PRESERVICE ELEMENTARY MATHEMATICS TEACHERS' EFFICACY BELIEFS ABOUT USING MANIPULATIVES IN TEACHING MATHEMATICS

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PRESERVICE ELEMENTARY MATHEMATICS TEACHERS' EFFICACY BELIEFS ABOUT USING MANIPULATIVES IN TEACHING MATHEMATICS

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ABSTRACT

PRESERVICE ELEMENTARY MATHEMATICS TEACHERS' EFFICACY BELIEFS ABOUT USING MANIPULATIVES IN TEACHING MATHEMATICS

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This study analyzes the preservice elementary mathematics teachers' self efficacy beliefs and outcome expectancies about using manipulatives and investigates whether, or not, university and gender differences have any significant effect on their self efficacy and outcome expectancies. In mathematics education, students' conceptions about abstract mathematical ideas and being able to convert them into concrete ideas are very important. For this reason, it is very beneficial to use manipulative materials in the mathematics lessons. However, most of the preservice mathematics teachers in Turkey lack knowledge about using manipulatives.

The sample of present study consisted of 77 senior undergraduate students studying in Elementary Mathematics Teacher Education programs at 2 different universities located in Ankara and Izmir. Data were collected in spring term of 2006-2007 academic years. The survey items were adopted from previously developed teacher efficacy instrument, which partly ensures the items to be parallel with the

existing theory about the construct. The survey consisted of three parts; demographic information, knowledge about the manipulatives, and 'The Instrument of Preservice Mathematics Teachers' Efficacy Beliefs about Using Manipulatives'(EBMU).

The present study demonstrated that the gender differences did not effect preservice elementary mathematics teachers' personal manipulative use teaching efficacy whereas the university differences had a significant effect on their personal manipulative use teaching efficacy. In addition, the gender and university attended produced statistically significant main effect on preservice elementary mathematics teachers' outcome expectancies.

Keywords: Manipulatives, Preservice Elementary Mathematics Teachers, Self Efficacy, Outcome Expectancy.

ÖZ

İLKÖĞRETİM MATEMATİK ÖĞRETMEN ADAYLARININ SOMUT MATERYALLERİ ÖĞTRETİMDE KULLANMAYA YÖNELİK ÖZYETERLİLİK İNANIŞLARI

Bakkaloğlu, Ezgi

Yüksek Lisans, Orta Öğretim Fen ve Matematik Alanları Eğitimi Bölümü

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Bu çalışma, ilköğretim matematik öğretmen adaylarının somut materyal kullanımıyla ilgili özyeterliliklerini araştırmak, cinsiyet ve üniversite farklılıklarının bu konu üzerindeki etkilerini incelemek amacıyla hazırlanmıştır. Matematik eğitiminde, öğrencilerin matematiksel kavramları iyi bir şekilde kavraması ve bu kavramları somut olarak ifade edebilmesi çok önemlidir. Bu nedenle, matematik öğretiminde somut materyallerden faydalanmak gerekir. Ancak, ülkemizde öğretmen adayları, matematik öğretiminde, somut materyal kullanımı ile ilgili bilgiye ve tecrübeye çok az sahiptirler.

Bu çalışmanın örneklemi 2006- 2007 eğitim yılı bahar döneminde Ankara ve İzmir illerindeki 2 üniversitenin ilköğretim matematik öğretmenliği bölümlerinde okuyan 77 öğretmen adayıdır. Veriler daha önce uygulanmış bir anketi bu konuya uyarlayarak oluşturulan yeni bir anketi uygulayarak toplanmıştır. Anket, öğretmen adaylarının kişisel bilgilerini, somut materyaller hakkındaki bilgilerini ve bu konudaki özyeterliliklerini ve beklentilerini öğrenmeye yönelik olarak üç bölümden oluşmaktadır.

Araştırmanın sonunda genel olarak ilköğretim matematik öğretmen adaylarının somut materyal kullanımıyla ilgili pozitif görüşlere sahip oldukları görülmüştür. Cinsiyet farklılıkları somut materyal kullanımıyla ilgili özyeterliliklerini etkilemezken, üniversite farklılıklarının bu durumu etkilediği saptanmıştır. Ayrıca cinsiyet ve üniversite farklılıklarının, öğretmen adaylarının materyal kullanımı ile ilgili beklentilerini etkilediği görülmüştür.

Anahtar Kelimeler: Somut Materyal, İlköğretim Matematik Öğretmen Adayları, Özyeterlilik, Beklentiler

To My Parents

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CHAPTER 1

INTRODUCTION

Society of the 21st century needs the individuals who search, ask questions, observe, evaluate, analyze, and communicate. With this motivation, Turkish school curricula were reconstructed (Ministry of National Education, 2004) including mathematics curriculum. The recent curriculum reform was initiated in 2005 and suggested that students use different representations to understand mathematical ideas (Çakıroğlu & Yıldız, 2007). To facilitate this goal, for the teaching of various concepts in school mathematics, the curriculum suggests the use manipulative materials in mathematics classes. This vision obviously requires a change in the current practices in teaching and learning school mathematics. The change should begin with the teachers, because they have an important role in combining manipulatives in mathematics lessons. On the contrary, until recent years there has been limited support for the manipulatives use in teacher education programs for the preservice teachers whereas preparing preservice teachers to use manipulative materials in Turkish schools will become very important for the near future (Çakıroğlu, Yıldız, 2007).

1.1 Background of the study

Manipulatives are useful materials in mathematics teaching. Manipulative materials are objects that the learner is able to feel, touch, hold, and move. Researchers use 'manipulatives' to combine both concrete and pictorial representations, including images on computers (Sowell, 1989). They may be real objects that we use them in our daily life and each of these might represent an idea to students.

The use of mathematical tools such as manipulatives has gained research support in the last two decades (Post, 1980; Raphael & Wahlstrom; 1989, Suydam& Higgins, 1977). Sowell (1989), stated that 'the mathematics achievement is increased by the long term use of manipulatives and that the student attitudes toward mathematics improved when they are instructed with manipulatives.' (p. 498).

The terms 'concrete materials' and 'manipulatives' are often used to be synonyms to mean concrete models that incorporate mathematical concepts appeal to several senses and can be handled and moved around by students (Hynes, 1986, p.11). The purpose of using manipulatives is to help students in filling the gap from their own concrete thinking to the abstract level of mathematics (Fennema, 1973).

Rockenbach (1997) stated that 'Two of the most prominent learning theorists, Piaget (1952) and Dienes (1970), have advocated the use of any concrete object that can be used to help represent a concept'(p.1). They argue that students' mental images and abstract ideas are based on their experiences. So, students who see and touch kinds of materials have clearer mental images and can represent abstract ideas more completely than those who do not have these. Unfortunately, many pre-service teachers do not have enough knowledge to use manipulatives in their classrooms. For instance, in the case of United States of America, preservice teachers often use traditional methods concerning the nature of teaching mathematics (O'Laughlin, 1990, Ball & Wilson, 1990); and most do not know manipulatives themselves (Trueblood, 1986).

Another important issue regarding the teachers' manipulative use is their judgments about themselves to be effective in utilizing these materials in their teaching. Such judgments can be referred as teachers' self-efficacy beliefs about the use of manipulatives in teaching. Much of the recent studies and thought on efficacy is based upon the social cognitive theory of Bandura (1986). He argues that through self-referent thoughts, people evaluate and change their own thinking and behavior. These self-evaluations consist perceptions of self-efficacy, that is, "beliefs in one's capabilities to organize and execute the courses of action required to manage prospective situations" (Bandura, 1986, p. 389). In his theory, Bandura (1986) stated that, "among the different aspects of self-knowledge, perhaps none is more

influential in people's everyday lives than conceptions of their personal efficacy" (Bandura, 1986, p. 390). Although individuals may have certain skills, there is a distinct difference between possessing such skills and being able to apply them. Self-beliefs of efficacy connect knowledge and action. Therefore, in order to perform specific actions effectively, it requires knowledge, skills, and efficacy beliefs (Plourde, 2002).

Even though there are many research studies about teachers' self-efficacy beliefs, there limited research that focus on preservice mathematics teachers (Swars, Daane & Giesen, 2006). Teacher efficacy is defined as the extent to which teachers can control or strongly influence, student achievement and motivation (Tschannen-Moran, Hoy, & Hoy, 1998). There have been many studies about teacher efficacy in order to understanding its nature, how it is related to other variables, such as student achievement, and how they can measure these variables and teacher efficacy best. Yet, there are still a lot of things about this significant subject. Especially, questions can be asked how preservice teachers' develop efficacy belief about certain instructional approaches and the use of particular instructional materials.

Manipulative materials are relatively new instructional materials that are expected to become significant components of mathematics education in Turkish schools and teachers have limited or no experience with them. In this sense, educating pre-service teachers about these materials and the possibilities they can provide for learning is becoming more and more critical. In recent years, manipulatives are being introduced and being part of some of the courses in many elementary mathematics teacher education programs throughout Turkey. However preservice teachers hold concerns about manipulatives, regarding difficulties in classroom management, lack of administrative and parental support, and poor logistics (Çakıroğlu & Yıldız, 2007). In this sense, preservice teachers' self-efficacy and outcome expectancy beliefs about using manipulatives in teaching is an important area of focus as a research study.

