlar. Devirli gruplar. Homomorfizmalar. Kosetler ve Lagrange teoremi. Normal alt gruplar, bölüm grupları. İzomorfizma teoremleri. p- grupları ve Sylow teoremleri. Grup serileri ve çözülebilir gruplar.

303 Diferansiyel Geometri (2203)

Koordinat yamaları, E^3 te yüzeyler. Yüzeyler üzerinde diferansiyellenebilen fonksiyonlar, tanjant vektörler, diferansiyel formlar. Yüzey dönüşümleri, yüzeyler üzerinde integrasyon, Yüzeylerin topolojik özellikleri. Manifoldlar. Şekil operatörleri, normal eğrilik, Gauss eğriliği. Yüzeyler üzerinde özel eğriler. Birinci ve ikinci esas formları.

305 Topoloji (2203)

Metrik Uzaylar, Topolojik yapı ve topolojik uzay kavramı. Topolojik uzayda açık ve kapalı kümeler. Topolojilerin karşılaştırılması. Topolojik alt uzay kavramı. Reel sayıların, düzlemin, metrik uzayın topolojisi.Komşuluk kavramı, değme noktası, yığılma noktası, kapanış, bir kümenin içi ve dışı. Bir kümenin sınırı. Çarpım ve bölüm uzayları.

307 Bilgisayar Programlama (2203)

Bilgisayarlar ve Bilgisayar teknolojileri, İşletim sistemleri, Bilgisayar desteğinde problem çözme teknikleri ve algoritmalar. Pascal programlama dili. İnput ve output prosedürleri. Koşul ve döngü deyimleri. Procedure ve function alt programları. Karakter dizi fonksiyonları. Pascal'da örnek program uygulamaları.

311 Seçmeli (C Programlama) (2203)

C programlama dilinin temelleri, Değişken ve türleri, Diziler, Bilgi türleri, Okutma ve yazdırma deyimleri. Fonksiyonlar ve Yapılar. Programların hazırlanması.

315 Seçmeli (Matematik Tarihi) (2203*)*

Eski Mısır ve Mezopotamya Medeniyetlerinde Matematik, Eski Yunan'da Matematik ve Gelişimi, Ortaçağ İslam Dünyasında Matematik, İslam Matematikçilerin Matematiğe Katkıları, Descartes'ten Günümüze Matematikteki Temel Kavramların Oluşumu.

309 Seçmeli (Matematiğe Bilgisayar İle Yaklaşım) (2203)

Bilgisayar ortamında grafik çizimlerinin matematiksel temelleri. Eğri yüzey tasarımları. İki ve üç boyut çizimlerinde temel grafik algoritmaları. Bilgisayar animasyonları.

319 Seçmeli (Matematiksel Yazılım Tasarımı) (2203)

Listeler, Ağaçlar ve Dinamik Yapılar. Sıralama Teknikleri. Arama Teknikleri. Graf ve uygulamaları. Uygulama Programları.

313 Seçmeli (Nümerik Analiz) (2203)

Polinom Köklerinin hesabı. Doğrusal denklem sistemlerinin çözümleri.Doğrusal olmayan denklemlerin çözümleri. Öz değerler ve öz vektörler. Sonlu farklar. Sayısal enterpolasyon ve enterpolasyon formülleri. Eğri fitleme. Sayısal türev ve optimizasyonu, sayısal integrasyon. Sayısal yaklaşım yöntemleri ve diferansiyel denklem sistemlerinin çözümleri.

321 Seçmeli (Fraktal Geometri) (2203)

Sayma ve Sayı sistemleri, Sayılar ve Noktalar, Fraktallar, Spiraller ve Yıldızlar, Fraktalların Analizi.

323 Seçmeli (Fonksiyonel Analiz) (2203)

Vektör uzayları ve bazlar. Topolojik vektör uzayları, metrik uzaylar, Normlu lineer uzaylar, Banach uzayları, Lineer dönüşümler, Düzgün sınırlılık prensibi, Hahn-Banach teoremi ve uygulamaları, Dual uzaylar ve zayıf topoloji, Hilbert uzayları.

