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Pre-Service Classroom Teachers' Opinions on Using Different Manipulatives in Mathematics Teaching

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Abstract

In the study, pre-service teachers' opinions on the usage of virtual and physical manipulatives in mathematics teaching have been designated. In this context, questionnaires and interviews have been carried out with the students from the Department of Classroom Teaching in Kafkas University. From the acquired findings, pre-service teachers generally preferred to use virtual manipulatives, but they have stated that using physical manipulatives will be advantageous for 1st and 3rd grade students. In addition, it has appeared that pre-service teachers preferred virtual manipulatives to physical manipulatives owing to the reasons such as including extra activities, providing saving of time, feedback and movement independence, presenting activeness for students and constructing the information by itself, being enjoyable, decreasing the possibility of making mistakes and ensuring exploring and interrogation.

Key Words: Interactive electronic textbook, prospective mathematics teachers, blended learning model, affective learning

1. Introduction

Manipulatives are defined as "*objects that appeal to several senses and that can be touched, moved about, rearranged, and otherwise handled by children*" (Kennedy, 1986, p. 6). These are one way of making mathematics learning more meaningful to students (Stein & Bovalino, 2001), as "*they are materials designed to represent explicitly and concretely mathematical ideas that are abstract*" (Moyer, 2001, p. 176). Similarly, Gagnon and Maccini (2001) described manipulatives as objects that students physically manipulate to represent mathematical concepts and relationships. Indeed, Moyer (2001) and

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Moyer&Jones (2004) have emphasized the unique power of both virtual and physical manipulatives, in supporting learner understanding.

Physical manipulatives are a fundamental tool for teaching mathematics that is supported by many researches (Marzano 1998; Sowell 1989). McNeil and Jarvin (2007) described physical manipulatives as concrete objects which students use to explore mathematical concepts through the students visual and tactile senses. According to NCTM (2000), physical manipulatives that include an array of items such as tangrams, numbercubes, 3-D models, etc. are objects to be handled and arranged by students and eacherst hat are used to transmit abstract ideas or concepts by modeling or representing their ideas concretely. Also, Clement (1999) argues that physical manipulatives help students in building, reinforcement and connecting various representations of mathematical ideas that are meaningful to the leaner, promote control and flexibility to the learner. Thompson and Lambdin (1994) considered concrete materials appropriate for two purposes: (1) enabling teachers and students to have discourse about something concrete—discussing how tothink about materials and the meanings of various actions with them; and (2) providing something upon which students can act.

In recent years, computer technologies (Java and Flash applets) have ensured a method for creating and spreading a new type of web-based manipulatives, known as virtual manipulatives. Virtual manipulatives are hands-on materials that are presented as interactive tools that students interact with in a virtual environment and click and drag to move the materials into desired locations. Also, virtual manipulatives are often dynamic visual/pictorial replicas of physical manipulatives. Moyer, Bolyard, and Spikell (2002*;* p. 373) described them: "*A virtual manipulative is best defined as an interactive, Web-based visua l representation of a dynamic object that present support unities for constructing mathematical knowledge. Currently, virtual manipulatives are modeled on the concrete manipulatives commonly used in schools. ... However, their ability to be used interactively—that is, to allow the user to engage and control the physical actions of these objects—combined with the opportunities that they offer to discover and construct mathematical principles and relationships, distinguishes them as virtual manipulatives".*

Many studies have documented the perceived benefits of virtual manipulatives. One ofthe most important of these benefits is their availability online (Clements & McMillen 1996; Heath 2002; Moyer & Bolyard 2002). Moyer et al (2002) point out that, "*... the advantage of many emergent virtual manipulatives is that they are on the web, thereby allowing free access for schools that are online and constant availability for busy teachers and students who have limited time to get these sites during class*" (p. 375). Furthermore, virtual manipulatives are talented of doing things that are simply not possible with physical manipulatives, pencil and paper, or other tools (Clements & McMillen 1996; Crawford & Brown 2003; Forster 2006; Clements, 2002; Reimer & Moyer 2005). Further, because virtual manipulatives provide students with instantaneous, corrective feedback, this ability makes virtual manipulatives well-suited to inquiry-based learning and problem solving (Clements & McMillen 1996; Crawford & Brown 2003; Durmus & Karakirik 2006; Reimer