1.2 Purpose of the Study

The purpose of this study was to explore pre-serivce teachers' self-efficacy beliefs about using manipulatives in teaching mathematics. To investigate efficacy beliefs of pre-service teachers, following research questions were formulated:

1. What are the pre-service elementary mathematics teachers' familiarity with manipulatives and what manipulative materials did they use in university A and university B?
2. What are the pre-service female and male mathematics teachers' familiarity with manipulatives and what manipulative materials did female and male students used?
3. Is there a difference in efficacy scores of preservice mathematics teachers based on gender and university attended?
4. Is there a difference in outcome expectancy scores of preservice mathematics teachers based on gender and university attended?

1.3 Null Hypotheses

1. There is no statistically significant difference in personal manipulative use teaching efficacy mean scores of preservice mathematics teachers based on gender.
2. There is no statistically significant difference in personal manipulative use teaching efficacy mean scores of preservice mathematics teachers based on university attended.
3. There is no interaction between gender and university variables regarding the mean scores of manipulative use teaching efficacy.
4. There is no statistically significance difference in outcome expectancy mean scores of preservice mathematics teachers based on gender
5. There is no statistically significance difference in outcome expectancy mean scores of preservice mathematics teachers based on university attended.
6. There is no interaction between gender and university variables regarding the outcome expectancy mean scores of preservice mathematics teachers.

1.4 Significance of the Study

This study gives insights into Turkish preservice elementary mathematics teachers and their instructors about the differences of familiarity with manipulative materials among universities and among gender. Besides, it also provides insights about what kind of manipulative materials do preservice elementary mathematics teachers use if we consider the university and gender differences. This study also explores the differences of personal manipulative use teaching efficacy and outcome expectancy beliefs based on university attended and gender. Exploring these points will lead the future developments of preservice teachers' manipulative use teaching efficacy and outcome expectancy beliefs about using manipulatives in teacher education programs in Turkey.

1.5 Assumptions and Limitations

It is assumed that the participating pre-service mathematics teachers paid attention to each item in the survey and their responses were parallel to what they feel and what they think. Also, it is assumed that their self efficacy and their outcome expectancies can be fairly measured by several survey questions. Besides, it is assumed that all the participants learn manipulatives in their universities.

The nature of this study is limited to the data collected from 77 pre-service elementary mathematics teachers studying at 2 different universities, located in 2 different cities whereas there are 23 universities that have elementary mathematics education program in Turkey. Therefore it cannot be generalized to all pre-service elementary mathematics teachers. However, it might give a different perspective from a specific study to other universities and pre-service teachers.

Another limitation is the study was based on quantitative data collected through structured item questionnaire. Therefore, the study was limited to several items on the survey.

1.6 Definitions

Manipulatives are objects or things that the pupil is able to feel, touch handle, and move (Reys, 1971). In the present study, however, the scope of the term "manipulatives" was used in a limited manner. The meaning of the term "manipulative" for this study was limited to a number of concrete materials that national Turkish mathematics curriculum for elementary schools specifically acknowledged and recommended to schools.

Self-efficacy refers to beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments (Bandura, 1997).

Outcome expectancy is a judgment of the likely consequences of a specific performance will produce (Bandura, 1997). Based on this definition, in the present study, manipulative use outcome expectancies were defined as pre-service teachers' beliefs that manipulative use in teaching mathematics will results in positive student learning.

Teacher efficacy is teachers' belief that they can influence how well students learn, even those who may be difficult or unmotivated (Guskey & Passaro, 1994). As an extention of this construct, this study defined Teacher Efficacy Beliefs Regarding the Use of Manipulatives as teacher's belief that he or she is capable of using manipulatives effectively while teaching mathematics.

The definitions of the manipulative materials that were used in the survey are in Appendix A.

CHAPTER 2

REVIEW OF RELATED LITERATURE

This chapter is about the review of related literature about the study. In the first part, the meaning and uses of manipulatives was described. In the second part, self efficacy and outcome expectancy, in the third part self efficacy and teachers, in the fourth part, self efficacy and preservice teachers were described. Lastly, the summary of the chapter was concluded.

2.1 The Meaning and Uses of Manipulatives

Mathematics always seems to be isolated phenomenon from real life. However, mathematics is a way of producing solutions to the problems by modeling real life situations (Durmuş & Karakırık, 2006). So, in modeling real life, manipulative materials should be used in mathematics instruction. Here are some definitions about manipulative materials made by different researchers.

Kennedy (1986) (as cited in Yıldız, 2004) defines manipulatives as objects that can be touched moved, rearranged and handled by children. Thay can be materials from the environment, such as money or measuring instruments or objects specifically designed to teach mathematical concepts, such as base ten blocks and balances.

Heddens (2005) defines manipulatives as concrete materials that include mathematical concepts, appeal to several senses including the socio-cultural needs that can be handled and moved by the learners. Moyer (2001) states that manipulative materials are objects that are designed to represent abstract mathematical ideas explicitly and concretely. They have visual and tactile attractiveness that can be manipulated by learners.

In her review literature, Bayram (2004) concluded that there are different attitudes toward the use of manipulatives in mathematics classrooms for children of

different ages. For instance according to Fennema (1972) while beginning learners usually benefit from the use of concrete materials, older learners not always do. Suydam and Higgins (1977), on the other hand, reported that manipulatives may be beneficial for all learners. While middle and upper primary students observed by Labinowics (1985) experienced considerable difficulty making sense of base-ten-blocks, Fuson and Briars (1990) who investigated the use of base-ten blocks in teaching addition and subtraction algorithms reported that their students had amazing success. In another study study, base-ten-blocks had little effect on upper primary students' understanding of whole-number addition and subtraction algorithms (Thompson, 1992). On the contrary, Wearne and Niebert (1988) reported consistent success in students' understanding of decimal fractions and decimal numeration when concrete materials were used.

According to Heddens (2005), the use of manipulative materials in teaching mathematics will help students learn to make relationships with real word and mathematical symbolism, to study cooperatively in solving problems, to discuss mathematical ideas, to verbalize their mathematical thinking, to make presentations in front of their peers, to find many different ways to solve problems and to symbolize mathematics problems, and to solve problems without only by following teacher' directions. Besides, Bruner (1966) stated that ideas could be represented in one of the three ways; enactive, iconic, and symbolic. Yıldız (2004) states that "If we provide the opportunity for students to interact with their environment in such a way that they join a set of two objects with a set of three objects and determine that there are five objects then students' experience is iconic representation. In enactive representation, students see a picture of two objects, a picture of three objects and a picture of five objects. When students write 2+3=5 then symbolic representation occurs" (p.12).

In addition to Heddens (2005) thoughts, Reys (1971) explained the benefits of using manipulatives such as it varies classroom activities, provides experiences in problem solving, provides a basis for analyzing sensory data, provide an opportunity to the pupils find relationships and make generalizations and provides a basis for analyzing sensory data.

However, while using manipulatives in the lessons, teachers should be aware of how children interpret the manipulative materials. Assuming that students understand materials in the same way as teacher does may damage the communication between the teacher and the students in the situations when students' understanding is different. There is a danger of misusing concrete models by teachers. This usually happens when the teacher has a prescribed activity in mind and rejects students' findings that do not correspond to the convention (Bayram, 2004). According to recent studies, one of the factors that influence teachers' use of manipulatives include to cover curriculum in a limited time, to have problems with classroom management, availability of the materials, teachers' ability to use manipulatives in mathematics lessons, students' excite and motivations toward activities (Çakıroğlu & Yıldız, 2007). In the study of Yıldız (2004), she found that there are several factors that affect teachers in using manipulatives, including the reactions of school administration, reactions of both parents and students, familiarity of students toward material and teaching technique, students' grade level and economic status of teachers. According to Bayram (2004) another factor that influence teachers' use of manipulatives is about the experiences of teachers. The results showed that the less experienced teachers tend to use manipulatives more often than the more experienced ones, because probably experienced teachers have lack of knowledge compared to the more recent graduates.

There are many criteria for effective use and selection of manipulative materials. One of the most significant questions is that: 'Does the selected manipulative serve its purpose?' Reys (1971), investigated selection criteria in two perspectives; pedagogical and physical.

For the pedagogical perspective; first, the mathematically appropriate materials should be selected, second, the mathematical concepts should be represented clearly by the manipulative materials and they should be used more than one purpose, third, the materials should motivate students, fourth they should construct a basis for abstraction and last, they should be organized for individual manipulation.

For the physical criteria, first, manipulative materials should be durable that it must not be easily damaged by the students; second, they should be attractive so as to appeal students' interest on the subject, third, they should be easy to manipulate and they should take so much time, fourth, their sizes should be suitable for storing them and last the cost of them should be reasonable.

2.2 What does self efficacy and outcome expectancy mean?

Self efficacy is belief that an individual is able to organize and execute the actions necessary to succeed at a given task (Bandura, 1997). Stevens, Olivárez, and Hamman (2006), (cited in Siegle & McCoach, 2007) stated that self-efficacy predicts mathematics achievement stronger than the general mental ability. Efficacy beliefs are best measured degree by degree from one's own high self efficacy to low self efficacy. Individuals with high self efficacy beliefs tend to complete a given task more successful than the others that have low self efficacy beliefs, besides those individuals with low self efficacy beliefs become inactive and tend to give up when facing with specific given tasks (Schunk, 2000).

Bandura and other social cognitivists think that efficacy beliefs are very important for affecting human performance. Outcome expectancies considering with efficacy beliefs, help to determine one's level of success when attempting to complete a task (Barkley, 2006).

