A STUDY ON PATTERN OF 6TH GRADE ELEMENTARY MATHEMATICS LESSON

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

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ABSTRACT

A STUDY ON PATTERN OF 6TH GRADE ELEMENTARY MATHEMATICS LESSON

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The purpose of this study is to interpret observations of three 6th grade elementary mathematics classrooms throughout a unit in detail. Specifically, this study examined the patterns and traditions related with teaching practices in the context of teaching a unit, teaching a topic, and single lessons, and described frequently observed teaching features in mathematics lessons. This study presented a detailed description and analysis of teaching practices of three experienced mathematics teacher from three public elementary schools. The participated teachers were directly observed through teaching a different mathematics unit. The teaching and learning practices in each classroom was described and analyzed both separately and together.

The results of this study indicated that teaching a mathematics unit could be described as the combination of separately taught topics where the sequences of

topics are strictly determined by elementary mathematics curriculum. There was no specific practice aiming to construct relation between unit's concepts and other school subjects, other mathematics concepts, and among these concepts. Teaching practices throughout a topic showed explicit similarities so that a pattern for teaching a topic can be described as demonstrating the new content, practicing the new content, and assigning and doing homework. It was not possible to draw a pattern for teaching practices in elementary mathematics lessons by using single lesson periods as a unit of analysis. 'Practicing' was the most occurred activity in elementary mathematics lessons. Based on the findings some suggestions for future research studies were proposed, and some implications for teachers, teacher educators and policy makers were delivered.

Keywords: teaching practices, classroom observations, elementary mathematics lessons, lesson pattern

ÖZ

6. SINIF İLKÖĞRETİM MATEMATİK DERSLERİNİN YAPISI ÜZERİNE BİR ÇALIŞMA

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Yüksek Lisans, İlköğretim Fen ve Matematik Alanları Eğitimi Bölümü

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Bu çalışmanın amacı üç 6.sınıf ilköğretim matematik sınıfının bir ünite süresince gözlemlerini sunmak ve açıklamaktır. Bu çalışma, özellikle, bir ünitenin öğretimi süresince, bir konunun öğretimi süresince ve tek bir ders süresince karşılaşılan öğretim etkinliklerindeki alışılagelmiş yapıyı incelemeye ve matematik derslerinde sıklıkla gözlemlenen öğretim uygulamalarını tanımlamaya çalışmıştır. Bu rapor üç farklı devlet ilköğretim okulundan üç deneyimli matematik öğretmeninin öğretim etkinliklerinin betimlerini ve analizlerini sunmuştur. Çalışmaya katılan öğretmenler farklı bir ünitenin öğretimi süresince gözlemlenmiştir. Öğretim ve öğrenim etkinlikleri her sınıf için ayrı ayrı ve hep birlikte tanımlanmış ve analiz edilmiştir.

Bu çalışmanın sonuçları göstermiştir ki, bir matematik ünitesinin anlatımı ayrık olarak öğretilmiş konuların birleşiminden ibarettir ve bu konuların sıralaması

ilköğretim matematik müfredatı tarafından katı bir biçimde belirlenmektedir. Ünitenin kavramlarının, diğer okul dersleri, diğer matematik konuları ve kendi içinde ilişkisini kavratmaya yönelik herhangi özel bir öğretim etkinliği gözlemlenmemiştir. Bir konunun anlatımı süresince karşılaşılan öğretim etkinlikleri öyle açık benzerlik göstermişlerdir ki bir konunun anlatımı, o konunun sunulması, konuyla ilgili alıştırmalar yapılması ve ödev verilip, ödev sorularının cevaplanması şeklinde modellenebilir. Analiz birimi olarak tekil matematik dersleri kullanıldığında, ilköğretim matematik derslerindeki eğitim etkinliklerine dair bir modelleme oluşturmak mümkün olmamıştır. Bununla birlikte, matematik derslerinde en sık gözlemlenen etkinlik alıştırma yapmak olarak gözlemlenmiştir. Çalışmanın sonuçlarına dayanılarak ileride yapılabilecek çalışmalar için bazı öneriler getirilmiş ve öğretmenler, öğretmen yetiştirenler ve eğitim politikalarında söz sahibi olanlar için bazı tavsiyelerde bulunulmuştur.