& Moyer 2005; Suh & Moyer 2005; 2007). Different pedagogical benefits of virtual manipulatives have the ability to provide multiple representations of a single concept at the same time (Clements & McMillen 1996; Heath 2002; Moyer & Bolyard 2002; Suh & Moyer 2005; 2007). Reimer & Moyer (2005) contended that this ability supplies an advantage over physical manipulatives, "*Unlike physical manipulatives, electronic tools use graphics, numbers, and words on the computer screen to connect the iconic with the symbolic mode*" (p. 7). However, teacher perceptions of manipulative value have been reported in different educational studies. Of times, both virtual and physical manipulatives are viewed as play objects, suitable only for children and, thus, have no validity for application in higher-level mathematics (Tooke, Hyatt, Leigh, Snyder & Borda, 1992). In addition, some teachers use manipulatives as rewards for appropriate student behavior. "*Teachers who view manipulatives as time wasting or secondary to the serious work of learning mathematics will inadvertently encourage their students to use these materials for play, rather than for mathematical learning or understanding*" (Moyer & Jones, 2004, p. 29).

One of the main objectives of new Primary School Mathematic Curriculum started to be applied in Turkey in 2005 is to enable students to explain the meaning of mathematic concepts from real and concrete experiences. With this aim, especially at first part in elementary education, teachers and students are encouraged to use concrete material (such as physical manipulative). Students at early ages learn more meaningfully in environments where information is represented with concrete models. In subjects where abstract concepts and relations are discussed such as mathematics, it is very beneficial to use manipulative to concretize the concepts and relations. Even though it is predicted that using different manipulatives support learning, studies this area does not provide clear and consistent results (Fuson & Briars, 1990; Raphael & Wahlstrom, 1989; Sowell, 1989). The researches state that the principal cause of this condition stems from using type of different manipulatives in lessons and especially the knowledge, beliefs andexperience of teachers are important factors (Ozdemir, 2008). In order to use manipulatives effectively in mathematics teaching and have competency to prepare effective teaching materials, teachers should be completely aware of the functions of these in teaching environments, the principles to consider while preparing these and authors and limitations of commonly used manipulatives (materials) and the features to pay attention selecting these. For this reason, it is very important to give necessary support to pre-service teachers in university years. As a matter of fact, preference and beliefs of pre-service teachers about using different manipulatives and their knowledge about using these manipulatives are very significant. At this point, it should be stated for the purposes for which and what kind of manipulatives pre-service teachers prefer; their reasons for this preference and their perspectives on different manipulatives. This is important both preparing manipulatives and designing teaching environments for manipulatives using. The aim ofthis study is to investigate pre-service classroom teachers' opinions about using different manipulatives in the mathematics teaching.

2. Method

2.1. Sample

The sample of research includes total 187 pre-service teachers in the Departments of Classroom Teaching in Kafkas University during the spring semester of 2010-2011 academic years. While 92 of these pre-service teachers were 1st grade students who have not taken Material Development and Mathematics Teaching lesson, 95 of them were 3rd grade students who have completed course.

2.2. Procedure

Virtual and physical manipulatives used in this study were chosen considering the gains in fraction sub-learning field of numbers learning in the mathematics curriculum of classroom teaching. The prepared and chosen manipulatives in both kinds were presented to usage of pre-service teachers in Computer and Mathematics Teaching lesson and in free classes during the spring semester (a total of 28 course hours). Questionnaires applied teacher candidates at the end of spring term. While the virtual manipulatives used in the search and presented in Table1 were the manipulatives presented in website of NLVM (2005) (National Library of Virtual Manipulatives-http://nlvm.usu.edu/), physical manipulatives was developed by pre-service teachers, researcher and purchased from. When virtual manipulatives in website of NLVM are selected, pre-service teachers' knowledge of English was taken into account. For this purpose, the English text is selected manipulativesless.