There are four main sources of information that can change self-efficacy and influence individual's behavior: (a) mastery experiences—based on first-person engagement in activities or enactive performance, (b) vicarious experiences—gained by observing other similar actors as they model situational competencies, (c) social persuasion—praise communicated by peers or more knowledgeable others, and (d) physiological states—explained by following their somatic responses to optimal and suboptimal situations (Bandura, 1986). Vicarious experiences can play an important role in changing self-efficacy without the need for direct participation whereas mastery experiences, social persuasion, and physiological states need immediate first hand involvement of the person (Yoon, Pedretti, Pedretti, Hewitt, Perris, & Oostveen, 2006).

In the interview of Shaughnessy with Woolfolk (2004), Woolfolk describes general principles of those four information to guide teachers (p.159);

For modeling; it is suggested to the teachers allow peer models to demonstrate a task, verbalizing their thoughts and reasoning as they perform, encourage peer tutoring when appropriate, provide children with comparative information that focuses on behavior that support learning, use flexible grouping for small group learning to avoid labeling individuals. Form and reform groups on the basis of students' performance in the current subject; change groups frequently when students' achievement changes, avoid comparisons between groups and encourage students to form a whole-class spirit, organize and teach groups so that low-achieving students get appropriate extra instruction—not just the same material again.

For the mastery experiences; it is suggested to the teachers create daily routines so that children have a sense of expectation and control over their environment, react the routines with a daily schedule so that all students are reminded and know what to do next, make sure that learning tasks are on an appropriate level for all students. This requires both an intimate knowledge of each student's performance level in each subject along with the creation of individualized tasks as necessary, create opportunities for students to experience the "practice effect" by providing familiar tasks so as to to improve their performance, provide instructional support to guarantee students' success, help students to maintain incremental views of intelligence and adopt learning goals rather than performance goals, teach cognitive and metacognitive skills such as planning, monitoring, and goal setting, teach specific self-regulatory strategies that effect student performance, such as maintaining task focus and attention, applying memory strategies, managing time, and organizing.

For the verbal persuasion; it is suggested to the teachers to take care of children's actual ability to succeed when encouraging, provide feedback that focuses on effort.

For the physiological arousal; it is suggested to ensure all instructions are clear. Uncertainity can cause to anxiety; instead of giving students oral directions,

write test instructions on the board or on the test itself, check with students to make sure they understand, ask students how they would do the first question or an exercise, correct any misconceptions, avoid unnecessary time pressures and remove some of the pressures from tests and exams, teach test-taking skills; give practice tests; provide study guides.

Outcome expectancies, considering with efficacy beliefs, help to determine one's level of success when they try to complete a task. That is to say, if an individual pays attention to the completion of a task, often the outcome that is produced is very different than the outcome for individuals attempting the same task but with a low expectancy (Bandura, 1997). Efficacy beliefs and outcome expectancies are task specific so that both these beliefs and expectancies may be manipulated and controlled. If Bandura's theory of self efficacy is applied to the study of teachers,

> ...teachers who believe students' learning can be influenced by effective teaching (outcome expectancy beliefs) and who also have confidence in their own teaching abilities (self efficacy beliefs) should persist longer, provide a great academic focus in the classroom and exhibit different types of feedback than teachers who have lower expectations concerning their ability to influence student learning (Gibson & Dembo, 1984, p.570).

2.3 Two Dimensional Structure of Teacher Efficacy

In recent years educational researchers have defined teachers' perceived sense of efficacy in teaching and learning situations as a powerful variable in studies of instructional effectiveness. The Rand Corporation's Change Agent Study (1977), (as cited in Guskey & Passaro, 1994) found teacher efficacy to be the most powerful variable in predicting program implementation success. Based on Bandura's construct, Ashton and Webb (1986) were among the first researchers to develop a multi-dimensional model of teacher efficacy for assessing two dimensions of teacher efficacy. Following Ashton and Webb's work, in attempt to further development of teacher efficacy belief instrument, beginning with teacher interviews and analyses of

previous studies of teachers reported to have a strong sense of efficacy, Gibson and Dembo (1984) developed a 30-item measure of teacher efficacy scale to measure two dimensions of teacher efficacy which they called those dimensions as personal teaching efficacy reflecting self-efficacy, and another dimension was called general teaching efficacy reflecting outcome expectancy.

In years, teacher efficacy scale of Gibson and Dembo (1984) became the most used measure of teachers' efficacy beliefs (Wheatley, 2005). Although this scale is commonly used, there were some concerns regarding to Gibson and Dembo's (1984) teacher efficacy scale and their interpretation of the two-factor structure (Siwatu, 2007). Woolfolk and Hoy (1990) argued that the general teaching efficacy factor is not congruent with Bandura's description of the construct of outcome expectations. According to Woolfolk and Hoy (1990), the general teaching efficacy factor reveals that it concerns the perceptions that teachers in general can overcome external factors that may influence student learning outcomes. Bandura (1977), however, contends that outcome expectations are individual judgments about the potential outcomes of their behaviors.

2.4 Self-efficacy, Outcome Expectancy and Teachers

The study of teacher efficacy is significant topic for educators over the past two decades since it strongly influences the behaviors of teachers and students (Cheung, 2006).

For researchers, the important question is how self-efficacy and outcome expectancy beliefs are related to teaching performance (Bleicher & Lidgren, 2005). Ashton and Webb (1986) (as cited in Enochs, Smith & Huinker, 2000) defines personal teaching efficacy has been defined as a belief in one's ability to teach effectively and teaching outcome expectancy as the belief that effective teaching will have a positive effect on students learning. Research on efficacy of teachers suggests that behaviors such as persistence on a task, risk taking, and use of innovations are related to degrees of efficacy. When teachers have high self efficacy, their students are observed to have a high level of academic achievement, autonomy, motivation and construct belief on their own efficacy (Tschannen-Moran & Hoy, 2001).

As mentioned by Bandura, efficacy beliefs are good predictors of performance, not only for students, but also for teachers (Barkley, 2006). Tschannen-Moran and Woolfolk Hoy (2001) defined teacher efficacy as the teacher's "judgment of his or her capabilities to bring about desired outcomes of student engagement and learning, even among those students who may be difficult or unmotivated" (p. 783). Guskey and Passaro (1994) further defined teacher efficacy as 'teachers' belief or conviction that they can influence how well students learn, even those who may be difficult or unmotivated' (p. 4). In other point of view, teacher efficacy is defined as the personal responsibility that a teacher accepts for a student's learning or behavior while professional teaching efficacy is the belief that any teacher has the capability of competing with external factors (Wheatley, 2002).

Teachers with low efficacy beliefs have difficulties in teaching to the individual needs of their students. Teachers who are highly efficacious in their teaching beliefs, on the other hand, find it easier to both confront and correct educational mistakes in the classroom (Barkley, 2006). Teachers who have high efficacy are more motivated to help students in teaching and more optimistic, democratic, and humanistic in classroom. However, teachers with low self efficacy tend to give up on students' problems easily and their classroom management style is characterized as angry and authoritarian (Levy & Shechtman, 2005)

Gibson and Dembo (1984) developed a 30-item measure of teacher efficacy that was based on two-factor structure which were general teacher efficacy and personal teaching efficacy. General teaching efficacy means the teacher's belief that his or her ability for teaching is limited by external factors. Against this, personal teaching efficacy means a teacher's belief that he or she has the ability to bring about students learning (Yeh, 2006). Direct mastery experience is a strong prerequisite for the occurrence of sense of efficacy (Bandura, 1995). One way to obtain mastery experience is well guided practices in teacher training (Yeh, 1997).

2.5 Self Efficacy and Preservice Teachers

Teacher efficacy has become significant factor of teachers' professional development. The question is how to best help preservice teachers to become efficient, some researchers have suggested that guided practices should be involved into their education, while others have claimed that a greater emphasis should be placed on the nurturing of certain personal traits, especially those that involve the monitoring and development of the cognitive processes required in teaching situations (Yeh, 2006). Pre-service teachers' self efficacy has been related to their personalities (Harrison, Moore, & Ryan, 1996) and teaching practice (Clement, 1999; Kushner, 1993; Poulou & Spinthourakis, 2002; Smith, 2000). With limited research in the area of mathematics teacher efficacy of elementary preservice teachers and the importance that is given to teacher efficacy regarding instructional practices and willingness to reform, further investigation should occur in this area (Swars , 2005).

As Ross and Tschannen-Moran,Woolfolk-Hoy and Hoy study (as cited in Gordon & Debus, 2002), higher quality learning in a preservice teacher education program would translate into improved teaching practice, and greater self confidence in the capacity to manage teaching tasks. Therefore, an increased use of deep learning approaches on behalf of the students was expected to result in improvements to teaching self-efficacy. Teacher training programs that help the development of learning approaches may be better able to produce students with the kind of problem-solving capabilities which sustain their self-efficacy in the teaching role. Ashton (1984, p.31) stated that 'A potentially powerful paradigm for teacher education can be developed on the basis of the construct of teacher efficacy', and suggested a number of modifications to teacher training programs to enhance preservice teachers' self efficacy beliefs (Gordon & Debus, 2002).

One of the most important components of teacher preparation programs and teaching practice is the teachers' sense of efficacy (Bembenutty, 2007). In this regard, Tschannen-Moran and Woolfolk (2001) stated, "teachers' sense of efficacy is an idea that neither researchers nor practitioners can afford to ignore" (p. 803).That is to say; the more sense of self efficacy can help preservice teachers sustain motivation

and engage in self-regulation, the stronger their performance in academic courses will be(Bembenutty, 2007). Thus, it is expected that preservice teachers' self efficacy beliefs would be associated with their motivational beliefs and self-regulation of learning (Bembenutty, 2007). In a study of urban preservice teachers' self-efficacy and the accuracy of assessing their own academic learning, Chen and Bembenutty (2005) (as cited in Bembenutty, 2006) found that preservice teachers who had higher self-efficacy and used time and study environment management strategies gave more effort than the teachers with lower efficacy. Preservice teachers giving more effort were also more accurate in their performance capabilities, and immediately after that they scored higher on their practice tests.