325 Seçmeli (Sonlu Yansıma Grupları) (2203)

İç çarpım uzayları ve ortogonal dönüşümlerin bazı temel özellikleri. İzometri tanımı, bir izometrinin ortogonal dönüşümler cinsinden karakterizasyonu. İzometri grupları ve ortogonal gruplar. n=1,2,3 için R^n standart iççarpım uzayı üzerinde tanımlı izometri çeşitlerinin belirlenmesi ve geometrik anlamları. Grup etkisi ve Burnside teoremi. İki boyutlu uzayda sonlu dönme gruplarının belirlenmesi. Üç boyutlu uzayda sonlu dönme gruplarının belirlenmesi. Coxeter gruplarına giriş.

317 Seçmeli(Matematikte Seçme Konular)

Matematik ile ilgili yeni konular verilecektir.

302 Cebire Giriş (2203)

Halka tanımı ve örnekler. Alt halkalar, homomorfizmalar. Bazı komütatif olmayan halka örnekleri. İdealer ve izomorfizma teoremleri. Bir tamlık bölgesinin kesirler cismi. Bir halka üzerinde tanımlı polinom halkası, değer homomorfizması. Bir cisim üzerinde tanımlı polinom halkasında çarpanlara ayırma. Eisenestein indirgenmezlik kriteri. Tek türlü çarpanlara ayırma bölgeleri, ebob. TÇAB olmayan tamlık bölgesi örnekleri. Öklid Bölgeleri, Gauss tamsayıları.

304 Diferansiyel Geometri (3204)

Euclidyen 3-uzayda tanjant (teğet) vektörler, vektör alanları, yöne göre türevler, eğriler, eğrilerin yeniden parametrelenmesi, 1-formlar, diferansiyel formlar, dönüşümler. Diferansiyel enebilen fonksiyonlar.. Birim-hızlı eğriler, Frenet çatı alanı ve Frenet formülleri, keyfi-hızlı eğriler, bazı kovaryant türevler, çatı alanları, bağlantı formları, yapı denklemleri.

306 Topoloji (2203)

Topolojik ve metrik uzaylarda süreklilik.Açık ve kapalı fonksiyonlar. Homeomorfizm. Fonksiyonlarla üretilen topoloji. Birinci sayılabilir, ikinci sayılabilir ve ayrılabilir topolojik uzaylar. Topolojik uzaylarda dizilerin ve ağların yakınsaklığı. Ayırma aksiyomları. Kompakt uzaylar. İrtibatlı uzaylar.

308 Bilgisayar Programlama (2203*)*

Pascal'da kayıtlar ve dosyalar. Kayıt tanımlı dosyalarda erişim teknikleri. Dinamik değişkenler ve dizinler. Sıralama teknikleri ve Pascal Programları. Arama teknikleri. Sayısal yöntemler. Pascal özellikleri ve uygulamaları.

310 Sayılar Teorisi (2203))

Tamsayıların bölünebilme özellikleri, en büyük ortak bölen, en küçük ortak kat, Asal sayılar. Aritmetiğin temel teoremi, Euler fi- fonksiyonu, Fermat, Euler ve Wilson teoremleri. Euler fi-fonksiyonunun özellikleri, kongruensler, Birinci dereceden kongruens denklemlerinin çözümü, Çinli kalan teoremi, n. Dereceden kongruenslerin çözümü, Asal modüle göre kongruenslerin çözümü, Kuadratik kalanlar, Legendre ve Jacoby sembolleri, Kuadratik karşılık teoremi.

320 Veri Analizi

Veri tabanı kavramı; (veri, bilgi, kayıt kavramları), (veri, bilgi, kayıt tipleri). Veri tabanı oluşturma, Güncelleme, Veri tabanı komutları, Veri tabanında programlama, Veri tabanında dosya işlemleri, Raporlama, Diğer paket programlar ile veri alışverişi, Veri tabanında proje hazırlama.

