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An Investigation of Pre-Service Mathematics Teachers' Views and Reflections about Elementary Mathematics Classes' Instruction Issues

Matematik Öğretmen Adaylarının İlköğretim Matematik Sınıflarının Öğretim Konuları Hakkındaki Görüş Ve Düşüncelerinin İncelenmesi[1]

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Abstract

The purpose of this study was to investigate the nature of changes in pre-service mathematics teachers' views and reflections about instructional issues in elementary mathematics classes as they progress in teacher education program. For this aim, 19 pre-service mathematics teachers, making their observations in their cooperating schools for 3 months, wrote and submitted their reports. The reports were analyzed via content analysis. The results indicated that although there was commonality in the views and reflections of pre-service mathematics teachers' about instructional issues in elementary mathematics classes, there were differences in their knowledge in the way they perceive instruction as they progressed through their education.

Keywords: Pre-service Mathematics Teacher, Mathematics Instruction

Özet

Bu çalışmanın amacı, ilköğretim matematik öğretmen adaylarının ilköğretim matematik sınıflarının öğretim konuları hakkındaki görüş ve düşüncelerindeki değişikliğin doğasını incelemektir. Bu amaçla, 3 ay boyunca okullarda gözlem yapan 19 ilköğretim matematik öğretmen adayı birer rapor yazmış ve teslim etmiştir. Raporlar içerik analizi yöntemi ile incelenmiştir. Çalışma sonuçları, ilköğretim matematik öğretmen adaylarının ilköğretim matematik sınıflarının öğretim konularındaki görüş ve düşüncelerinde ortaklık olmasına rağmen, matematik öğretimi hakkındaki düşüncelerinde bazı değişiklikler olduğunu göstermiştir.

Anahtar Kelimeler: Matematik Öğretmen Adayı, Matematik Öğretimi

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Introduction

Since the most basic function of education is to educate qualified individuals the society needs, existing education programs must be developed parallel to the changes occurring in the society and education programs should answer the current needs (Yüksel, 2000; Özden, 2002). Turkey is among the many nations which put great emphasis on the importance of education and follow the changes in theory and practice of education (Koç, Işıksal, & Bulut, 2007). As a strong indication of Turkey's efforts to improve its education system, the National Ministry of Education reformed the elementary education curriculum, which was put into practice throughout Turkey in 2005-2006 education year (Ministry of National Education [MoNE], 2005). As part of the curriculum reform project, the elementary school mathematics curriculum (grades 1 thru 8) was also reshaped. In 2013, the middle school mathematics curriculum (grades 5 thru 8) was revised again to increase the quality mathematics teaching (MoNE, 2013).

By means of the elementary mathematics curriculum, roles of the students and teachers have changed drastically. Prior to 2005, the teacher was regarded as the sole authority of the classroom who presents the information and assesses student learning; however, in the 2005 and 2013 curricula, the teacher was declared as the facilitator of student learning. In other words, students are expected to actively participate in the learning process and develop their mathematical knowledge on their own (Koç, Işıksal, & Bulut, 2007). The school curriculum reform became a motivation for the revision of elementary mathematics teacher education curriculum (Isiksal, Koc, Bulut, & Atay-Turhan, 2007). In 2006, the Higher Education Council (HEC) revised the teacher education curriculum. Among different changes, the number of school experience courses decreased from two to one. After the revisions, there is only one school experience course offered in the seventh semester of the teacher education program and one teaching practice course offer in the last semester of the program.

The School Experience and Teaching Practice courses have always been acknowledged as essential elements of the teacher education curriculum. These courses provide pre-service teachers with opportunities of making observations in real classrooms to see complexities of classroom life, and Practice Teaching course is a different kind of opportunity for pre-service teachers to have first-hand classroom teaching experience (Hoşgörür, Kuşdemir, & Katrancı, 2006). Moreover, these courses are functional and beneficial to familiarize pre-service teachers with the teaching profession (Yapıcı & Yapıcı, 2004). Therefore, field experience courses are essentially important for educating qualified teachers and helping them understand the link between theory and practice.