Table1. Some of virtual and physical manipulatives used in the study

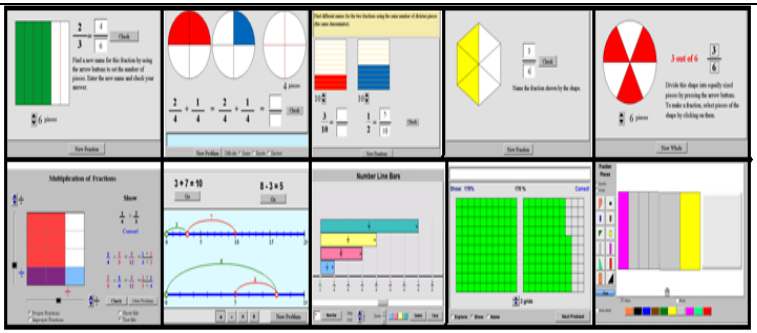
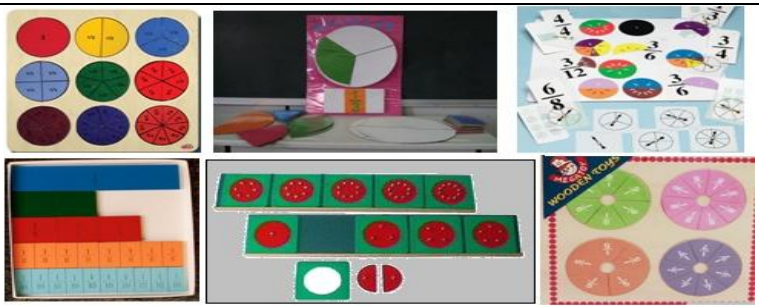
Some examples of virtual manipulatives	

Table 1 continued

Some examples of physical	

2.3. Data Sources

In this study, two surveys based on literature were used to collect data (Drickey, 2000; Kay & Knack, 2007b, 2008; Suh, 2005). These surveys were translated into Turkish and together with additions from other surveys in literature. Then survey items have been examined by three Mathematics educators and the final corrections have been done in accordance to their suggestions. The language, level, and extent analysis of the survey items prepared as literature-supported have been enabled. Survey to determine opinions about the manipulatives included 5 point Likert type total 26 items. Each item was measured on a 5-point Likert-type scale (strongly disagree-strongly agree). This survey aimed to expose the pre-service teachers' opinions about two different manipulatives. "Preference survey" consisting of 11 questions was the manipulatives types preferred by pre-service teachers and was prepared to search preference reasons of them. Last two question of this survey are open-ended questions: (1) Do you believe virtual and physical manipulatives can help you in mathematics teaching?" Why? Explain? 2) According to you, which kind of manipulatives is more proper for mathematics teaching? Explain the reason?"

2.4. Data Analysis

Priority, frequency and percentage of pre-service teachers' answers to two survey items were calculated. The answers given to 5-point Likert-type scale in the calculation of the arithmetic averages of each items in "survey to determine opinions about the manipulatives", "Strongly Disagree (SD) = 1, Disagree (D) =2, Undecided (U) = 3, Agree (A) = 4, Strongly Agree (SA) = 5"as scored. With the help of these scores, comparisons were made between the classes and compared with pre-service teachers' preferences manipulative. Moreover the same or common answers to two open- ended questions were presented as tables and discussed.

3. Findings

In this section, the findings obtained from "survey to determine opinions about the manipulatives" which aims to reveal views of pre-service teachers using virtual and physical manipulatives were presented in Table 2 and Figure 1 and interpreted.