Anahtar Kelimeler: öğretim etkinlikleri, sınıf gözlemleri, ilköğretim matematik dersleri, ders modeli

To my family

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CHAPTER I

INTRODUCTION

Improving the quality in elementary education has a high priority on the educational agenda of many countries. One of the important questions is concerned with how we can effectively measure the quality and describe it. The quality of mathematics classrooms has been generally studied through paper and pencil tests (Bedi, 1997). In assessing the quality of mathematics education, the emphasis has been given to results of national assessment test, such as, high school entrance examination in Turkey. Although, these tests have provided some indication of the learning taking place and have offered some insight into the quality of the learning, they have not highlighted the quality of the teaching. Neither have they illuminated suggestions for improving quality (Bedi, 1997).

It has been argued that there is a need to understand what is happening in the classroom context and more specifically on the teaching and learning processes in order to increase the quality of education. Methods such as lesson observations, learner interviews, and teacher interviews may provide us with a critical understanding of assessing and improving the quality which paper and pencil tests cannot provide (O'Sullivan, 2006).

In the case of Turkey, the quality of education and in particular, the quality of mathematics education is still discussed through the results of the national examinations or international comparison studies. For example, it was found that students could achieve no more than 50% of the curricular objectives in mathematics and science (Eğitim Araştırma Geliştirme Dairesi Başkanlığı [EARGED], 2002). Similarly, the results of High School Entrance Exam (LGS) indicated that the mean number of correctly answered questions in mathematics section was 1.1 out of 25 questions in 2004 and 2.35 in 2005 (Milli Eğitim Bakanlığı [MEB], 2005). According to the results of Third International

Mathematics and Science Study (TIMSS), the ranking of mathematics scores of Turkish 8th graders were 32nd out of 38 countries. In addition, the results of Program for International Student Assessment (PISA) showed that Turkey was the 35th of 41 countries in terms of mathematics literacy. Although the statistical results related to the quality of mathematics education are accessible through these studies, we have limited knowledge about what actually happens in a typical mathematics classroom in Turkey.

As the results of several international studies presented a great difference among the participated countries, studies were conducted in order to understand the factors impacting students' achievement level. While searching for the factors, a significant concentration was given to understanding the nature of the classroom practices (Stigler, Gonzales, Kawanaka, Knoll, and Serrano, 1999; Hiebert Gallimore, Garnier, Givvin, Jacobs, and Smith, 2003). The major questions investigated through these studies were focusing on the differences in elementary mathematics classrooms and the teaching practices in the countries that have relatively high scores. These studies documented what happened in typical classrooms and explored the differences in the teaching and learning processes in different countries. However, little attention was given in understanding the classroom practices in Turkey despite the low achievement level of Turkish students.

Considering the lack of sufficient knowledge about the typical practice of mathematics teaching in Turkey, this study aimed to provide insight on the practices in elementary mathematics classrooms. Specifically, the study investigated what actually happens in the mathematics classrooms in Turkey through lesson observations. The main idea during the study was that the classroom practices constituted the center of the quality issues in education.

1.1 The Significance of Classroom Observation

There are no ready to use recipes that result an important shift in lesson effectiveness for each classroom. However, the literature on mathematics teaching and mathematics classrooms can give us crucial information where we should

focus our attention on. The research on classroom procedures is one of the crucial fields to focus on for improvements.

Recently, increasing attention has been given to the observation of mathematics classrooms and identification of common instructional practices in many international studies (Stigler et al., 1999; Hiebert et al., 2003; Clarke and Mesiti, 2004). Researchers pointed out the importance of examining classroom practices. For example, Stigler et al. (1999) argued that studying classroom processes is important in the sense that they can help developing instructional quality and monitoring implementation of instructional policies. According to them studies of classroom process can serve two broad purposes. First, such studies are likely to emphasize the classroom practices that can be used while developing and validating models of instructional quality. The classroom processes that connect instruction to learning should be understood so as to improve quality of the processes. Second, studies of classroom process are functional tools to examine the accomplishment of instructional policies in classrooms. In a view of the fact that the need of developing instructional quality and examining implementation of instructional policies is an important matter for mathematics education in Turkey, similar to many other countries, examining Turkish mathematics classrooms is very crucial.

Furthermore, the success of a classroom in specific, and success of the educational system in general is directly related with the teacher's practices in classroom (Külahçı, 1984). However, teacher's practices in classroom do not only serve for students' achievement but also serve for constructing positive attitudes toward mathematics. The methods and behaviors of teachers while teaching mathematics are one of the important reasons of developing positive or negative attitude towards mathematics (Baykul, 1997; Kızıloğlu & Konyalıoğlu, 2002). Examining the teacher practices in classroom settings, then, can contribute the discussions on increasing students' positive attitude toward mathematics.