The School Experience course was planned to help teachers gain the necessary qualities of teaching profession (MoNE, 1998). Within the scope of the courses, pre-service teachers were observing mathematics lessons in their cooperating schools. It is assumed that by means of these observations, pre-service mathematics teachers could assimilate their experience and relate them to the work being done at the university; therefore, it provides opportunities to improve their professional competence. Although pre-service mathematics teachers only observe the classroom during the School Experience course, they make observations and also get ready for teaching in the Teaching Practice course. That is, the general goal of the second course is to prepare pre-service teachers for teaching mathematics. At

the end of the Teaching Practice course, it is expected that pre-service teachers develop the following skills: planning a mathematics lesson, teaching mathematics, using classroom management techniques, asking questions, and evaluating of students' works (HEC, 1998).

Various studies have been conducted on pre-service teachers' perceptions about school experience (Aksu & Demirtaş, 2006; Cephe, 2001; Gökçe & Demirhan, 2005; Oral & Dağlı, 1999; Özkılıç, Kartal, & Bilgin 2008; Turgut, Yılmaz, & Firuzan, 2008). These studies have shown that School Experience and Teaching Practice courses have various effects on pre-service teachers' views and reflections, and on their growth as a teacher. For instance, these courses motivate pre-service teachers to enjoy teaching and gain experience (Turgut, Yılmaz, & Firuzan, 2008), and the courses provide both the necessary knowledge and experience for teaching (Cephe, 2001). Similarly, these courses have a profound effect on pre-service teachers' understanding of subject (Peterson & Williams, 2008). Pre-service teachers learn from these courses that they would not do in their future teaching life (Anderson, Barksdale & Hite, 2005). Moreover, School Experience and Teaching Practice courses gave pre-service teachers the opportunity to organize their personal and professional identity (Poulou, 2007). Although there are a number of studies about the effects of School Experience and Teaching Practice courses on pre-service mathematics teachers' professional growth, less focus has been given to the changes of pre-service mathematics teachers' views and reflections from the School Experience to the Teaching Practice course. More specifically, inadequate number of studies investigated the nature of changes in pre-service mathematics teachers' views and reflections about instructional issues in elementary mathematics classes during their involvement in teacher education program. Yet, it is important to see how pre-service mathematics teachers' views and perceptions change to understand how they grow professionally. Hence, it is believed that this study contributes to the literature in this context.

The purpose of the present study is to investigate the change in pre-service mathematics teachers' views and reflections about instructional issues in elementary mathematics classes as they progress in teacher education program.

Methodology

Participants

Since the aim of this study is to investigate the changes in pre-service mathematics teachers' views and reflections about instructional issues in elementary mathematics classes throughout their university education, the participants were selected via the purposive sampling method. 19 pre-service teachers who took both courses were selected as the participants.

Data collection and data collection instrument

To reach the goals of the study, pre-service mathematics teachers were expected to write reflection papers. They described mathematics lessons, teaching methods being used, interactions, and curricular activities conducted in their cooperating schools based on their classroom observations. They also interviewed their cooperating teachers related to the classroom practices. Then, they wrote their views and reflections on issues regarding mathematics instruction.

Data analysis

In this study, via content analysis pre-service mathematics teachers' reflection papers were first read and main issues related to mathematics instruction that appeared in their statements were recorded. The most recurring issues were considered as the themes of mathematics instruction. During this process, the concepts, sentences, phrases, words that would be coded under these subcategories were also defined. These subcategories were compared with other participants' reflection papers. After finishing the comparison of reflection papers with each other, subcategories were redefined. The same strategy was followed while analyzing the reflection papers of the Teaching Practice course. That is, this process was performed for reflection papers of School Experience and Teaching Practice course separately. Then, findings of both courses were compared and contrasted. In addition, multiple coders coded the data during the data analysis and an expert in mathematics teacher education program monitored the whole data analysis process. Both coders were graduate students in mathematics education and mathematics teachers. After reading the reflection papers of the pre-service teachers in order to reach a common understanding of the data, subcategories that would be used in the analysis were determined together. Independent coding a portion of the data yielded over 80% agreement. This process of categorizing continued until no data was left uncategorized.