328 Gruplar ve Geometriler

Bir grubun tanımı ve temel özellikleri.Bir grubun bir küme üzerine etkisi. Dengeleyiciler ve yörüngeler. Geçişli G- kümelerinin belirlenmesi. Burnside teoremi, yörüngelerin sayılması. Geometriye giriş. Geometrinin aksiyomları. Afin Geometri, Projektif Geometri. Öklid geometrisi. İki ve üç boyutlu Öklid uzaylarında sonlu dönme gruplarının belirlenmesi.

312 Seçmeli (Kümeler Teorisi) (2203)

İyi sıralı kümeler, Küme Aksiyomlar, Ordinal ve Kardinal Sayılar, Ordinal ve Kardinal Sayıların Aritmetiği.

314 Seçmeli (Reel Analiz) (2203)

Kümeler, Sayılabilir kümeler, Reel Sayılar, R'de topolojik kavramlar, Sürekli fonksiyonlar, metrik uzaylar. Cauchy integrali, Fourier serileri ve Dirichlet şartları, Riemann integrali, sıfır ölçülü kümeler, Riemann integralinin varlığı, Riemann integralinin tanımlılığı, Rietz metodu. Basamak (Basit) fonksiyonlar ve onların integralleri, Temel iki lemma, L^+ sınıfı, lebesgue integrali, Beppo-Levi ve monoton yakınsaklık teoremleri, Lebesgue yakınsaklık teoremi ve L^p uzayı.

316 Seçmeli (C Programlama) (2203)

C program yapısı, Array, Rekorsiyon, Structure, Kütükler, Özel konular

318 Seçmeli (Uygulamalı Matematik)

Gamma ve Beta fonksiyonları ve özellikleri, Fourier serileri ve Trigonometrik seriler, Fourier Kosinüs ve Sinüs serileri, Ortogonal seriler, Ortogonal fonksiyonların Fourier serileri. Fourier integralleri ve dönüşümleri.

322 Seçmeli (Matematikte Seçme Konular)

Matematik ile ilgili yeni konular verilecektir.

330 Seçmeli (Cebirsel Sayılar Teorisi)

Cebirsel Sayılar Teorisi ile ilgili yeni konular verilecektir.

324 Seçmeli (Matematiksel Yazılım Tasarımı) (2203)

Matematiksel Yazılım ilkeleri. Matematiğin çeşitli dallardaki konularına bilgisayar desteği sağlamak üzere algoritmaların geliştirilmesi ve örnek programların tasarımı. Uygulamalar.

326 Seçmeli (Diskret Matematik) (2203)

Rekörsiyon ve rekörsif bağıntılar. Graf teori. Ağaçlar. Cebirsel sistemler. Boolean cebiri. Monoidler ve sonlu durumlu makineler.

401 Soyut Cebir (3204)

Cebirsel cisim genişlemeleri, sonlu genişlemeler ve cebirsel kapanış. Geometrik çizimler. Cisim otomorfizmaları, cebirsel cisim teorisinin esas teoremi, bir alt cismi sabit bırakan otomorfizmalar grubu, Frobenius otomorfizması. Otomorfizma genişletme teoremi, cisim indeksi. Parçalanma cisimler. Dairesel genişlemeler. Galois teorisine giriş. Beşinci dereceden bir polinomun radikallerle çözülemezliği.

403 Dönüşümler ve Geometriler (3204)

Bir geometrik dönüşümün tanımı, Dönüşüm grupları, Geometrik değişmezler, Euclid düzleminde hareketler, Ötelemeler, Dönmeler, Yansımalar, Katı hareketler ve ters hareketler, Hareketler grubunun denklemleri, Benzerlik dönüşümleri, Radyal dönüşümler. Metrik geometri. Afin dönüşümler. Afin grup. Afin geometri. Projektif dönüşümler ve projektif grup. İzdüşümler. Harmonik bölünme. Topolojik dönüşümler.