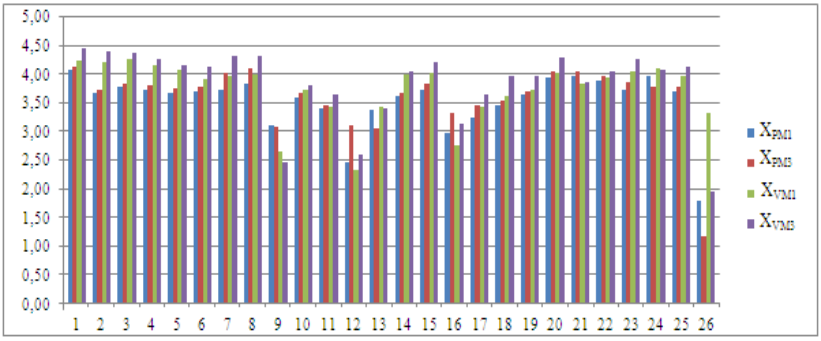
Table 2. Arithmetical averages obtained from survey to determine opinions about different Manipulatives

Survey items and numbers		Grades arithmetical averages	1st grade		3rd grade	
			X_{PM}	X_{VM}	X_{PM}	X_{VM}
1	I liked working with manipulatives		*4,08*	*4,14*	*4,25*	*4,45*
2	Manipulatives provides positive effects on motivation of students		*3,67*	*3,73*	*4,23*	*4,40*
3	Manipulatives enable mathematical reasoning.		*3,78*	*3,85*	*4,27*	*4,38*
4	Manipulatives support the usage of mathematical language.		*3,74*	*3,82*	*4,18*	*4,27*
5	Manipulatives help student to better understand concepts and principals.		*3,68*	*3,76*	*4,09*	*4,18*
6	Manipulatives allow students to structure the knowledge		*3,70*	*3,78*	*3,93*	*4,13*
7	It may be easy and amusing to use manipulatives for students.		*3,74*	*4,02*	*3,99*	*4,34*
8	Manipulatives increase the wonder of students and enable them to explore mathematical relations.		*3,84*	*4,12*	*4,01*	*4,34*
9	I believe continuous usage of manipulatives will decrease the interest in time.		*3,12*	*3,09*	*2,65*	*2,47*
10	Manipulatives are more beneficial for students at different learning level.		*3,59*	*3,68*	*3,75*	*3,83*
11	Manipulatives are time-saving.		*3,41*	*3,47*	*3,45*	*3,65*
12	I believe manipulatives are not proper for cooperative learning.		*2,48*	*3,11*	*2,34*	*2,61*
13	Manipulatives are more beneficial for low-leveled students		*3,38*	*3,07*	*3,45*	*3,41*
14	Manipulatives encourage the problem solving skills of students.		*3,62*	*3,67*	*4,01*	*4,05*
15	Manipulatives help student to create and solve different problems.		*3,75*	*3,84*	*4,04*	*4,23*
16	Manipulatives including learning environments don't enable communication between students.		*2,98*	*3,33*	*2,76*	*3,15*
17	Manipulatives provide feedbacks.		*3,25*	*3,48*	*3,44*	*3,65*

	Table 2 continued				
18	Manipulatives ease learning	*3,48*	*3,54*	*3,64*	*3,98*
19	I believe that will foster the success of student using manipulatives.	*3,66*	*3,72*	*3,75*	*3,99*
20	I believe students will be interested to reuse manipulatives	*3,95*	*4,07*	*4,04*	*4,29*
21	It may take time for teachers to design lessons including manipulatives.	*3,98*	*4,05*	*3,84*	*3,87*
22	By using manipulatives, the mistakes of students can be more easily corrected.	*3,90*	*3,98*	*3,95*	*4,07*
23	I believe teaching mathematics by using manipulatives can be amusing.	*3,75*	*3,88*	*4,07*	*4,28*
24	Manipulatives help teacher to design problems related with daily life.	*3,97*	*3,80*	*4,11*	*4,09*
25	Teachers may use manipulatives at different times and different gains.	*3,70*	*3,78*	*3,98*	*4,13*
26	I have used these kinds of manipulatives before.	*1,79*	*1,17*	*3,33*	*1,97*