Findings

Since the purpose of this study is to investigate the nature of changes in pre-service mathematics teachers' views and reflections about instructional issues in elementary classes, the School Experience data and then the Teaching Practice data was analyzed. Finally, a comparison of both data set was conducted. Results obtained from the reflection papers were presented in two ways. First, an overview of subcategories of the coding categories was given in tables. The tables indicated the number and percentage of the reflection papers. Then, pre-service teachers' interpretations or direct quotes taken from their reflection papers were given for the categories.

Pre-service mathematics teachers' views and reflections about instruction in the School Experience course

The findings indicated that at the end of the School Experience course the participants, in their papers, reflected on four main themes (categories) about mathematics instruction: Teachers' methods of instructions, usage of material, teachers' behavior and teachers' everyday routines (See Table 1). Each of these categories includes a number of sub-categories. Table 1 indicates the number and percentage of reflection papers that contain each of the subcategories.

Table 1. Numbers of subcategories derived from the School Experience reflection papers

Subcategories of instruction	**Number of participants who reflected on the subcategory (out of 19 participants)**

Teachers' Methods of Instruction	
Question-answer method	10
Problem solving method	1
Group work	2
Student-centered instruction	2
Giving examples from daily life	9
Showing different ways of solutions	4
Using word problems	1
Induction method	4
Making students discover	1
Deduction method	1
Explanation method	2
Demonstration	1
Direct teaching	1
Teacher-centered instruction	2
Sharing basic information	2
Sharing definition	4
Sharing formulas	2
Solving routine examples	6
Teachers' Usage of Material	
Using materials (manipulative, OHP…)	18
Using different textbooks	2
Teachers' Behavior	
Using body language	1
Making jokes	3
Being enthusiastic	2
Giving opportunity to students	1
Giving equal permission to students	2
Encouraging students to ask questions	6
Ignoring unsuccessful students	2
Teachers' Everyday Routines	
Making connection with previous subjects	6
Asking questions about previous subjects	2
Giving clues about the new topic	2
Starting lesson with an interesting question	1
Caring about whether the subject is understood	2

The participants wrote about various teaching methods that teachers use to help students understand mathematics. In particular, as seen in Table 1, they

reflected on 18 different subcategories of "*teachers' methods of instruction*." The *question-answer method* (10 participants), *giving examples from daily life* (9 participants), *solving routine examples* (6 participants), *showing different ways of solutions* (4 participants), *induction method* (4 participants) and *giving definition* (4 participants) were the most frequent topics. Thus, the *question-answer method* was the most cited subcategory. While 10 of the 19 pre-service mathematics teachers expressed views about question-answer method, 3 of them were positive, 2 of them were negative about the teachers' use of the question-answer method, and five of them did not provide their opinion about it. Regarding the three positive comments, they stated that the question-answer method makes the students think and discover. The positive statements were:

> I think question-answer is a good method, because the teacher propels the students to think in this way. She does not give the information readily. I think this method prevents memorizing the subjects without learning (S5).
>
> Asking questions to arise the interest on the topic is useful in mathematics instruction so that the students pay attention to the lesson (S8).
>
> By means of question-answer method, the teacher learns both how much the student knows and where to start teaching (S12).

As can be seen, the three pre-service teachers stated that since the teachers know how they teach the subject and what their students already know about the subject, they can make the students participate in the lesson by means of the question-answer method. Therefore, they imply that students learn the conceptual meanings of mathematical rules instead of memorizing them. On the other hand, some of the pre-service teachers raised negative opinions about usage of the question-answer method in mathematics classes.

> There are several learning intelligence and learning abilities. For example, some students can understand the topics by listening, whereas some of them need visual things to understand. Students can construct a link with their knowledge; on the other hand, some links need to be constructed by teacher. In other words, the teacher should address the students' needs. Therefore, in my opinion my cooperating teacher should have used different methods. She should try to reach more students' learning style (S10).
>
> Although the question-answer method encourages students and makes students' learning more effective, there may be waste of time (S18).