***405 Kompleks Değişkenli Fonksiyonlar (3204*)**

Kompleks sayıların inşası ve kompleks sayıların kutupsal gösterimleri, kompleks terimli dizi ve seriler, kompleks değişkenli fonksiyonlar ve onların sürekliliği,türevleri ve integraller Taylor teoremi ve sonuçları, Laurent teoremi ve Laurent serisi, Singüler noktaların sınıflandırılması, Rezidü kavramı ve Cauchy rezidü teoremi, , Rouche teoremi ve cebirin esas teoremi.

407 Bilgisayar Cebiri (2203)

Cebirsel yapıların temsili ve ağaç yöntemi ile incelenmesi. Rekörsif veri yapıları. Çizelge formları. En büyük ortak bölen. Toplam, çarpma ve fark algoritmaları. Bölüm problemleri. Polinomlar ve modüler yöntemler. Doğrusal denklemler. İntegrasyona giriş. Kanomik ve normal formlar. Richardson teoremi.

ÖFD 402 Öğretmenlik Mesleğine Giriş (3003)

Öğretmenlik mesleğinin özellikleri ve ilkeleri, sınıf ve okul ortamı, eğitimde alternatif perspektifler, eğitimin sosyal, psikolojik, felsefi ve tarihi temelleri, Türk eğitim sistemi.

ÖFD 404 Gelişim ve Öğrenme (3003)

Çeşitli yönlerden insan gelişimi (bilişsel, sosyal, psikolojik, ahlaki, fiziksel, vb.), öğrenme yaklaşımları ve süreçleri, biçimleri ve öğrenmede bireysel farklılıklar.

ÖFD 406 Öğretimde Planlama ve Değerlendirme (3204)

Temel program geliştirme kavramları ve süreçleri, ders programı, yıllık, ünite, günlük planların geliştirilmesi, içerik seçimi ve organizasyonu, öğretim yöntemleri ve stratejileri, materyallerin özellikleri ve seçimi, ölçme ve değerlendirme, değerlendirme yaklaşımları, test türleri, izleme ve başarı testlerinin geliştirilmesi, sınav sorusu yazma teknikleri, not verme.

ÖFD 408 Özel Öğretim Yöntemleri I (2203)

Konu alanında öğretim yöntemleri öğrenme-öğretme süreçleri genel öğretim yöntemlerinin konu alanı öğretimine uygulanması, konu alanındaki ders kitaplarının eleştirisel bir açıyla incelenmesi ve özel öğretim yöntem ve stratejileri ile ilişkilendirilmesi. Micro öğretim uygulamaları, öğretimin değerlendirilmesi

ÖFD 410 Okul Deneyimi I (1403)

Bu derste öğretmen adaylarının mümkün olduğu kadar erken bir aşamada, bir uygulama öğretmeni nezaretinde okulu, öğrencileri ve öğretmenlik mesleğini çeşitli yönlerden tanıması amaçlanmaktadır. Bu ders kapsamında yer alması önerilen başlıca etkinlikler şunlardır: okul örgütü ve yönetimi, okuldaki günlük işler, zümre etkinlikleri, bir öğrencinin okuldaki günlük yaşantısı, bir öğretmenin okuldaki günlük yaşantısı, okul-aile işbirliği, ana ve yan branşlarla ilgili derslerin gözlenmesi, okul ve sorunları, araç-gereç ve yazılı kaynaklar ve öğretmenlik mesleğinin çeşitli yönleri.

ÖFD 501 Öğretim Teknolojileri ve Materyal Geliştirme (2203)

Çeşitli öğretim teknolojilerinin özellikleri, öğretim sürecindeki yeri ve kullanımı, öğretim teknolojileri yoluyla öğretim materyallerinin (çalışma yaprakları, saydamlar, slaytlar, video, bilgisayar temelli ders materyali, vb.) geliştirilmesi ve çeşitli nitelikteki materyallerin değerlendirilmesi.