In addition, Hiebert et al. (2003) further argued about the importance of studying teaching and classroom practices while reporting the results of the 1998–2000 TIMSS Video Study. They emphasized that being aware of what is going on in the mathematics classrooms is a must for better understanding of students'

learning and developing it. Although the relationships between teaching practices in classroom settings and students' learning are complicated, researchers provided enough evidence that teaching makes a difference in students' learning (Brophy and Good, 1986; Stigler and Hiebert, 1999). Therefore, research on teaching practices can stimulate discussions of ways to improve classroom learning opportunities for students. Gathering more data on teaching practices in Turkish mathematics classroom will contribute to the discussions of mathematics learning of Turkish elementary students.

Moreover, while highlighting the results of TIMSS 1999 Video Study of Eighth-Grade Mathematics Teaching, National Center for Education Statistics (NCES) (2003) suggested focusing on classroom practices so that to provide rich descriptions of what actually takes place in mathematics classrooms. These descriptions could contribute to further research about features of teaching that most influence students' learning.

Classroom teaching is the process that brings the curriculum into contact with the students and through which national education goals are to be achieved. Although indicating the difficulty of studying the direct effects that teaching procedure may have on student learning, NCES (2003) concentrated on classrooms where teaching is actually practiced. They argue that studying classroom practices can help educators and researchers to learn more about teaching and in turn, help them to better "identify factors that might enhance student learning opportunities and, by extension, student achievement" (p. 3).

According to Clarke and Mesiti (2004), classroom practices are "the most evident institutionalized means by which the policies of a nation's educational system are put into effect" (p.4) and therefore it is rational to pay consideration on these practices. They added that "the classroom seems a sensible place to look for explanations and consequences of the differences and similarities identified in international comparative studies of curriculum, teaching practice, and student achievement" (p. 4).

It has been known that teaching influences students' learning, but it is not the sole cause of learning. Several factors, both inside and outside of school, can affect students' levels of achievement (Floden 2001; Wittrock, 1986). For these reasons,

while presenting the results of this study, the descriptions of teaching will not be linked to students' level of achievement.

The concentration on classroom practices at national and international studies made the comparisons of these practices among cultures more critical. The comparisons were not only useful for "discovering new alternatives" for teaching practices but also "revealing one's own practices more clearly" (Hiebert et al., 2003). A conceptual framework/legitimate unit for analyzing teaching practices was needed to make more influential comparisons (Clarke & Mesiti, 2003; Jablonka, 2003; Mesiti, Clarke & Lobato, 2003; and Shimizu, 2003; Stigler et al., 1999). "Lesson Pattern" is one of the frameworks for describing teaching practices in a national respect and being a unit of comparative analysis in international studies of classroom practice (Hiebert et al., 2003; Stigler et al., 1999).

1.2 Lesson Pattern

The broad purpose of the TIMSS 1999 Video Study was stated as to "investigate and describe teaching practices in mathematics and science in a variety of countries" (Hiebert et al., 2003, p.1). This comparison study tried to identify similar or different lesson features across countries and to describe patterns of teaching practices within each country. On the other hand, studying a single country, as in the current study, may form a base for the future studies that will have an aim to compare teaching practices of different school cultures.

One of the important questions related with classroom practices is that a single lesson period can be a base for drawing a representative structure of mathematics classrooms. For example the researcher participated in TIMMS Videotaped Classroom Study reported one of their goals as to "develop objective observational measures of classroom instruction to serve as valid quantitative indicators, at a national level, of teaching practices in the participant countries" (Hiebert et al., 2003, p.1). They used one videotaped lesson from each classroom and analyzed the content and organization of the lessons, as well as described the instructional practices used by teachers during the lessons.

After TIMSS 1999 Video Study, an important number of publications have been made about the structure of mathematics lessons in different countries. For example, Clarke (2003) discussed the structure of mathematics lessons in Australia, Jablonko (2003) interested in German Mathematics classroom, and Shimizu (2003) concerned with the structure of Japanese mathematics classrooms. One common criticism of these studies to TIMSS Video Studies (1995 & 1999), which intended to find out representative structures of mathematics classrooms, was that the observation of single lessons could not adequately capture the variety of essence and structure within a teacher's classroom practice (Clarke, 2003; Jablonko, 2003; Shimizu, 2003). All of these improvements, supports, and critiques have showed the increasing interest on structure of mathematics lessons.