As seen above, the pre-service teachers believed that although using different styles may be time consuming due to different learning intelligences, teachers should still use different styles. Another important issue raised in the pre-service mathematics teachers' reports related to instruction was *giving examples from daily life* (9 participants):

> Teacher uses the current events when lecturing so this provides the lesson to be more fun and interesting. Therefore, the students learn and understand the subject

> easily. For example, she gave some examples for the usage of milliliter and liter in the daily life. She said that "we use milliliter in medicine and chemistry"; in addition, she made a joke about the usage of them that was; "in movies bombers use these units to make a bomb" and everyone laughed including me. By this way classroom management was provided and she got all the attention on the subject and provided students concentrate on the subject (S3).

Another pre-service teacher mentioned,

> He showed shopping as an example of rounding numbers in the last digit. He told that people pay 100 although the price of the product is written as 99 on the ticket (S7).

Parallel to this view, Participant 9 indicated,

> Memorizing the formulas and the ways of the solutions are not beneficial in the mathematics teaching. This may be prevented by telling how the formula was gathered and in which areas these subjects are used in daily life (S9).

The above views and reflections showed that some of the pre-service mathematics teachers believed that lessons are more meaningful and interesting when teachers use examples from daily life. If the teachers make connection with real life instead of having students memorize the rules or the subject, the students will learn them meaningfully.

As seen from Table 1, nearly all of the pre-service mathematics teachers (18 out of 19, 95%) expressed the importance of *using materials* in mathematics classes. They expressed that use of materials during instruction helped students learn the concepts meaningfully and effectively.

> Use of materials enables the teachers to use the time properly and reach to the aims in a shorter period of time. As a result of these, using materials gives them sense of confidence and comfort about what they should do for better teaching (S8).

> In my opinion, using materials in geometry is logical because students require more concrete examples in geometry and using materials is very beneficial for students to understand the subject (S9).

As seen from pre-service mathematics teachers' reflection papers, they believe that use of materials facilitates the teachers' work of instruction, and students construct their knowledge meaningfully by means of materials. That is, the participants, in general, noted that in order to make the instruction more effective, teachers should use materials in teaching mathematics. Additionally, two participants wrote about the teachers' use of different textbooks or support materials.

Teachers' behavior was another topic of reflection among the pre-service teachers. Among others, *encouraging students to ask questions* was noted by six participants. Three of them reflected on *making jokes*, and the rest of the subcategories of teachers' behavior were touched by one or two participants.

Teachers' everyday routines were the fourth theme that the participants wrote about. Among the subcategories of this theme, *making connection with previous subjects* was the most frequent one (8 participants). The pre-service teachers mentioned that in order to get a better result in instruction process,

making connection with and asking questions about a previous subject is essential. Pre-service mathematics teachers emphasized this as expressed below:

> The teacher asks the students what they know about the subject that he will discuss. By doing this, he can learn about their background. He can learn whether the concepts of that issue are clear in the students' mind or not. He sees the level of their knowledge, after that he decides how he will teach the lesson. If the students do not know a lot about the topic, he tells it in more detail and gives more examples (S7).

> Making a comparison between the previous topic and the new topic prevents the student from forgetting the previous issues. Asking the students previous issues make them participate in the lesson (S19).

> My cooperating teachers start lesson with asking questions about previous lecture. By means of making her students remember the topic, she tries to deep silence (S10).

In sum, nearly all of the pre-service mathematics teachers stressed the importance of using the materials in teaching mathematics. Although positive views were expressed about the question-answer method, negative views were also noted about it. Pre-service teachers also mentioned that mathematics subjects should be connected with other topics in mathematics and real life for teaching mathematics for understandings.

Pre-service mathematics teachers' views and reflections about instruction in the Teaching Practice course

In this section, pre-service mathematics teachers' views and reflections about the mathematics instruction that they observed as part of requirements of the Teaching Practice course is given. Table 2 indicates the number and percentage of reflection papers that contain each of the subcategories.