ÖFD 503 Sınıf Yönetimi (2203)

Öğrenci davranışını etkileyen sosyal ve psikolojik faktörler, sınıf ortamı ve grup etkileşimi, sınıf yönetimi ve disiplinle ilgili kurallar geliştirme ve uygulama, sınıf içinde zaman kullanımı, sınıf organizasyonu, motivasyon, iletişim, yeni bir döneme başlangıç, olumlu ve öğrenmeye uygun bir ortam yaratma, sınıf içinde karşılaşılan davranış problemleri ve bunlara karşı geliştirilecek önlemler.

ÖFD 505 Özel Öğretim Yöntemleri II (2203)

Konu alanında öğretim yöntemleri öğrenme-öğretme süreçleri genel öğretim yöntemlerinin konu alanı öğretimine uygulanması, konu alanındaki ders kitaplarının eleştirisel bir açıyla incelenmesi ve özel öğretim yöntem ve stratejileri ile ilişkilendirilmesi. Micro öğretim uygulamaları, öğretimin değerlendirilmesi

ÖFD 507 Okul Deneyimi II (1403)

Okullarda bir uygulama öğretmeni nezaretinde Öğretmenlik Uygulaması dersine temel oluşturmak amacıyla yapılan gözlem ve uygulamalar; bazı gözlem ve uygulama konuları: öğretimde soru sorma, yönerge ve açıklamalar, dersin yönetimi ve sınıfın kontrolü, çeşitli yönlerden bir öğrencinin incelenmesi, öğrenci çalışmalarının değerlendirilmesi, dersi planlama, ders kitaplarından yararlanma, grup çalışmaları, sınıf organizasyonu, çalışma

yapraklarının hazırlanması ve kullanılması, sınıf içinde mikro öğretim uygulamaları.

ÖFD 509 Seçmeli (Konu Alanı Ders Kitabı İncelemesi -1) (3003)

Konu alanında MEB tarafından onaylanmış ders kitaplarının ve öğretim programlarının eleştirel bir bakış açısı ile incelenmesi; kitapların içerik, dil, öğrenci seviyesine uygunluk, format, çekicilik, anlamlı öğrenmeye katkısı, öğretimde kullanım kolaylığı, vb. açılarından incelenmesi.

ÖFD 502 Konu Alanı Ders Kitabı İncelemesi -2 (2203)

Konu alanında MEB tarafından onaylanmış ders kitaplarının ve öğretim programlarının eleştirel bir bakış açısı ile incelenmesi; kitapların içerik, dil, öğrenci seviyesine uygunluk, format, çekicilik, anlamlı öğrenmeye katkısı, öğretimde kullanım kolaylığı, vb. açılarından incelenmesi.

ÖFD 504 Rehberlik (3003)

Öğrenci kişilik hizmetlerinin amaçları ve eğitim içindeki rolü, rehberlik hizmet alanlarının tanıtımı, rehberliğin genel ilkeleri, öğrenciyi tanıma, yönlendirme, bilgi toplama ve yayma, psikolojik danışma, yerleştirme, izleme, danışmanlık, araştırma ve değerlendirme, çevre ile ilişkiler, mesleki yönlendirme, özel eğitimin amacı ve özel eğitime muhtaç öğrencilerin saptanması ve eğitimi.

ÖFD 506 Öğretmenlik Uygulaması (2605)

Haftada bir tam gün ya da iki yarım gün (minimum 12 hafta) öğretmen adaylarının bizzat sınıf içinde öğretmenlik becerisi kazanmasına ve belirli bir dersi ya da dersleri planlı bir biçimde öğretmesi ve iki saat öğretmenlik uygulaması semineri (öğretmenlik uygulamasının değerlendirilmesi ve paylaşılması).

ÖFD 508 Seçmeli (Cebirsel Kavramlar ve Cebirsel Denklemlerin Çözümleri)

Basit gruplar, $A_n (n \geq 5)$ nin basitliği; Grup serileri, çözülebilir gruplar, komutatör serileri, kompozisyon serileri; Parçalanma cisimleri, normal genişlemeler, ayrılabilir genişlemeler, Galois genişlemeleri, bir polinomun Galois grubu; Dairesel polinom ve daresel genişlemeler, düzgün n-genin çizilebilirliği için gerek ve yeter şart; Derecesi $n \leq 4$ olan polinomların çözümü, Galois gruplarının belirlenmesi ve diskriminantlarının hesaplanması; Radikallerle çözülebilirlik, $f(x) = 2x^5 - 5x^4 + 5 \in Q[x]$ polinomunun radikallerle çözülemezliği.