Preservice teachers' expectancies of efficacy are linked to the doubts about classroom management. Those preservice teachers with a lower degree of personal efficacy have a more pessimistic view of their students' motivation, and trust more in setting up strict behavior rules, using external rewards and applying punishments to involve the students in the task (Cruz & Arias, 2007). The study of Woolfolk and Hoy (1990), (as cited in Cruz & Arias, 2007), shows that the greater the confidence of the preservice teacher in the power of the school to achieve the influence that the family may have on the student's academic performance, and the higher the preservice teacher's ability to carry out teaching tasks successfully, the more likely the preservice teacher will consider the school as a community in which learning takes place through positive cooperation experiences between the different participants. The preservice teachers' experiences of failure with mathematics in school may have caused a lower sense of mathematics teacher efficacy. These past negative experiences led the preservice teachers to perceive that they would be effective mathematics teachers, but it would take more time, work, and effort.

Enon (1995) states that (as cited in Swars, 2005) teacher implementation of effective instructional practices has been related with teacher efficacy. Besides, teacher efficacy is an important predictor of mathematics instructional strategies. By the instructional strategies, the preservice teachers, ignoring the level of mathematics teacher efficacy, indicated the importance of motivating students to learn mathematics through the use of "real world" experiences (Swars, 2005).

Additionally, related with instructional strategies, the manipulatives use was strongly adopted by the preservice teachers with the highest degree of mathematics teacher efficacy (Swars, 2005). The NCTM (2000) stated the importance of teachers using "representations to model and interpret physical, social, and mathematical phenomena" (p. 70). The view of the preservice teachers about mathematics manipulative usage with the highest degree of mathematics teacher efficacy is adequate with the correction of mathematics presented by NCTM (Swars, 2005).

While several studies have conducted the level of self-efficacy and the characteristics of self-efficacious teachers, there is a need to assess prospective male and female teachers' beliefs about their ability to perform specific teaching competences.

2.6 Gender and Teacher Efficacy

Gender differences in students' self-efficacy judgments regarding academic tasks are often evaluated. Pajares (2002) states that gender differences are influenced by function of home, cultural, educational, and mass media. According to Phillips and Zimmerman (1990) families often underestimate their daughters' academic ability and hold lower expectations for them. In some cultures, parents also often believe that males are more successful than females in mathematics and science (Meece & Courtney, 1992). As girls enter middle and high school, since they accept mathematics and science are a masculine domain, this perception may further weaken their interest in it. For example, boys and girls are equal confidence in mathematics ability in elementary years, but, by middle school, boys begin more confident than girls (Wigfield, Eccles, & Pintrich, 1996). Besides, several studies have shown that self efficacy had turned out to be a critical predictor for female students' choice of academic courses and careers. Female students have significantly lower self efficacy than male students regarding math- related and traditionally male-dominated subjects (Betz & Hackett, 1981).

While several studies have conducted the level of self-efficacy, preservice male and female teachers' beliefs about their ability to perform specific teaching competences should be investigated (Brandon, 2000). Garrett (1977) have found that

female teachers were more successful than male teachers in teaching to teacher-controlled activities. Besides, male teachers were more successful than female teachers in teaching to the students' family socioeconomic level. Male teachers also give more importance to teaching to the academically able students. Brennan and Robison (1995) have found that there was no significant difference between male and female preservice teachers in sense of teaching efficacy, high personal teaching efficacy and low personal teaching efficacy. On the other hand, the results showed that teachers' belief in effecting student change when considering external factors is weaker in male versus female preservice teachers.

2.7 Past Studies about Teaching Efficacy

For the enhancement of teacher efficacy, in Yu-Chu Yeh' s study (2006), he suggested that positive personal traits together with guided practices should have interactive effects on teacher efficacy during training sessions. Personal traits and the mechanisms that make improvements in personal teaching efficacy need to be understood in order to maximize the effectiveness of such teacher training. Similarly, in the study of Romi and Leyser (2006), it is suggested that during the training program for preservice teachers, self efficacy beliefs should be evaluated and explored. Although beliefs change very hardly, empirical studies provide evidence that training programs during the initial preparation stage are effective in the development and enhancement of preservice teacher beliefs. In such programs, experienced and successful teachers are expected to present and demonstrate effective instructional and behavior management strategies in their lessons and provide many opportunities for successful learning experiences. During field experience, preservice teachers have opportunities to observe those teachers and learn effective teaching strategies, while being provided with constructive and positive feedback by their university supervisors and cooperating teachers.

It is found that there is a high correlation between the preservice teachers' motivational beliefs, willingness to gratification; their self regulated learning strategies and their self efficacy beliefs (Bembenutty, 2007). These findings supported that the preservice teachers who have higher teaching efficacy reported a

high academic interest, task value, and control of time and study environment. Similarly, preservice teachers who have higher self efficacy beliefs that they could motivate and communicate with their students also reported that greater preference to stay task-focused, preferred to avoid having fun with friends when assignments are not completed, and selected to control their social and physical environment. In addition, preservice teachers with higher efficacy also selected ways to approach learning, particularly, their use of metacognitive strategies, which includes effective planning, self-monitoring, and self-evaluating of their academic progress (Bembenutty, 2007).

In a study conducted by Palmer (2006), it was found that preservice teachers' self efficacy was increased by participation in a science methods course, and this was reinforced by having the opportunity to each science in a practicum. In addition, the changes in self-efficacy were not short-lived - the majority of students obtained higher science teaching self-efficacy for 8-11 months, when they completed their other university courses in the absence of any further science-related studies. There have been two important implications for primary teacher education program. First, well designed method courses should be organized supported by practicum experiences till the end of the teacher education program. If the method course is arranged one year before the end of their university studies, then probably most students would be graduating and entering their professional life with higher teaching efficacy. Second, the results offered that a practicum placement should be timed to occur fairly soon after the end of the science methods course. During this practicum, students should be allowed to teach science to primary children, and this should have the effect of firming the positive effects of the methods course (Palmer, 2006).

2.8 Summary of the Review of Related Literature

There has been much written on the subjects of the manipulatives, self efficacy and teacher efficacy separately. The studies pointed out that manipulatives are the materials that are helpful in representing abstract mathematical ideas as

concrete. They are very effective materials in students' learning, understanding and motivation if they are used properly.

Self efficacy is the belief of an individual that he or she is capable of doing a given task. There are four main sources of information that can change self-efficacy; mastery experiences, vicarious experiences, social persuasion, and physiological states. Teaching efficacy is the teachers' beliefs that how well they are to teach their students. Literature points out that pre-service teachers' self efficacy is related to their personal theories and teaching practice. In literature there are many studies about preservice teachers' efficacy but there is limited study about preservice teachers' efficacy about using manipulatives. This study determines the preservice teachers' efficacy about using manipulatives.

CHAPTER 3

METHODOLOGY

This study aimed to investigate preservice mathematics teachers' efficacy beliefs of manipulative use in teaching mathematics. The research design and procedures are mentioned in this chapter that consists of five parts. The first part explains research design and variables of the study, the second part explains participants, the third part explains instruments, the fourth part explains procedures of the study, and the fifth part explains data analysis.

3.1 Research Design

This study was causal-comparative study collect information about preservice elementary mathematics teachers' efficacy beliefs about manipulative use by an instrument which was prepared by the researcher. Causal-comparative study which is sometimes type of descriptive study since it describes conditions that already exist and also it describes reasons or causes for the existing condition (Gay & Airasian, 2000).

The sample of the present study consisted of 77 senior elementary mathematics teacher candidates studying at 2 different universities in two different cities located in Turkey. Participants were administered a Likert type questionnaire '*The Instrument of Preservice Mathematics Teachers' Efficacy Beliefs about Using Manipulatives*'(EBMU) adopted from Mathematics Teaching Efficacy Beliefs Instrument (MTEBI), that was prepared by Enochs, Smith and Huinker (2000). In the spring semester of 2007, the questionnaire was administered to both universities and the results were analyzed with SPSS software program.

This study had two dependent variables and three independent variables. The dependent variables were the items of EBMU with two dimensions; the independent variables were the university attended and gender.

Dependent Variables: EBMU had two dimensions that were; (1) personal manipulative efficacy beliefs and (2) manipulative use outcome expectancies. Preservice teachers' scores on each of these scales were considered as dependent variables. Scores were ranged from 1 to 5.

Independent Variables: The independent variables were (1) university attended (a categorical variable with two categories), (2) gender

A summary of the research design is shown in the Table 3.1.

Table 3.1 Summary of Research Design

Research Design	Causal- Comparative Study
Sampling	Convenience Sampling (Convenience in access)
Variables	*Dependent variables:* The scores on the subscales of EBMU (personal efficacy and outcome expectancy scores) *Independent Variables:* University, gender
Instrument	'*The Instrument of Preservice Mathematics Teachers' Efficacy Beliefs about Using Manipulatives*' (EBMU) adopted from MTEBI.
Data Collection Procedure	Administration of survey to 77 preservice elementary mathematics teachers from 2 universities.
Data Analysis Procedure	Descriptive Statistics and ANOVA

3.2 Participants

The target population of the present study was all senior preservice teachers studying in Elementary Mathematics Teacher Education programs in Turkey. There are 23 universities offering this program in Turkey. 2 universities among these 23 universities were chosen. The universities were selected on the basis of convenience of access. Since the sampling procedure is not based on random selection from the targeted population, the findings of this study was limited to the selected universities.