Abbreviations used in table1*: X_{PM}: arithmetic averages of physical manipulatives, X_{VM}: arithmetic averages of virtual manipulatives*

Manipulatives as well as a more appropriate comparison between both grades and chart that contains the arithmetic averages in Table 2 are given in Figure 1 which enables a column chart.



Abbreviations used in figure1*: X_{PM1}: 1st grades' arithmetic averages of physical manipulatives, X_{PM3}: 3rd grades' arithmetic averages of physical manipulatives, X_{VM1}: 1st grades' arithmetic averages of virtual manipulatives, X_{VM3}: 3rd grades' arithmetic averages of virtual manipulatives.*

Figure 1. Column chart that contains the arithmetic averages in table 1

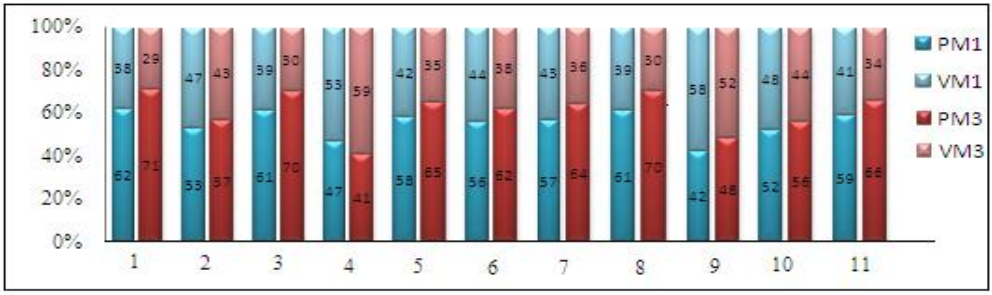
Looking at Table 2 and Figure 1, pre-service teachers stated that they generally used or saw PMs (1, 79; 3, 33) more than VMs (1, 17; 1, 97). More than half of third grade pre-service teacher stated they have used or saw PMs before (XPM = 3, 33). Most of pre-service teachers expressed, they like to use both manipulative type and these manipulativeshave positive effects on the motivation of students. Compared to first grade pre-service teachers, third grade pre-service teachers stated they like VMs more (XVM – XPM = 0, 06; XVM – XPM = 0, 20) and VMs will have more positive effects on the motivation of students (XVM – XPM = 0, 06; XVM – XPM = 0, 17). The arithmetical average values in survey items- "manipulatives enable mathematical reasoning, manipulatives support the usage of mathematical language, manipulatives help student to better understand concepts and principals"- belonging to VMs and third grade pre-service teachers are higher than the arithmetical average value of PMs and first grade pre-service teachers. While more than half of pre-service teachers stated that VMs will be more effective for "student's structuring knowledge" the difference between arithmetical average values of third grade pre-service teachers (XVM – XPM = 0, 20) are higher than the difference of first grade pre-service teachers (XVM – XPM =0, 0 8). The arithmetical average values of third grade pre-service teachers (XVM = 4, 34) who state it is easier and more amusing to work with VMs and the difference (XVM – XPM = 0, 35) between two arithmetical average values are higher than the arithmetical average value and the difference (XVM – XPM = 0,28) between arithmetical average values of first grade pre-service teachers (XVM = 4,02). Similarly, arithmetical average values (XVM = 4, 12) of first grade pre-service teachers who state VM will increase students' wonder and enable themto discover mathematical relations and the difference (XVM – XPM = 0, 28), between arithmetical average values belonging to two manipulatives are less than the arithmetical average values (XVM = 4,34) of third grade pre-service teachers and relevant difference (XVM – XPM=0,33). Although unlikely VMs and third grade pre-service teachers was in favor of arithmetical average values of survey items- "manipulatives are time-saving, manipulatives help student to create and solve different problem, I believe manipulatives will increase the success of students, I believe students will be interested to reuse manipulatives"-, the differences between arithmetical average values of first and third grade pre-service teachers are not very close values. It is again seen that VMs and third grade pre-service teachers was in favor of arithmetical average values values belonging to some survey items, but the differences between arithmetical average values of first and third grade pre-service teachers are close values. Moreover most of first and third grade pre-service teachers stated that PMs will be more beneficial for low-leveled students and more effective in designing problems for daily life. Compared to first grade pre-service teachers, third grade pre-service teachers stated that the lesson design including both manipulative would not be time-consuming. Most of pre-service teachers stated that PMs will provide much to communication between students and cooperative learning but the interests in PMs can get lesser in time.