APPENDIX C

DEMOGRAPHIC DATA INSTRUMENT

MATEMATİĞE, MATEMATİK ÖĞRETİMİNE, ÖĞRETMENLİĞE VE PROGRAMA YÖNELİK BAKIŞLARINIZ

Bu çalışmanın amacı, Gazi Üniversitesi, Eğitim Fakültesi, Ortaöğretim Fen ve Matematik Alanları Eğitimi Bölümü, Matematik Eğitimi Anabilim Dalında 5 yıllık (3,5+1,5) programda kayıtlı olan öğretmen adaylarının eğitim derslerini almaya başladıkları dönemin (8. dönem) başında öğretmenliğe, matematiğe, matematik öğretimine ve kayıtlı oldukları programa yönelik görüşlerini almak ve görüşlerini değiştiren faktörleri belirlemektir.

Elde edilen tüm verilerde gizlilik esastır. Ancak katılımcıların takip edilmesi ve analiz sürecindeki karışıklığının engellenmesi için katılımcılardan isim almak zorunlu hale gelmiştir. Ancak bu bilgileri araştırmacı dışında hiç kimsenin görmemesi sağlanacaktır.

Cevaplarınızı içtenlikle ve doğru olarak vermeniz daha iyi araştırma sonuçlarına ulaşmak ve bunun sonucunda daha iyi ve kaliteli eğitime ulaşmaya katkı da bulanacaktır. Cevaplarınızı ayrıntılı şekilde yazmanız bizim için önemlidir. Cevaplarınız için ayrılan yerleri kullanabilirsiniz. Bu yerler yeterli gelmediği takdirde kağıtların arkasını da kullanabilirsiniz. Katılımınız için teşekkür ederiz.

Ayşegül Eryılmaz

Kişisel Bilgiler:

1- Adınız- soyadınız:
2- Yaşınız:
3- Hangi liseden mezun oldunuz?
4- Bu bölüm kaçıncı tercihinizdi?
5- Üniversite sınavında yaptığınız bölüm tercihlerinizden ilk beşini sırasıyla yazınız.
   I. .....
   II. .....
   III. .....
   IV. .....
   V. .....
6- Matematik öğretmenliğinden başka öğretmenlik tercihiniz var mıydı?
   Evet ( ) Hayır ( )
   Evetse hangi alan öğretmenliklerini tercih etmiştiniz? Neden?

7- Mezun olunca yapmak istediğiniz üç meslek sırasıyla nedir?
   I. .....
   II. .....
   III. .....
8- Annenizin eğitim durumu nedir?
9- Annenizin mesleği nedir?
10- Babanızın eğitim durumu nedir?
11- Babanızın mesleği nedir?
12- Bu döneme kadar almış olduğunuz dersler arasında eğitim dersleri var mıydı?
13- Evet ( ) Hayır ( )
14- Bu dönem almakta olduğunuz dersler nelerdir?

15- İş deneyiminiz var mı? Özel ders verdiniz mi? Herhangi bir işte daha önce çalıştınız mı?)

16- Lütfen aşağıya sizinle iletişim kurabileceğimiz telefon ve/veya e-mail adresinizi yazınız.