At first, this study applied to senior preservice elementary mathematics teachers who are studying at University A in İzmir. In University A, the education language is Turkish. Then, it was applied to senior preservice elementary mathematics teachers who are studying at University B in Ankara whose education language is English. Therefore, the sample of the present study consists of 90 senior preservice elementary mathematics teachers studying at Elementary Mathematics Teacher Education programs at 2 different universities located in İzmir and Ankara.

Table 3.2 shows the number of senior preservice elementary mathematics teachers based on the university they attend. There were totally 120 senior preservice elementary mathematics teachers in those 2 universities. From University A among 80 senior preservice elementary mathematics teachers 42 preservice teachers participated. From University B among 40 senior preservice elementary mathematics teachers 35 preservice teachers participated.

Table 3.2 Number of Senior Preservice Elementary Mathematics Teachers

University	Number of Preservice Teachers	Number of Participants	Percentage of Participants
University A	80	42	52
University B	40	35	86
Total	120	77	64

Since the study was applied in spring semester, and senior preservice teachers were in mood of graduating, and started to study for KPSS examination, many of them were not attending their courses. Because of this reason, the participation hardly reached to %64. All of the preservice elementary mathematics teachers were selected from 4th year students so that they have enough subject area and pedagogy background. Table 3.3 shows the gender and university distributions of the participants. Among 77 preservice teachers 55 were female and 22 were male.

Table 3.3 Gender and University Distributions of the Participants

	Female		Male		Total	
University	N	%	n	%	N	%
University A	31	73.8	11	26.2	42	54.5
University B	24	68.5	11	31.5	35	45.5
Total	55	71.4	22	28.6	77	100

3.3 Instruments

For collecting data for this study a survey were used, which consisted of three parts; (1) Demographic Information; (2) knowledge about the manipulatives; (3) '*The Instrument of Preservice Mathematics Teachers' Efficacy Beliefs about Using Manipulatives*'(EBMU). In the demographic information part, there were some statements asking their university, grade level, age and gender. In the second part of the questionnaire, there were two questions, one to ask their knowledge about 14 manipulative materials which were chosen from the Ministry of National Education's elementary mathematics curriculum document for grades 1 to 5 and a question whether they had used these materials before. The participants were informed that if

their answer was ‘yes’ to a given question, mark the space as X, if their answer is ‘no’, do not mark the space (Appendix, B).

The third part of the instrument included EBMU items. EBMU was adopted from the Mathematics Teaching Efficacy Beliefs Instrument (MTEBI) that was constructed by Enochs, Smith and Huinker (2000). MTEBI included two dimensions, which was based on Bandura’s (1995) theory of self-efficacy. These dimensions were personal mathematics teaching efficacy and mathematics teaching outcome expectancies. Since the current study taking MTEBI as a base in developing an instrument for manipulative use efficacy beliefs, the developed instrument used similar dimensions; that were personal efficacy beliefs about manipulative use (PEMU) and outcome expectancies regarding manipulative (OEMU) use. The distribution of the items into these two dimensions is given in Table 3.4.

Table 3.4 The Distributions of the Survey Questions

The Items about Personal Manipulative Use Teaching Efficacy	The Items about Manipulative Use Outcome Expectancies
1, 2, 3, 5, 6, 7, 12, 15, 16	4, 8, 9, 10, 11, 13, 14

In EBMU, there were twenty four items concerning their efficacy beliefs and outcome expectancies about the use of manipulatives. These items were asked in a 5 point Likert type to get information about the preservice teachers’ efficacy beliefs and their outcome expectancies. In the questionnaire there were negatively stated items. These items were reversed while scoring. Participants informed to state their agreements and disagreements about the items on a five-point Likert scale ranging from 1 to 5; 1 indicating ‘strongly disagree’; 2 indicating ‘disagree’; 3 indicating ‘neutral’; 4 indicating ‘agree’; and 5 indicating ‘strongly agree’. In calculating the scores the responses were labeled a numeric value from 1 to 5 with 1 is least

favorable and 5 with most favorable. Two different scores were calculated regarding PEMU and OEMU. Maximum possible score for each scale was 5, and minimum possible score was 1.

In order to estimate internal consistency reliability by determining how all items were related to the other items and to the total test, Cronbach alpha (α) coefficient was used (Gay & Airasian, 2000). In the present study the alpha reliability was found to be 0.81 for PEMU and 0.79 for OEMU which were considered reasonable values for this study.

To ensure the validity of EBMU first the items were adopted from previously developed teacher efficacy instrument, which partly ensures the items to be parallel with the existing theory about the construct. In addition, a faculty member of mathematics education at Middle East Technical University reviewed the items in terms of their relevance to the construct being investigated.

3.4 Procedures

The final draft of the survey was administered to 77 senior elementary mathematics education preservice teachers studying and University A and University B. In order to administer the survey, the permission of the related instructors was taken. The students were informed about the purpose of the study, and it was declared that all the respondents' answers would be kept confidential and only used for this study. At both universities, administration took 15 minutes at the beginning of their course.

3.5 Data analysis

In this study the SPSS software program was used in order to analyze the results. First, the data was analyzed by descriptive statistics. Second, while looking at the gender differences and the effects of university attended to the efficacy scores of preservice teachers, Analysis of Variance was used. To analyze preservice teachers' familiarity with manipulatives, frequencies of each related item was found.

CHAPTER 4

RESULTS

This chapter is about the results obtained from the data analysis. In the first part the demographic information of the participants were described by descriptive statistics. Then, each research question's findings and results were interpreted which were found by descriptive statistics and ANOVA.

4.1 Results of Demographic Information

The demographic information of the participants was their university, gender, and grade. The frequencies and the percentages were summarized in the Table 4.1 and Table 4.2 and Table 4.3. Since all the participants were senior, there was no need for listing their grade level. 42 preservice elementary mathematics teachers were participated from university A, 35 preservice teachers were participated from university B. Among those participants 22 were male, 55 were female. Their ages were between 20 and 25. 2 participants' age were 20, 22 participants' age were 21, 19 participants' age were 22, 24 participants' age were 23, 9 participants' age were 24, 1 participant's age was 25.

Table 4.1 Participants' Demographic Data (University)

University	Frequency	Percentage
University A	42	0.56
University B	35	0.44
Total	77	100

Table 4.2 Participants' Demographic Data (Gender)

Gender	Frequency	Percentage
Male	22	28.6
Female	55	71.4
Total	77	100

Table 4.3 Participants' Demographic Data (Age)

Age	Frequency	Percentage
20	2	2.6
21	22	28.6
22	19	24.7
23	24	31.2
24	9	11.7
25	1	1.3
Total	77	100

4.2 Results of the Research Questions

4.2.1 The pre-service elementary mathematics teachers' familiarity with manipulatives and the kind of manipulative materials they used in university A and university B

In the first research question, the pre-service elementary mathematics teachers' familiarity with manipulatives and the kind of manipulatives they used at university A and university B were investigated (Appendix C). In order to analyze this question, descriptive statistics was used. Each university's frequencies were examined. Table 4.4 and 4.5 shows frequency tables about knowing and using manipulative materials in university A and university B. In university A, 34 participants have knowledge about cubes which were most known materials; 28 participants used are geometrical objects (solids) which were most used materials in university A. In contrast, the least known material is hundreds table; that is 10 participants have knowledge about hundreds table, the least used materials are hundreds card and hundreds table that is only 1 participant used about hundreds card and hundreds table. Besides, the rate of the frequencies of both knowing and using were very low in university A. However, almost all of the participants from university B knew given manipulative materials but less number of participants were indicated that they used them. All of the participants from university B knew based ten blocks, cubes, geoboard, fraction bars, geometric shapes and grid paper and the least known material in university B is geometry strips that is 20 participants knew geometry strips. In addition, all of the participants from university B used grid papers; 10 participants used geometry strips which were the least used material in university B.

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Table 4.4 Frequency Table about Familiarity and Usage of Manipulative Materials in University A

	Total Participants from University A	Frequency of Familiarity	Frequency of Usage
Based ten blocks	42	15 (36%)	3 (7%)
Cubes	42	34 (81%)	21 (50%)
Geoboard	42	28 (66 %)	11 (26 %)
Pattern blocks	42	26 (62 %)	11 (26 %)
Symmetry mirror	42	20 (48 %)	4 (10 %)
Tangram	42	28 (66 %)	13 (31 %)
Fraction bars	42	15 (36 %)	5 (12 %)
Geometry strips	42	15 (36 %)	4 (10 %)
Tens card	42	11 (26 %)	2 (5 %)
Geometric objects	42	28 (66 %)	22 (52 %)
Isometric grid	42	24 (57 %)	11 (26 %)
Grid paper	42	33 (79 %)	19 (45 %)
Hundreds card	42	12 (29 %)	1 (2 %)
Hundreds table	42	10 (%)	1 (2 %)

Table 4.5 Frequency Table about Familiarity and Usage Manipulative Materials in University B

	Total Participants from University B	Frequency of Familiarity	Frequency of Usage
Based ten blocks	35	35 (100%)	26 (74%)
Cubes	35	35 (100 %)	30 (86 %)
Geoboard	35	35 (100 %)	30 (86 %)
Pattern blocks	35	30(86 %)	23 (66 %)
Symmetry mirror	35	34 (97 %)	20 (57 %)
Tangram	35	34 (97 %)	29 (83 %)
Fraction bars	35	35 (100 %)	29 (83 %)
Geometry strips	35	20 (57 %)	10 (29 %)
Tens card	35	30 (86 %)	21 (60 %)
Geometric objects	35	35 (100 %)	31 (89 %)
Isometric grid	35	32 (91 %)	25 (71 %)
Grid paper	35	35 (100 %)	32 (91 %)
Hundreds card	35	28 (80 %)	18 (51 %)
Hundreds table	35	27 (77 %)	16 (46 %)

4.2.2 The pre-service female and male mathematics teachers' familiarity with manipulatives and the kinds of manipulative materials they used.