However, the discussion on constructing a lesson structure at the national level is a recent research area, and need development. Even the name of concept is still developing; Clarke (2003) indicated an interesting shift from discussion of "lesson scripts" (Stigler & Hiebert, 1998) to "lesson patterns" (Stigler & Hiebert, 1999) and from "hypothesized country models" to "lesson signatures". Similar to its name, the content of the concept is open to development.

Given that the new mathematics curriculum in the Turkish elementary schools has been initiated recently, this study also highlights what kinds of mathematics teaching practices the new curriculum intends to change in the classroom and what kinds of lesson pattern the new curriculum intends to construct.

1. 3 The New Curriculum and the Practice of Mathematics Teaching

The emphasis on alternative mathematics teaching practices has been increased over the past few decades (Özsoy, N., 2003; Türnüklü, E.B. & Yeşildere, S., 2004). Turkey, similar to many other developed and developing countries, has been engaged in the attempt of searching for improved classroom practices. Ministry of National Education has just embarked on the implementation of a new national mathematics curriculum which is quite different from the mathematics curriculum previously used in schools. This curriculum has been implemented in the 1st to 5th grade since the year 2005, and implemented in 6th grades in the

following academic years. Yet, looking at these attempts globally, the discussions on the influence of such curricular reforms to the classroom practices are highly loaded (Obando, 1993). For the case of Turkey, a reliable understanding of the possible influence of such reforms in classroom practices is obviously required that the characteristics of current mathematics classroom practices should be studied in depth. Detailed described characteristics can create chance for future comparisons with the characteristics of reformed mathematics classrooms.

In the new mathematics curriculum in Turkey, the mathematical content from the previous curriculum was mostly maintained. However, a major shift was proposed in the implementation of new pedagogies used to teach mathematics. The new mathematics curriculum that is being implemented requires the active engagement of students in the learning process as its main focus. What will be the effect of such changes in mathematics classroom practices? How can we decide that which classroom practices reflect such changes and which do not? It is crucial to characterize current mathematics classrooms for more clear comprehension of the effect of new curriculum.

According to Trow (1971) "reform implies that some on-going process is ineffective or has harmful by-products, and does not satisfy the purposes for which it was intended, and so needs repair or renovation to operate satisfactorily" (p. 87). In the light of this argument and the report of EARGED indicating that students could achieve no more than 50% of the curricular objectives in mathematics, one can clearly argue that mathematics education in Turkey need a reform. However, such statistical results can not give enough information about what components of mathematics education need to be reformed. It is crucial to analyze on-going process of mathematics education critically; such analyzes will also help us to make useful suggestions to increase the positive effects of reform (Şahin, 2005).

Although the number of experimental researches that studied the effect of new teaching method by comparing traditional one is very high, there was very limited - almost none - research examining the practices of so called "traditional" mathematics classrooms. While these studies defined the characteristics of experimental method in detail, the traditional mathematics classrooms is characterized superficially as; the learning process had been handled in a more

passive way, instruction consisted mainly of lecture, and teachers were supposed to hold the knowledge that could be transferred to students. One of the important parts of these experimental studies is the difference that the experimented practices, strategies and methods produce in students' achievement in comparison to traditional teaching practices. However, the nature and the substance of traditional teaching practices are crucial aspects of such studies in order to make more powerful conclusions. Although research on characteristics of mathematics lessons in developed countries has a huge literature (Stigler et al., 1999; Hiebert et al., 2003; Henke, Chen, and Goldman, 1999; O'Sullivan, 2006; Weis, 1994; Good & Biddle, 1988; Brophy & Good, 1986), the related literature about characteristics of Turkish mathematics classrooms is very limited. The characterization that drawn below was not mainly based on the observations of mathematics classrooms but on the description of traditional mathematics classrooms in international mathematics education community.

Although there is an increasing literature about the instructional practices in international mathematics community, there is no detailed research focusing on the teaching and learning process of elementary mathematics classrooms that will help us to identify on-going process of mathematics lessons in elementary schools of Turkey. Therefore, this study aimed to interpret detailed observations from three 6^{th} grade elementary mathematics classrooms throughout a unit, to conclude pattern for participated three mathematics classrooms by examining the sequence of activities throughout mathematics lessons, and describe frequently observed teaching features throughout observations.

1. 4 Problem of the Study

Problem Statement: What are the patterns in instructional practices that are used by the teachers throughout a unit, a subject, and a lesson in the 6th grade mathematics classrooms?