In addition to this, percentage values of answers of the preference survey of pre-service teachers using VMs and PMs were given in Table 3 and Figure 2, later comparisons were conducted between grades.

Table 3. Percentage values of the preference survey

Survey items and numbers	Grades Percentage Values	Grade 1		Grade 3	
		PM	VM	PM	VM
1	I want to use these tools much in future.	%62	%38	%71	%29
2	Teaching mathematics via these tools is a good method.	%53	%47	%57	%43
3	It is fun to understand how these tools are processed.	%61	%39	%70	%30
4	It is boring to use these tools.	%47	%53	%41	%59
5	Handling mathematic problems by using these tools is just like doing crossword	%58	%42	%65	%35
6	In order to use these tool kinds, I need more time.	%56	%44	%62	%38
7	It is interesting and fun to learn and teach by using these tools.	%57	%43	%64	%36
8	I could make activities more easily by using these tools.	%61	%39	%70	%30
9	These learning tools make me feel anxious and unsafe.	%42	%58	%48	%52
10	It is easy to use these tools.	%52	%48	%56	%44
11	These tools help me to reach right answers.	%59	%41	%66	%34

A more appropriate comparison between both grades and manipulatives and column chart that contains the percentage values in Table 3 are given in Figure 2.



Abbreviations used in figure2: *PM1: 1st grades' percentage values of physical*

manipulatives, PM3: 3rd grades' percentage values of physical manipulatives, VM1: 1st grades' percentage values of virtual manipulatives, VM3: 3rd grades' percentage values of virtual manipulatives.

Figure 2. Column chart with percentage values of the preference survey

Looking at Table 3 and Figure 2, pre-service teachers generally are preferred VMs in all items of survey. Besides, in most of survey items, percentage values of the third grade pre-service teachers are higher than first grade pre-service teachers. Especially when the percentage values of items- "I want to use these tools much in future, it is fun to understand how these tools are processed, I could make activities more easily by using these tools"- are compared in means of VMs and PMs, the percentage values of the third grade pre-service teachers preferring VMs are between 70 and 71%, but the percentage values of the first grade pre-service teachers are between 61 and 62%. In negative items of survey, generally pre-service teachers found PMs more boring than VMs and they felt anxious and unsafe using PMs. But compared to first grade t pre-service teachers, third grade pre-service teachers found VMs less boring and felt less anxiety using VMs. Besides, when the percentage values of items -"handling mathematic problems by using these tools is just like doing crossword, in order to use these tool kinds, I need more time, it is interesting and fun to learn and teach by using these tools, these tools help me to reach right answers"- examined, it is seen that the differences between percentage values of VMs and PMs are equal and again pre-service teachers prefer VMs. Percentage values of pre-service teachers who believe it will be a better method to teach mathematics by using VMs and the usage will be easier are higher than the percentage values of pre-service teachers who believe it will be a better method to teach mathematics by using PMs and the usage will be easier. But the number of pre-service teachers preferring PMs is not a small one. Besides compared to first grade pre-service teachers, third grade pre-service teachers stated VMs are a more effective teaching tool and they are more easily used.