In this research question, pre-service male and female mathematics teachers' familiarity with manipulatives and what kind of manipulative materials female and male students used were analyzed. Table 4.6 and 4.7 shows frequency tables of males and females about knowing and using manipulative materials. 51 females

among 55 ones have knowledge about cubes which were the most known materials for females. The least known materials among females were geometry strips, that are 24 females have knowledge about geometry strips. The most used materials for females were geometric objects, that is 38 females used geometric objects, however the least used ones were geometry strips and hundreds table, that is only 11 females used them before. Besides, 18 males among 22 were indicated that they were familiar with cubes, geometric objects and grid paper which were the most known materials for males. The least known materials among males was hundreds table that is 8 males had knowledge about hundreds table. The most used materials for males were cubes, that are 17 males used cubes before, however the least used ones are geometry strips, that is only 3 males used them before.

Table 4.6 Frequency Table of Female Participants about their Familiarity and Usage of Manipulative Materials

	Total Female Participants	Frequency of Familiarity	Frequency of Using
Based ten blocks	55	37 (67%)	20 (36%)
Cubes	55	51 (93 %)	34 (62 %)
Geoboard	55	48 (87 %)	30 (55 %)
Pattern blocks	55	41 (75 %)	23 (42 %)
Symmetry mirror	55	41 (75 %)	18 (33 %)
Tangram	55	44 (80 %)	30 (55 %)
Fraction bars	55	38 (70 %)	23 (42 %)
Geometry strips	55	24 (44 %)	11 (20 %)
Tens card	55	39 (71 %)	14 (25 %)
Geometric objects	55	45 (82 %)	38 (69 %)
Isometric grid	55	44 (80 %)	27 (49 %)
Grid paper	55	50 (90 %)	35 (64 %)
Hundreds card	55	31 (56 %)	12 (22 %)
Hundreds table	55	29 (53 %)	11 (20 %)

Table 4.7 Frequency Table of Male Participants about their familiarity and usage of Manipulative Materials

	Total Male Participants	Frequency of Knowing	Frequency of Using
Based ten blocks	22	13 (59%)	9 (41%)
Cubes	22	18 (82 %)	17 (77 %)
Geoboard	22	15 (68 %)	11 (50 %)
Pattern blocks	22	15 (68 %)	11 (50 %)
Symmetry mirror	22	13 (59 %)	6 (27 %)
Tangram	22	18 (82 %)	12 (55 %)
Fraction bars	22	12 (55 %)	11 (50 %)
Geometry strips	22	11 (50 %)	3 (14 %)
Tens card	22	12 (55 %)	9 (41 %)
Geometric objects	22	18 (82 %)	15 (68 %)
Isometric grid	22	12 (55 %)	9 (41 %)
Grid paper	22	18 (82 %)	16 (73 %)
Hundreds card	22	9 (41 %)	7 (32 %)
Hundreds table	22	8 (36 %)	6 (27 %)

4.2.3 Personal Manipulative Use Teaching Efficacy Scores Based on University Attended and Gender

To find out the effects of gender and university attended on the efficacy scores of preservice teachers, Analysis of Variance (ANOVA))was run. Before, running the ANOVA, assumptions were checked.

4.2.3.1 Assumptions of ANOVA

There were three assumptions for ANOVA for hypothesis testing;

1. ‘The observations within each sample must be independent’

2. ‘The populations from which samples are selected must be normal’

3. ‘The populations from which the samples are selected must be equal variances’ (Gravetter & Wallnau, 2003, p.484).

The normality of the each university and gender were analyzed. And the results show that they could be considered as normally distributed. According to Levene’s Test of Equality of Variance at the significance level of 0.05, in general, homogeneity of variance was not violated in this study.

There were two independent variables (university attended and gender) and one independent variable (personal manipulative use teaching efficacy). Two way analysis of variance (ANOVA) was used to analyze the effects of university attended and gender on the preservice elementary mathematics teachers’ personal manipulative use teaching efficacy beliefs about using manipulatives.

Mean scores and standard deviation of participants’ personal manipulative use teaching efficacy beliefs with respect to university and gender are summarized in Table 4.8. It was observed that the mean scores for universities ranged from 3.66 to 4.17, indicating there is possible effect of universities attended on participants’ personal manipulative use teaching efficacy. However, the mean scores of males and females ranged from 3.81 to 3.91, demonstrating there is a small mean difference between males and females. In order to check whether these mean differences are statistically significant, inferential statistics were conducted.

Table 4.8 Personal manipulative use teaching efficacy Scores with respect to Gender and University

	Female			Male			Total		
	M	SD	N	M	SD	N	M	SD	N
University A	3.72	0.65	31	3.46	0.56	11	3.66	0.63	42
University B	4.17	055	24	4.16	0.54	11	4.17	0.54	35
Total	3.91	0.64	55	3.81	0.64	22	3.89	0.64	77

A two way ANOVA was used at the $p<0.05$ level of significance to identify the differences based on gender and university attended regarding participants' personal manipulative use teaching efficacy beliefs. As shown in Table 4.9 the gender did not reach a statistical significance ($F(1,73)=0.81$, $p=0.37$). On the other hand, the university attended produced a statistically significant main effect on preservice teachers' personal manipulative use teaching efficacy (($F(1, 73) = 14.57$, $p=0.00$). This means that being male or female did not effect the preservice teachers' personal manipulative use teaching efficacy beliefs. However, there was a significant difference in the preservice teachers' personal manipulative use teaching efficacy beliefs scores when the participants' universities were concerned. Besides, the effect size (eta squared = 0.17) was determined to be very large in Cohen's (1988) criteria. In addition, the interaction of gender and university attended ($F(1, 73) =0.69$, $p=0.41$) did not reach a statistical significance (Table 4.9). This means that there was no interaction effect of gender and university attended to their personal manipulative use teaching efficacy beliefs.

Table 4.9 Two-way ANOVA regarding Gender and University

Source	df	F	p	Partial Eta Squared
Gender (G)	1	0.81	0.37	0.01
University (U)	1	14.57	0.00	0.17
G x U	1	0.69	0.41	0.01
Error	73			

4.2.4 Outcome Expectancies about Manipulative Use Scores Based on University Attended and Gender

Mean scores and standard deviation of participants' manipulative use outcome expectancies with respect to university and gender are summarized in Table 4.10. It was observed that the mean scores for universities ranged from 3.81 to 4.29, demonstrating there is possible effect of universities attended on participants' outcome expectancy. However, the mean scores of males and females ranged from 3.85 to 4.10, indicating there is a small mean difference between males and females.

Table 4.10 Outcome Expectancies with respect to Gender and University

	Female			Male			Total		
	M	SD	N	M	SD	N	M	SD	N
University A	3.90	0.60	31	3.57	0.37	11	3.81	0.57	42
University B	4.36	0.44	24	4.13	0.49	11	4.29	0.46	35
Total	4.10	0.58	55	3.85	0.51	22	4.03	0.57	77

In order to control whether these mean differences are statistically significant, inferential statistics were conducted. Two way ANOVA was used at the $p<0.05$ level of significance to identify the differences based on gender and university attended on participants' outcome expectancies. To analyze the differences of gender and university attended to the participants' outcome expectancies, two-way ANOVA was conducted. Table 4.11 demonstrates the results.

Table 4.11 Two-way ANOVA regarding Gender and University

Source	df	F	P	Partial Eta Squared
Gender (G)	1	4.69	0.03	0.06
University (U)	1	15.52	0.00	0.18
G x U	1	0.13	0.72	0.00
Error	73	(0.263)		

As shown in Table 4.11 the gender produced statistically significant main effect on preservice elementary mathematics teachers' outcome expectancies (F (1, 73) = 4.69, p=0.03). However, the actual difference in the mean scores was medium (Cohen, 1988). This is evident in the medium effect size obtained (eta squared= 0.06). This means that being male or female affected the preservice teachers' outcome expectancies about using manipulatives. In the same manner, the university attended produced a statistically significant main effect on preservice teachers' outcome expectancies (F (1, 73) = 15.52, p= 0.00). Besides, the actual difference between university differences and preservice teachers' outcome expectancy in the mean scores was very large (Cohen, 1988). This was evident in the large effect size obtained (eta squared = 0.18). In addition, there was a significant difference in the preservice teachers' outcome expectancies about using manipulatives scores when the participants' universities were concerned. Besides, the interaction of gender and university attended (F (1, 73) =0.13, p=0.72) did not reach a statistical significance (Table 4.11). This means that there was no significant difference in gender and university attended for males and females on their outcome expectancies about using manipulatives.

CHAPTER 5

CONCLUSION
&
DISCUSSION

This chapter is about the summary of the study, discussions and implications for the further research. In this study the following research questions were investigated.

1. What are the pre-service elementary mathematics teachers' familiarity with manipulatives and what manipulative materials did they use in university A and university B?
2. What are the pre-service female and male mathematics teachers' familiarity with manipulatives and what manipulative materials did female and male students used?
3. Is there a difference in efficacy scores of preservice mathematics teachers based on gender and university attended?
4. Is there a difference in outcome expectancy scores of preservice mathematics teachers based on gender and university attended?