Specifically, this study focused on the following issues in relation to the research problem;

(a) the overall characteristics of practices in mathematics classrooms

(b) the teaching practices throughout a mathematics unit, and the flow of these practices,
(c) the teaching practices throughout a mathematics topic, and the flow of these practices,
(d) the teaching practices throughout a single lesson period, and the flow of these practices,
(e) teaching practices that are frequently observed in mathematics lessons.

1.5 Significance of the study

If the researchers and educators can learn about teaching as it is actually practiced, it will be much easier for them to identify factors that might enhance students' learning opportunities (Stigler et al., 1999). The results of this study will provide a general description of how mathematics teaching is practiced in elementary schools and so will help researchers and educators to examine factors that improve students' learning. Having an idea about how teaching practices was organized in mathematics classrooms may give clues to researchers in examining the effects of these organizations.

This study may also give crucial information for the international comparisons of mathematics lessons by providing rich description of what actually takes place in mathematics classrooms. These comparisons will allow educators to assess their own teaching practices from different perspectives by displaying the other applications from different countries (Stigler et al., 1999; Hiebert et al., 2003).

Moreover, the findings of this study may contribute to discussions on constructing lesson patterns, signature, or structure of elementary mathematics instruction in national level and on comparisons of these patterns in international level. Construction and comparisons of lesson patterns highlighted the one's common practices and creates chances for discovering alternatives for these practices (Hiebert et al., 2003).

One of the major factors that have an influence on the instructional practices of mathematics classrooms is the teacher education programs. Information about the patterns in instructional practices of elementary mathematics lessons can give

useful suggestion for reorganizing and reconstructing the repertoire of method courses of teacher education programs. Being aware of common practices through teaching a concept may serve as a base of discussing alternatives methods and practices for teaching it. In addition, it is an ongoing concern of teacher educators that teacher education programs in universities are far from the realities of classroom cases (Cakiroglu & Cakiroglu, 2003). By providing practices from real cases, this study will give teacher education programs an important chance to go over their curricula to make improvements and to fill the gap between university courses and real classroom cases.

It is also expected that the result of this study will provide insights to prospective mathematics teachers about the current practices and flow of these practices in elementary mathematics lessons. This insight may lead teachers to make critical changes in their classrooms to increase effectiveness. Allowing prospective teachers criticize the ways classroom practices was organized may encourage them for using alternative organizations.

1. 6 Definitions of related terms

Lesson Pattern: "Certain recurring features that typified many of the lessons" (Shimizu, 2003, p.2) within a classroom, school, or country. If there are features that characterize teaching in a particular classroom, there should be enough similarities across lessons within the classroom to reveal a particular pattern. For example, in the TIMSS Videotape Classroom Study, certain recurring features that typified many of the lessons within a country, Germany, Japan, or the United States, and distinguished the lessons among three countries were identified as "lesson patterns"(Stigler & Hiebert, 1999). Lesson signature (Hiebert et al. 2003), and lesson structure (Shimizu, 2003; Clarke & Mesiti, 2004) are synonymously used with the term lesson pattern in this study.

In the present study, if the teaching and learning practices through a single lesson period or through teaching a topic was recorded in a similar sequence and formation, then this sequence and formation was labeled as lesson pattern of single lesson or teaching a topic, respectively.

Teaching and Learning Practices: The act of teachers and students in the context of teaching and learning throughout a lesson. In the present study, teachers' and students' actions and behaviors which serve for teaching and learning of the related mathematics concept was considered as teaching and learning practices.

CHAPTER II

LITERATURE REVIEW

This chapter provides a review of literature related with the importance of classroom observations, practices in Turkish elementary mathematics classrooms, the design and results of the studies related with the lesson pattern, and the discussions on lesson pattern.

2. 1 Importance of Classroom Observation

‘‘If policy makers were able to enter the classroom and have the experience of learners and teachers, how might their debates and decisions about quality be transformed?’’ (Schubert, 2001, p. 6). This challenging statement is one of the bases of this study. It is also believed that the debates and decisions about the educational quality should stand on the practices in the classrooms. It is very important to strengthen our capacities to systematically access the classroom practices, conditions for teaching and learning, and to use this knowledge as a basis for reforming national policy and local practice. This study also sought to bring the classroom experience of teachers and learners to the policymakers, teachers, and researchers by reporting detailed observations from three elementary mathematics classrooms throughout a unit.