Table 2. Numbers of subcategories derived from the Teaching Practice reflection papers

Subcategories of instruction	**Number of participants who reflected on the subcategory (out of 19 participants)**
Teachers' Methods of Instruction	
Question-answer method	3
Problem solving method	2
Group work	2
Student-centered instruction	3
Giving clues to find mistakes	1
Giving enough time to think	4
Giving feedback	1
Explaining reason of rules	1
Giving examples from daily life	8

Showing different way of solutions	2
Story problems	2
New curriculum	7
Demonstration	1
Direct teaching	14
Teacher-centered instruction	3
Sharing rules	1
Traditional way	3
Memorizing rules	4
Erasing wrong solutions	2
Students copy from the board	3
Writing definitions on the board	6
Discussion-discovery	3
Specific method	4
Teachers' Usage of Material	
Using materials (manipulative, OHP…)	17
Preparation activity	7
Teachers' Behavior	
Using body language	1
Being enthusiastic	1
Being monotone	1
Reinforcements, punishments, reprimands	3
Giving equal permission to students	2
Encouraging students	3
Trying gain students' interest	1
Allowing students to ask/solve	2
Teachers' Everyday Routines	
Making connection between with subjects	3
Starting lesson with an interesting question	2
Correcting misconceptions	1
Well planned lessons	2
Summary of lesson	2

Table 2 shows that the participants raised 23 different subcategories of Teachers' Methods of Instruction. Among all the 23 subcategories*, direct teaching* (14 participants), *giving examples from daily life* (8 participants), *writing definitions on the board* (6 participants) were the most frequent subcategories. Most of them (14 out of 19, 74%) indicated that the implementation of the elementary school mathematics curriculum was not efficient as teachers continue to use *direct instruction methods* instead of the new reformist methods such as guided

instruction and problem solving. In their reflection papers, they reacted to teachers' use of direct teaching in mathematics classrooms:

> I think the direct instruction method is not an effective way in students' learning. Students only try to copy the notes from the blackboard in the direct instruction, because their only aim is to write, not to understand the concept. Since students' attention easily decreases, their learning decreases (S2).

> The teacher gives the information directly and then solves a question by herself and this also shows students how the procedure is applied. The students do not conceptually learn the topic; they could not relate the information given in the lesson with the information in their schema. That is, just introducing the definitions and the algorithm of the issues without posing meaning to them makes no sense and actual learning cannot be accomplished (S17).

> Students' learning took place in a classical way as a result of direct instruction. Lessons were generally teacher based and what students do commonly was to copy the problems on the board to their notebooks (S9).

It could be deduced from above excerpts that pre-service teachers implied that since the students copy the notes from the board, they do not learn the subject; but, only learn the rules which leads to rote memorization. Therefore, the students do not have the opportunity to construct the meaning of mathematics.

Furthermore, eight participants pointed out the importance of *giving examples from daily life* as illustrated below:

> The teacher sometimes gives real life examples in lessons. That will make sense for the students by connecting the mathematics and the real world (S8).

> In my opinion my cooperating teacher should ask questions which provide a way to integrate communication into mathematics instruction. Through these activities, he can increase his students' understanding of methods and build connections between mathematical topics and real life (S10).

As seen from Table 2, nearly all participants (17 out of 19) expressed the importance of *using materials* in mathematics classes. They mentioned that teachers should use materials in order to help students better understand mathematical concepts and to make the lessons more effective and interesting. They stated that materials were useful in mathematics instruction.

> Teachers think that if the student uses the materials on their own with the guidance of the teacher, they learn the concept easily and the usage of materials becomes effective in the lesson. As a result, they understand the concepts of mathematics by using materials and their thinking skills improve (S4).

> The students would characterize and interpret the mathematical concepts easily by means of materials (S6).

> Use of technology such as overhead projector or worksheets also facilitates learning and also makes math more concrete (S14).

There were also less frequently mentioned subcategories such as using body language, being enthusiastic, being monotone under the topic of teachers' behavior. One of the pre-service teachers stated her thoughts about being monotone and enthusiastic in the following:

> Since the teacher is not enthusiastic about teaching, I am sad about that. This makes his teaching monotonous and different from the requirements of the new curriculum. He solves some of the problems, and then asks students to solve the problems. I wish he would try to be more energetic and enthusiastic because the students lose their motivation (P3).

To summarize, most of the pre-service mathematics teachers had negative views and reflections about the use of direct instruction method in mathematics classes in their Teaching Practice reflection papers. In addition, they did not observe the implementation of the new curriculum in their cooperating schools. Almost all of the pre-service mathematics teachers expressed that use of materials were important for students' better understanding during mathematics instruction. In addition, pre-service teachers mentioned that although materials were necessary for better implementation of the new curriculum, this could be also done by means of real world examples.