Telefon :……

e- mail :……

APPENDIX D

BELIEF INSTRUMENT

Matematik, Matematik Öğretimi ve Öğretmenlik Hakkındaki Görüşleriniz:

1- Sizce matematik nedir?
2- Matematik denince neler hissediyor neler düşünüyorsunuz?
3- Üniversite eğitiminiz öncesindeki matematik eğitiminiz sizin matematiğe karşı bakışınızı nasıl etkiledi?
4- Üniversite eğitiminde aldığınız matematik dersleri matematiğe olan bakışınızı nasıl etkiledi?
5- Matematik öğretimi denince neler hissediyor neler düşünüyorsunuz?
6- Matematik öğretimine olan bakışınız lisans programına kayıt olmanızdan itibaren değişikliğe uğradı mı? Nasıl?
7- Üniversite eğitiminizde gördüğünüz matematik müfredatı hakkında neler düşünüyorsunuz?
8- Neden öğretmen olmak istiyorsunuz?
9- Sizce öğretmen olmak ne demek?
10- Bir öğretmeni iyi yapan özellikler nelerdir?
11- Kendinizi öğretmen olarak nasıl görüyorsunuz?
12- Öğretmen olduğunuz okullarda neleri değiştirebileceğinizi ve değiştiremeyeceğinizi düşünüyorsunuz?
13- Öğrencilerin iyi şekilde matematik öğrenmesinde ne gibi etkiniz olacağını düşünüyorsunuz?
14- Kendinizi bir matematik öğrencisi olarak nasıl görüyorsunuz?
15- Matematiği iyi öğrenmek için neler yapmak gerektiğini düşünüyorsunuz?

16- Sınıfta iyi bir ders işlemek için neler yapmak gerekir?
17- Sizce sınıflarda nasıl bir matematik öğretimi ortamı oluşturuluyor?
18- Sizce iyi bir öğretim ortamı nasıl olmalı?
19- Sınıftaki matematik öğretimini etkileyen faktörlerin neler olduğunu düşünüyorsunuz?
20- Sizin düşündüğünüz sınıf ortamını kurmanızı engelleyecek faktörler nelerdir?
21- Sizce liselerde matematik öğretmenlerinin karşılaştığı en önemli sorunlar nelerdir?
22- Aldığınız eğitim size matematik, matematik öğretimi ve öğretmenlik hakkında nasıl bir katkı sağlıyor?

Program Hakkındaki Beklentileriniz ve Kazanımlarınız:

23- Bu dönemde almakta olduğunuz *Öğretmenlik Mesleğine Giriş, Gelişim ve Öğrenme, Eğitimde Planlama ve Değerlendirme, Özel Öğretim Yöntemleri I, Okul Deneyimi I* dersleri hakkında ne düşünüyorsunuz? Size neler kazandıracağını düşünüyorsunuz? Bu derslerden beklentileriniz neler? Bu derslerin sizin matematik ve matematik öğretimine olan bakışınıza olan etkisinin ne olacağını düşünüyorsunuz? Lütfen ayrı ayrı belirtiniz.

Öğretmenlik Mesleğine Giriş

Gelişim ve Öğrenme

Eğitimde Planlama ve Değerlendirme

Özel Öğretim Yöntemleri I

Okul Deneyimi

APPENDIX E

PILOT INSTRUMENT

ÖĞRETMENLİĞE YÖNELİK BAKIŞLARINIZ

Bu anket sizin öğretmenliğe yönelik bakışlarınızı tutumlarınızı ve kayıtlı olduğunuz tezsiz yüksek lisans programı hakkındaki görüşlerinizi almak için hazırlanmıştır. Görüşlerinizi yazarken lütfen temel unsurlar üzerinde durarak geniş açıklamalar yapınız. Burada yazacağınız her şey sadece araştırmacı tarafından bilinecek ve gizli tutulacaktır. Cevaplarınız için ayrılan yerleri kullanabilirsiniz. Bu yerler yeterli gelmediği takdirde kağıtların arkasını da kullanabilirsiniz. Katılımınız için teşekkür ederiz.

Ayşegül Eryılmaz

Kişisel Bilgileriniz

1- Adınız- soyadınız :
2- Yaşınız :
3- Mezun olduğunuz lise :
4- Annenizin eğitim durumu :
5- Annenizin mesleği :
6- Babanızın eğitim durumu :
7- Babanızın mesleği :

Görüşleriniz

8- Sizce matematik nedir?
9- Matematik denince neler hissediyor neler düşünüyorsunuz?
10- Matematik öğretimi denince neler hissediyor neler düşünüyorsunuz?
11- Sizce öğretmen olmak ne demek?
12- Bir öğretmeni iyi yapan özellikler nelerdir?