5.1 The preservice elementary mathematics teachers' familiarity with manipulatives and the kind of manipulative materials they used in university A and university B

In this research question, descriptive statistics were used to examine the preservice elementary mathematics teachers' familiarity with manipulatives and what kind of manipulative materials they used in university A and university B. Bandura (1986) (as cited in Swars, 2005) stated that efficacy beliefs are firstly shaped as the consequence of an individual's previous performance and experiences. It was found that the familiarity of the participants from university B is more than the participants from university A. Similarly, the participants from university B used manipulatives more than the participants from university A. Participants in university A had familiarity with cubes which were most known materials. Besides, geometrical objects were most used materials in university A. In contrast, the least known material was hundreds table, and the least used materials were hundreds cards and hundreds table in university A. In addition, all of the participants from university B were familiar with based ten blocks, cubes, geoboard, fraction bars, geometric shapes and grid papers and the most used materials were grid papers, on the contrary, the least known and least used material in university B were geometry strips. Almost all of the participants from university B knew given manipulative materials, but less number of participants indicated that they used these materials.

When the courses that preservice teachers' took were considered, it was found that almost all of them had taken the Methods of Mathematics Teaching which consists of methods and teaching strategies in elementary mathematics education. Methods courses are beneficial for preservice teachers to learn how to teach mathematics in an effective way. Swars (2005) stated that preservice teachers need positive experiences within mathematics methods courses to build teaching efficacy towards mathematics teaching. However, those two universities' education language is different, that is University A's education language is Turkish; University B's education language is English. That might be occurred a difference of the results. That is to say, the participants who studied at university B might have more chance to research the resources about manipulatives both in Turkish and in English whereas

the participants who studies at university A only have a chance to research in Turkish.

5.2 The pre-service female and male mathematics teachers' familiarity with manipulatives and the kind of manipulative materials they used before.

Descriptive statistics were used to explore the gender differences of the preservice teachers' familiarity and the kind of manipulative materials they used. Cubes were the most known materials for females and the least known materials among females were geometry strips. Besides, the most used materials for females were geometric objects however the least used ones are geometry strips and hundreds table. Cubes, geometric objects and grid paper were the most known materials for males. On the contrary, the least known materials among males were hundreds table however the least used ones are geometry strips. The most used materials for males were cubes, however the least used materials were geometry strips.

Besides, it was found that female preservice teachers' familiarity were more than that of the male preservice teachers. However, male preservice teachers used manipulatives more than female preservice female teachers. It means that female preservice teachers have more familiarity with manipulatives but male preservice teachers tend to use them more. Although a significance test was not used, this result still suggest that female and male pre-service teaches may have different levels of perceptions about the use of manipulatives and knowledge about manipulatives. In this sense, teacher educators should pay careful attention to the gender differences.

5.3 Personal Manipulative Use Teaching Efficacy Based on University Attended and Gender

There were two independent variables (university attended and gender) and one independent variable (personal manipulative use teaching efficacy). Two way analysis of variance (ANOVA) was conducted to explore the differences based on university and gender regarding the preservice elementary mathematics teachers' personal manipulative use teaching efficacy beliefs about using manipulatives. It was found that the participants' gender did not produce differences on preservice

elementary mathematics teachers' personal manipulative use teaching efficacy whereas university effected their personal manipulative use teaching efficacy beliefs. This university difference might be occurred by students' general success in entering university entrance exam, which may indirectly influence preservice teachers' confidence level in academic tasks. In addition, in both universities, preservice teachers had different levels of knowledge and experience of manipulatives. In the university where the preservice teachers had used manipulatives more, they had higher efficacy beliefs about manipulative use in teaching. Such experiences may have an obvious effect. When both gender and university were considered, they did not effect personal manipulative use teaching efficacy of preservice elementary mathematics teachers' personal manipulative use teaching efficacy.

5.4 Outcome Expectancies about Manipulative Use Based on University Attended and Gender

There were two independent variables (university attended and gender) and one independent variable (manipulative use outcome expectancy). In order to explore the differences of gender and university on the preservice elementary mathematics teachers' outcome expectancies about using manipulatives, two way analysis of variance (ANOVA) was conducted. It was found that gender produced differences on the participants' manipulative use outcome expectancies, likewise, university also effected on participants' manipulative use outcome expectancies. However the interaction of gender and university did not make differences on the participants' manipulative use outcome expectancies. Similarly, differences in the rate of using manipulatives may be a major reason of such a difference. Preservice teachers who had worked with manipulatives were seemed to be more convinced about the positive outcomes of manipulative use in the classroom.

5.5 Internal and External Validity

Internal validity means the degree to which differences in dependent variable are related to only independent variable (Fraenkel & Wallen, 1996). External validity, on the other hand, means the degree to which results are generalizable to

groups and environments outside the research. Population generalizability refers to degree to which sample represents population

A research study is valid if results are due only to the manipulated independent variable and if they are generalizable to individuals or contexts beyond the experimental setting (Gay, Airasian, 2000). There are two criteria for this; internal and external validity. Internal validity is concerned with threats or factors that the independent variable affects dependent variable; external validity is concerned with the extent which the results can be generalized to groups and settings (Gay, Airasian, 2000). There are four main internal validity threats; mortality, location, instrumentation, and instrumentation decay (Fraenkel, Wallen, 1996).

Mortality is the case in which participants drop out of a study (Gay, Airasian, 2000). In the present study, the instrument was directly administered to the participants only once in a time, so there was no mortality threat. Next, location threat occurs when the collection of data is carried out in places that may affect participants' responses (Maxwell, 1996). In the present study, the 77 participants studying at two different universities located at two different cities and it was not possible to bring them all together. But, the location kept constant for the participants studying at the same university.

Instrumentation threat means unreliability or lack of consistency in measuring instruments that can result an invalid assessment of performance (Gay & Airasian, 2000). In the present study, the instrument was administered at once to the participants and there were not any changes during the administration of the instruments to the others. So, instrumentation is not a threat in this study. Another threat for internal validity is instrumentation decay is such an example "in interview surveys if the interviewers get tired or they are rushed" (Fraenkel & Wallen, 1996, p.383). In the present study, it did not take too much time that participants get rid of doing the survey, it took only 15 minutes; so, instrumentation decay is not a threat to internal validity.

The target population of the present study was all senior preservice teachers studying in Elementary Mathematics Education program in Turkey. There were 23 universities offering this program in Turkey. Although the researcher tried to apply

more universities because of time limitation, the present study administered to two different universities and the sample of this study is 77 senior preservice elementary mathematics teachers in Turkey. Therefore, it is a limitation as mentioned before and the results cannot be generalized to all pre-service elementary mathematics teachers. But, it might give a different perspective from a specific study to other universities and pre-service teachers.

5.6 Implications for Teacher Education

In mathematics education, representing abstract ideas with the concrete materials is very important. In order to make teachers use those manipulative materials in mathematics lessons, teacher education is an important place to focus on. Preservice teachers' self efficacy beliefs and their outcome expectancies about using manipulatives give clues about their tendency to use manipulatives in their further teaching life.

Ashton (1984) stated that 'A potentially powerful paradigm for teacher education program can be developed on the basis of the construct of teacher efficacy'. Teacher efficacy beliefs play an important role in obtaining and interpreting the knowledge offered in teacher training programs; these beliefs effect on the way preservice teachers organize their teaching acts than knowledge, and are stronger indicators for predicting their teaching behavior (Pajares, 1992). Bembenutty (2006) suggested instructors of the teaching programs may consider the four sources of self-efficacy information while training teachers. They could facilitate enactive learning by engaging teachers in authentic mastery experience. Also, instructors could serve as model that teachers could observe and have therefore a vicarious learning experience.

Providing the preservice teachers to use more manipulative materials in their university life, they are keener on using the manipulative materials and this would be a habit for them in their further teaching life. Besides, this also provides to reach targets in our education system such as giving more applied mathematics lessons to the students. So, enabling opportunities about learning to the preservice teachers in their universities would effect them positively in their further teaching life.

In order to educate teachers to be well informed about using manipulatives, more courses that utilize manipulative materials must be offered in the teacher education programs. Preservice teachers should be provided to use the manipulative materials while they are learning those materials theoretically.

This study indicates that gender difference is not seem to be a critical issue for personal manipulative use teaching efficacy and manipulative use outcome expectancy but university difference is very important for personal manipulative use teaching efficacy and manipulative use outcome expectancy. Therefore, universities should work to minimize the differences among teacher education programs.

5.7 Recommendations for Further Research

The results indicating that participants in University B have more familiarity with manipulatives than the participants in University A. Future research should investigate specific causes of this difference to obtain more in-depth information. Such information will be helpful in minimizing the differences among the teacher education programs.

In the present study, the data were only gathered with questionnaire items with attendance of two universities. A further research might be carried out with more detailed way such as obtaining data from more universities, making interviews with preservice elementary mathematics teachers.

Also, different version of this study can be applied to the in-service teachers in order to evaluate their personal manipulative use teaching efficacy and manipulative use outcome expectancy.

Another research should be carried out the differences between studying with students' native language and studying with foreign language in the universities. The advantages and disadvantages of studying with native language or foreign language may also be studied in the future.

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APPENDICES

APPENDIX A

THE DEFINITIONS OF MANIPULATIVE MATERIALS

Based- ten blocks are made up of plastic or wood that represent digits such as one, tens, et.