Moreover, the data obtained from two open-ended questions of preference survey support the obtained data of surveys and the data obtained from these two questions were presented in Table 4-5.

Table 4. Preference reasons obtained from two open-ended questions distribution according to manipulatives

Types of manipulative	**Preference reasons**	*Numbers of pre-service teacher*
VM	time-saving	*10*
	to be more fun/motivating	*14*
	students to take a more active role in	*4*
	construction knowledge by the student	*5*
	computer-student interaction	*13*
	association with daily life	*2*

		activities or practices to be more	*8*
		repeatability/ usability	*7*
		technological development/ to be benefit from technology	*5*
		visualization and animation	*22*
		reasoning and exploring development	*3*
		practical and economical	*14*
		to appeal to many people or attainability	*6*
		be fun and enjoyable	*7*
		student control and group work	*12*
		feel-touch-sight: to address the sense organs	*22*
		learning by doing-living	*10*
		being close to everyday life examples	*10*
		easy to see parts of the manipulative	*4*
		be more convenient to play the game	*7*
PM		be easier to control student	*3*
		concrete experience or concrete examples of life	*15*

Table5. Preference reasons obtained from two open-ended questions distribution according to grades and manipulatives

Types of manipulative	**Grades**	**Preference reasons**	*Numbers of pre-service teacher*
VM	*3rd Grade*	be visual, activities or practices to be more, time-saving, animation, have pictures, to be enjoyable or fun, repeatability, self-study, developing computer technology, usefulness, making a discovery, construction knowledge by the student, student's active participation, easy to use, be less costly, to appeal to many people or attainability, pose different problems,…	*39*
VM/PM		while a more appropriate use of physical manipulative at the first level primary, more suitable for the use of both physical and virtual manipulative at middle school and more top grades; visual and have fun, active participation, making a discovery, construction knowledge by the student, be	*23*

		differences in learning, teaching different concepts, formalize the request,…	
PM		concrete experiences and concepts, being close to everyday life examples, be fun and enjoyable, to touch, group work is appropriate,…	*24*
VM	*1st Grade*	to be more visual, student to be more active, to be more fun, activities or practices to be more, practical and economical, usefulness, the error correction, development of trial and error skill,…	*22*
VM/PM		to form basis of physical manipulative first, then consolidate the virtual manipulative; students' cognitive level, visual, active participation, learning by doing-living, change of use of the material by subject,…	*14*
PM		to formalize, development of hand skills, to touch, course to make it more functional, student's feeling each level,…	*17*

4. Conclusions

Pre-service teachers generally expressed that they used or saw PMs more than VMs and more than half of the third grade pre-service teachers stated they have used or seen PMs before. One reason for this result, the pre-service teachers can more use of physical manipulatives which are more common in elementary and secondary levels. The other reason, due to advances in computing technology, the virtual manipulatives is newly used. Most of pre-service teachers expressed they liked to use both manipulative type and these manipulatives have positive effects on the motivation of students. Indeed, Jones, Uribe-Florez and Wilkins (2011) pointed that manipulatives will do a positive impact onof students'motivation. Compared to first grade pre-service teachers, third grade pre-service teachers stated that they liked the VM more and SM will have more positive effects on the motivation of students. Besides the number of third grade pre-service teachers stating VMs will contribute much too mathematical reasoning, the useof mathematical language, understanding of mathematical conceptsis higher than first grade pre-service teachers. This