13- Neden öğretmen olmak istiyorsunuz?

14- Sizce liselerde matematik öğretmenlerinin karşılaştığı en önemli sorunlar nelerdir?

15- Öğretmen olduğunuz okullarda neleri değiştirebileceğinizi düşünüyorsunuz?

16- Önceki yıllardaki matematik eğitiminiz sizin matematiğe karşı bakışınızı nasıl etkiledi?

17- Sizce öğretmenler matematiği en iyi şekilde nasıl öğretebilir?

18- Kendinizi bir matematik öğrencisi olarak nasıl görüyorsunuz?

19- Kendinizi öğretmen olarak nasıl görüyorsunuz?

20- Aldığınız eğitim bu sorunlarla ilgili olarak size nasıl bir katkı sağlıyor?

21- Bu dönemde aldığınız dersler sizin matematiğe bakışınızı nasıl etkiledi? Önceki düşünceleriniz nelerdi, nasıl bir değişim oldu? Her bir ders için ayrı ayrı düşüncelerinizi belirtiniz.(*Instroduction to Teaching Profession, Development and Learning, Instructional Planning and Evaluation, Methods of Science/Mathematics Teaching I, School Experience in Secondary Education)*

22- Bu dönemde aldığınız dersler sizin matematik öğretimine bakışınızı nasıl etkiledi? Önceki düşünceleriniz nelerdi, nasıl bir değişim oldu? Her bir ders için ayrı ayrı düşüncelerinizi belirtiniz.(*Instroduction to Teaching Profession, Development and Learning, Instructional Planning and Evaluation, Methods of Science/Mathematics Teaching I, School Experience in Secondary Education)*

Table F: Participants

Participant	Age	Lycee	Gpa Lycee	Gpa	Preference	Mother ed.	Mother Occupation	Father ed.	Father Occupation	Experience
P1	22	TAH	4,55	2,56	5	Middle School	Housewife	Vocational Higher Education.	Chief Of Police	Dersane\ Private Tutor
P2	22	TAH	4,65	2,1	5	Nonexistance	Housewife	Primary School	Retired	Private Tutor
P3	22	TAH	4,62	2,7	5	Primary School	Housewife	High School	Retired	Nonexistance
P4	21	TAH	4,83	2,59	5	Primary School	Housewife	High School	Unemployee	Nonexistance
P5	22	TAH	4,72	2,98	2	No Reading Writing	Housewife	Middle School	Retired	Private Tutor
P6	21	AH	4,96	2,5	1	High School	Nurse	High School	Electirical Technician	Private Tutor
P7	22	TAH	4,62	2,78	2	Vocational High School	Housewife	High School	Retired	Dersane\ Private Tutor
P8	22	AH	4,5	2,46	2	Nonexistance But Can Read And Write	Housewife	Vocational Higher Education.	Machine Technician	Private Tutor
P9	23	TAH	3,9	2,9	13	Primary School	Housewife	Primary School	Esnaf,Tornaci	Dersane\ Private Tutor
P10	22	TAH	4,74	2,86	18	Primary School	Housewife	Primary School	Labourer	Nonexistance
P11	22	FLH	4,52	3,05	12	Open Educatin Faculty	Bank Employee	Vocational Higher Education.	Retired	Nonexistance
P12	22	PH	3,79	3,12	9	Nonexistance	Housewife	Primary School	Farmer	Private Tutor
P13	21	PH	4,87	2,97	1	Primary School	Housewife	Primary School	Tradesmen	Dersane\ Private Tutor
P14	22	TAH	4,24	2,44	3	Primary School	Housewife	Primary School	Labourer	Dersane\ Private Tutor
		Mean	4.54	2.71	Mod=5					

P: Preservice Teacher; TAH: Teacher Anatolian High School; AH: Anatolian High School; PH: Public High School FHL: Foreign Language High School