Cubes are in ¾ inch sized cubes that connect on every side.

Geoboard can be 10*10 square arrays of pins that provide students calculate the areas, perimeters, etc of geometrical shapes.

Pattern blocks have six shapes in different colors, square in orange color, triangle in green, rhombus in ton and blues, hexagon in yellow, trapezoid in red. They are used to teach fractions.

Symmetry mirror is a kind of mirror that is used to teach symmetry.

Tangram is a Chinese puzzle that has five triangles, one parallelogram and one square.

Fraction bars are transparent and colored fraction models that are made up of acetate.

Geometry Strips are used to construct geometrical shapes; they are used as a skeleton of the constructed shapes.

Tens card is the chart which is divided into 10 portative squares, used to help students visually see how many "ten" is.

Geometric objects are objects which are prisms, pyramids, etc.

Isometric grid; there are 3 types of lines: vertical lines, 30° lines to the right, and 30° lines to the left, it is used to draw objects easily.

Grid paper; there are a lot of kinds of grid papers such as 1 centimeter grid paper, 10000 squared grid paper, etc., it is used to drawing patterns.

Hundreds card is the chart which is divided into 100 portative squares, used to help students visually see how many "hundred" is.

Hundreds table is the chart which is divided into 100 squares numbering from 1 to 100.

APPENDIX B

THE INSTRUMENT (TURKISH)

Bu anket matematik öğretmen adaylarının somut materyaller ile ilgili düşünceleri ve materyal kullanımları hakkında olup Orta Doğu Teknik Üniversitesi Ortaöğretim Fen ve Matematik Eğitimi yüksek lisans tezi araştırması için hazırlanmıştır.

Öğrenim gördüğünüz Üniversite:

Sınıf:

Yaş:

Cinsiyet:

Somut Materyal Kullanımına Yönelik Düşünceler

Aşağıda somut materyaller ile ilgili bazı sorular verilmiştir. Yanıtınız 'EVET' ise ilgili boşluğa 'X' işareti koyunuz, 'HAYIR' ise boş bırakınız.

	Somut araç hakkında bilginiz var mı?	Bu somut aracı kullandınız mı?
Onluk taban blokları	( )	( )
Küpler	( )	( )
Geometri tahtası	( )	( )
Örüntü blokları	( )	( )
Simetri Aynası	( )	( )
Tangram	( )	( )
Kesir takımı	( )	( )
Geometri Şeritleri	( )	( )
Onluk kart	( )	( )
Geometrik cisimler	( )	( )
İzometrik kağıt	( )	( )
Noktalı kağıt	( )	( )
Yüzlük kart	( )	( )
Yüzlük tablo	( )	( )

Aşağıda somut materyal kullanımına yönelik farklı fikirler bulunmaktadır. Belirtilen ifadelere ne derecede katıldığınızı yada katılmadığınızı ilgili seçeneği işaretleyerek belirtiniz.

1 =Kesinlikle Katılıyorum
2 =Katılıyorum
3 =Kararsızım
4 = Katılmıyorum
5 = Kesinlikle Katılmıyorum

	Kesinlikle katılmıyorum ←				Kesinlikle katılıyorum →
1. Somut materyallerle ders işlerken sınıfı kontrol edemeyeceğimi düşünüyorum.	(1)	(2)	(3)	(4)	(5)
2. Eğer somut materyal kullanarak işlediğim dersler amacına ulaşmazsa nedenini kendimde ararım.	(1)	(2)	(3)	(4)	(5)
3. Matematik öğretiminde somut materyal kullanımı ile ilgili bilgiye yeterince sahip değilim.	(1)	(2)	(3)	(4)	(5)
5. Dersi somut materyallerle işlemek için gerekli becerilere sahip olacağımı düşünüyorum.	(1)	(2)	(3)	(4)	(5)
6. Somut materyaller hakkında öğrencilerin sorularını cevaplayabileceğimi düşünüyorum.	(1)	(2)	(3)	(4)	(5)
7. Somut materyalleri ders içinde etkili biçimde kullanabileceğimi düşünüyorum.	(1)	(2)	(3)	(4)	(5)
8. Somut materyal kullanımı öğrencilerin kafasını karıştıracaktır.	(1)	(2)	(3)	(4)	(5)
9. Matematik öğretiminde materyal kullanımı öğrencinin başarısına büyük ölçüde yardımcı olur.	(1)	(2)	(3)	(4)	(5)

10. Eğer bir öğrenci matematik dersinde daha başarılı ise bunun nedeni büyük olasılıkla o dersin somut materyallerle işlenmesidir.	(1)	(2)	(3)	(4)	(5)
11. Öğrencilerin matematik bilgilerindeki yetersizliklerin üstesinden somut materyal kullanımı ile gelinebilir.	(1)	(2)	(3)	(4)	(5)
12. Derste somut materyallerin nasıl kullanılacağını öğrencilere anlatmakta zorluk çekeceğim.	(1)	(2)	(3)	(4)	(5)
13. Derslerin zengin somut materyal ile desteklenmesi öğrencinin başarısını doğrudan etkiler.	(1)	(2)	(3)	(4)	(5)
14. Matematikte somut materyal kullanmak zaman kaybıdır	(1)	(2)	(3)	(4)	(5)
15. Dersi somut materyal kullanarak işlemede yeterli olacağımı düşünüyorum.	(1)	(2)	(3)	(4)	(5)
16. Kendim de materyal geliştirebileceğimi düşünüyorum.	(1)	(2)	(3)	(4)	(5)

APPENDIX C

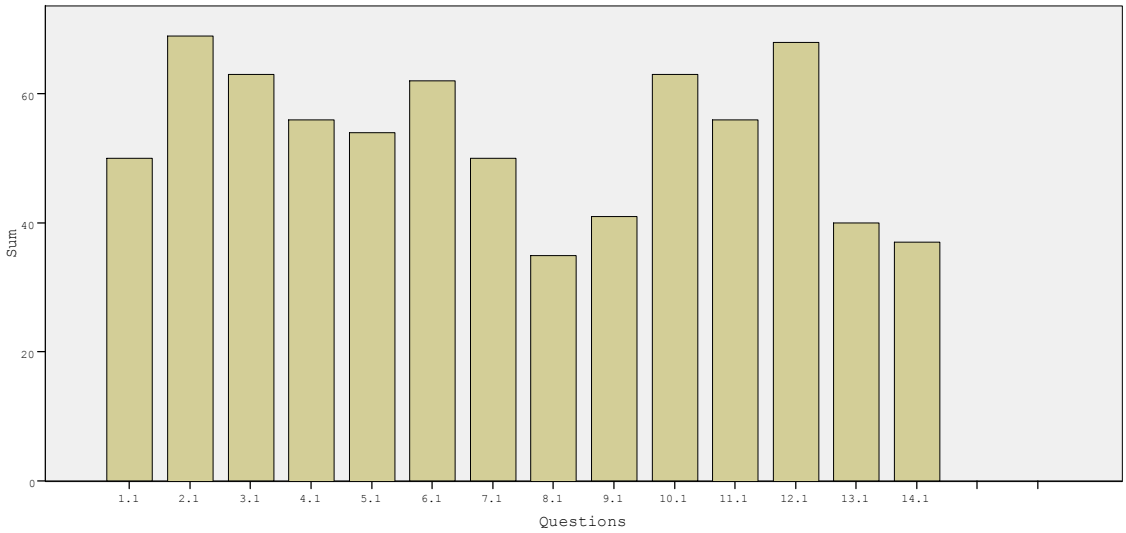

Fig. 1 The Number of Participants that Mark X to the space about Perceived Knowledge about Manipulative Materials

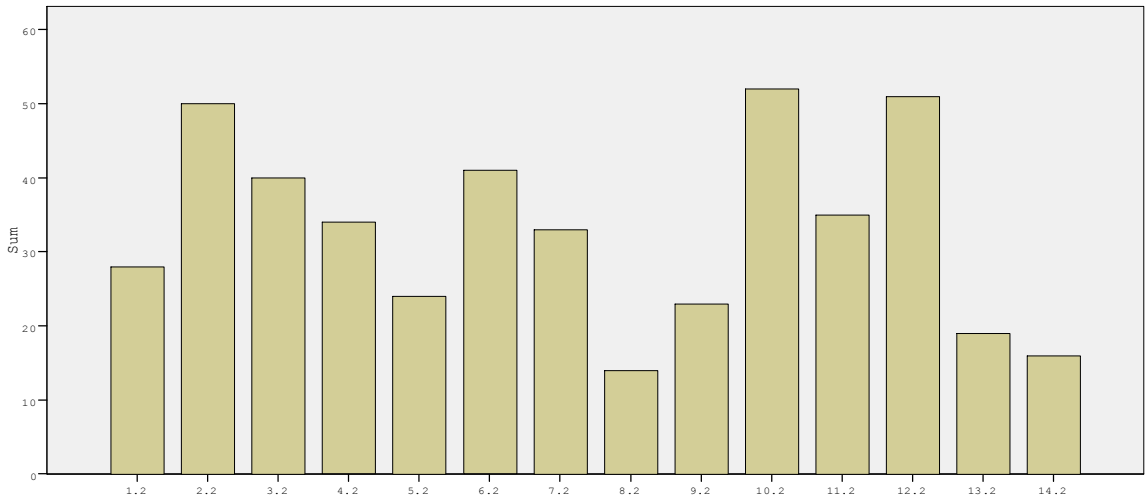

Fig. 2 The Number of Participants that Mark X to the Space about Whether They Used Manipulative Materials