may be related to the third grade preservice teachers'cognitive levels. While more than half of pre-service teachers stated that VMs will be more effective for constructing of mathematical knowledge by the student, the difference between arithmetical average values of third grade pre-service teachers are higher than the difference of first grade pre-service teachers. Because, when using virtual manipulatives in mathematics teaching courses third grade pre-service teachers, they may have sensed that virtual manipulatives would strengthen mathematical reasoning, more effective for constructingof mathematical knowledgeby the studentand help easier understanding the concepts. In fact, Moyer, Bolyard, and Spikell (2002) described VMs that a dynamic object which present sopportunities for constructing mathematical knowledge. The number of first grade pre-service teachers stating VMs will contribute much to explore mathematical relations expressing increasing students'curiosity is less than third grade pre-service teachers. Compared to first grade pre-service teachers, third grade pre-service teachers stated that VMs will be much more effective for developing problem solving skills, feedbacks, correcting mistakes, using over and over again at different times in students who have different levels of learning, but they also pointed out that PMs could be as effective as VMs.The number of third grade pre-service teachers stating VMs would be more effective in time-saving, posing and solving different problems, facilitating learning and increasing student achievement is higher than the number of third first pre-service teachers. As expressed inmany studies, because virtual manipulatives provide students with instantaneous, corrective feedback, this ability makes virtual manipulatives well-suited to inquiry-based learning and problem solving (Clements & McMillen 1996; Clements, 2002; Crawford & Brown 2003; Durmus & Karakirik 2006; Reimer & Moyer 2005; Suh & Moyer 2005). Most of first and third grade pre-service teachers stated that PMs will be more useful for low-leveled students and more effective in design problems related to daily life. This resultmay be related tothe physical manipulatives is close to the examples or it is within the daily life of physical manipulatives. Compared to first grade pre-service teachers, third grade pre-service teachers stated that the lesson design including both manipulatives wouldn't be time-consuming. Most of pre-service teachers stated that PMs will provide much to communication among students and cooperative learning, but the interests in PMs can get lesser in time. Also, third grade pre-service teachers are preferred more than the VMs.

The results of "preference survey" also are in support of the other survey and showed that pre-service teachers generally prefer VMs. While pre-service teachers try to use more VMs in future, the number of pre-service teachers who believe they can make activities more easily with SMs is also high. Most of pre-service teachers finds VMs less boring than PMs and they feels anxious and insecure using PMs. But compared to first grade pre-service teachers, third grade pre-service teachers find VMs less boring and feel less anxiety using VMs. Percentage values of pre-service teachers who believe it will be a better method to teach mathematics by using VMs and the usage will be easier are higher than the percentage values of pre-service teachers who believe it will be a better method to teach

mathematics by using PMs and the usage will be easier. But the number of pre-service teachers preferring PMs is not a small one. Besides compared to first grade pre-service teachers, third grade pre-service teachers stated VMs are a more effective teaching tool and they are more easily used. When pre-service teachers' reasons for choosing VMs are analyzed, the reasons can be listed as: "Visuality, high number of activities and examples, time-saving, animation and pictures, pleasure and fun, repeatability, individual work, improving computer technology, practicality, discoveries, student's structuring information, active attendance of student, easy usage, less costs, addressing to many people, accessibility, practicality, economic." In addition to this, some of pre-service teachers preferred PMs more than VMs and they explained their reasons as; "seeing with eyes and touching, hand skill, concretizing, functionalizing the lesson, student's feeling each level, easy obtainability, compliance to daily life, being fun, group work."

Although the value of manipulatives has been recognized for many years, some teachers and parents have been reluctant to include them in their lessons. Nevertheless manipulatives can play a role in students' construction of meaningful ideas. Most of the preservice teachers found generally both physical and virtual manipulatives important for teaching matematical concepts, exploring mathematical relations, and enhancing mathematical thinking. They also mentioned that, the manipulatives would enhance student academical achievements and problem solving skills. Therefore, preparing and promoting the use of these types of manipulatives, teachers and preservice teachers need to train on this issue. Also, preservice teachers should be guided the design of the activities that the both type of manipulative in mathematics teaching courses.

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