Differences between the courses

A comparison of the findings on Table 1 and Table 2 indicates that there are similarities and differences between the participants' reflections in the first and second reflection papers. Considering the similarities, the participants focused on the problem solving method, group work, student-centered instruction, giving examples from daily life, using word problems, demonstration method, teacher centered instruction, giving formulas, using materials, using body language, being enthusiastic, giving equal permission to students and starting lesson with an interesting question in equal or close numbers. With respect to the differences, while in the School Experience course, more participants wrote on the question-answer method, showing different ways of solutions, encouraging students to ask questions and making connection between previous subjects, in the second course, direct teaching and giving formulas were more mentioned by the participants. A comparative analysis of Table 1 and Table 2 indicates that the participants focused on several subcategories only in the first or in the second reflection paper. For instance, the induction, deduction, explanation method, solving routine problems, using different textbooks, ignoring unsuccessful students, asking questions about previous subjects and giving clues about the new topic were coded only in the first reflection papers; on the other hand, some different subcategories such as giving enough time to think, writing definitions on the board, memorizing rules, preparing activity, reinforcements-punishments-reprimands, and summary of lesson were elaborated only in the second reflection papers. As a result, the pre-service mathematics teachers reflected on the subcategories in varying degrees. Furthermore, the frequencies of subcategories in Table 1 and Table 2 indicated that

although there was commonality in the perceptions of pre-service mathematics teachers' views and reflections in mathematics instruction, there was a change in their knowledge in the way they perceive mathematics instruction as they progressed through their education.

Discussion and Conclusion

This study investigated the changes in pre-service mathematics teachers' views and reflections about instructional issues in elementary mathematics classes throughout their university education. The findings indicated that in addition to the similarities of subcategories, there are also differences between the pre-service mathematics teachers' School Experience and Teaching Practice reflection papers .

The pre-service mathematics teachers indicated positive thoughts about the use of materials during the mathematics instruction in their School Experience and Teaching Practice course reports. The number of this subcategory in Teaching Practice course reports is almost the same in the School Experience course reports. In School Experience course, pre-service mathematics teachers express that the use of materials during instruction helps students learn the concepts meaningfully. Also, consistent with previous research (Özgün-Koca, 2002; Bulut, 2007; Güven & Karataş, 2004; Halat, 2007) in practice course, pre-service mathematics teachers believe that the use of materials facilitates the teachers' instruction. In addition to the similarities of subcategories between two course reports, there are variations among pre-service mathematics teachers' views and reflections regarding the methods of instruction. Although the most frequent subcategory in School Experience reports is the question-answer method, the direct instruction method is the most frequent category in Teaching Practice reports. Pre-service mathematics teachers have both positive and negative views about the question-answer method in their School Experience reports. For the School Experience course, pre-service mathematics teachers state that since the teacher does not give the information directly to the students, they make students think about the subject. Furthermore, they express that since the learning intelligence and learning abilities of the students' are different from each other, the teachers should use different methods to reach each student. In the same way, different learning and thinking styles are emphasized in the elementary mathematics curriculum (MoNE, 2006). This finding has been supported by Temizöz and Koca's study (2009). Pre-service mathematics teachers had negative views and reflections about the use of the direct instruction method in mathematics lessons in their Teaching Practice reports. Along with the literature (Çınar, Teyfur & Teyfur, 2006; Koç, Işıksal & Bulut, 2007), they state that since the students copy the writing from the board, they do not learn the subject, they only learn the rules and this leads to rote memorization.

To conclude, School Experience and Teaching Practice reflection papers showed that there are some similarities and differences in pre-service mathematics teachers' views and reflections about instructional issues in elementary mathematics classes. In addition, Teaching Practice course reports show that university education contributed to the pre-service mathematics teachers' views about instruction in

elementary mathematics classes. That is, we have evidence that School Experience courses are beneficial for their professional growth.. A further study may be conducted not only by collecting their reports, but also interviewing with them and observing their teaching practices. By means of this, further evidence can be collected about pre-service mathematics teachers' views and reflections.

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