Fullan (1991) argued that ignoring teachers’ and students’ real experiences with curriculum is one of the main reasons of failure in achieving the goals of curriculum. Observations of classroom practices can assist to address the difficulties in reaching the aims of curriculum. Descriptive evidence that characterizes the nature of instruction and that provides a comprehensive portrayal of the learning environments is essential to understand the activities and processes that lead to greater mathematics achievement.

O'Sullivan (2006) argued that if Ministries of Education in developing countries are serious about improving the quality of education and aware of that quality is directly related with the teaching and learning that takes place in classrooms, then they should look more closely at practices in classroom context. Being aware of the importance of classroom practices, O'Sullivan (2006) stated that "lesson observations can illuminate teaching and learning processes and indicate the quality of education taking place at the chalk face and also highlight the realities within which teachers work and which practices can be effective in these realities" (p.251). O'Sullivan added that the use of lesson observation is not an innovative approach; yet, the literature suggests that it is rarely used in research and evaluation studies which seek to improve and assess quality in developing countries, and even more rarely, to inform policy or in implementation efforts. In addition, O'Sullivan emphasized that lesson observation creates chances for examining and determining the "nature of quality" for improving it. She also indicated that her work on an in-service teacher training project in Namibia showed that "lesson observations highlighted the realities within which teachers worked and indicated the potential or otherwise of specific teaching and learning approaches" (p.254).

As reviewed briefly above, researchers indicated that gathering detailed information from real classroom settings has a crucial importance for policy makers. Being aware of what teachers and students experienced in classrooms is not only useful for setting the goal of curriculum but also for applying and reaching the goals of it. It was also emphasized that direct observations of classrooms is one of the main tools for gathering this information. This argument in the literature guided the researcher while deciding the methodology of this study.

The critical importance of classroom observations in understanding the implemantation of an educational program became more comprehensible with some other studies. Clarke (2003), for example, designed an evaluation study about the District Primary Education Project (DPEP) in India. The study involved the observation of 243 teachers in order to understand whether the project was successful or not. The program attempted to "transform instructional practices in

primary school classrooms integrally through a holistic programme of pedagogical reform" (Clarke, 2003, p. 27). Lesson observation data indicated that even though teachers increased their use of instructional aids, activities and demonstrations during instruction, it did not

> Integrally transformed their teaching and learning in the classroom. They have skillfully integrated 'activity and joyful learning' into their traditional rote method of instruction where it is transferred en bloc and memorisedy. During instruction, though transformed with activity and demonstration, teachers remain primary players in the classroom (Clarke, 2003, p. 38).

It would not be possible to reach such detailed information without direct observations of classrooms.

With its importance in making national-level decisions, qualitative information from classrooms is also important for more specific teacher's decisions in classroom settings. For example, while indicating the possible purposes of observing classroom practices, Borich (2003) stated the following implications;

- Become aware of own behavior to help make decisions that consciously control and alter the stream of events in the classroom,
- Discover alternative instructional practices and new solutions to instructional problems,
- Determine personal teaching strengths and areas for improvement,
- Focus on reflections related with important areas of teacher effectiveness (p.14-15)

Borich added that the teachers make many decisions each day about the instructional practices (how to capture student attention, how to summarize the lesson, and what seatwork to assign), they sometimes make these decisions unconsciously by the flow of rapidly paced events in the classroom. Classroom observations could make teachers more aware of their teaching so that they can realize some of their unconscious decisions and unchecked assumptions. In

addition, these observations could make teachers aware of possible alternative organizations/flows so that teachers could change their traditions.

Good, Slavings, Harel and Emerson (1987) also contend that classroom teachers are unaware of much of their teaching practices. They argued that teachers ask factual questions more often than they realize while they ask higher level questions far less. And teachers make few attempts to motivate students. It is the observation and examination of classroom practices that brings such awareness.

There are several studies that focused on the classroom observations specifically in mathematics. The studies of Cho (2001), Nicol and Crespo (2004), and Demuth (2005) could be examples of such a focus. These studies used classroom observations as a resource of analyzing what is going on in mathematics classrooms.

For instance, after indicating the decline in mathematics performance of U.S. students, and negative attitudes and beliefs of U.S students toward mathematics, Cho (2001) indicated the urgent need to conduct comprehensive research on mathematics education and develop a sound instructional strategy at that level. He focused on how mathematics is being taught and learned in mathematics classrooms and conducted a case study to describe and analyze the actions of participants in four college mathematics classes.

According to findings of his study (Cho, 2001), the traditional characteristics of observed mathematics classes could be summarized as; strongly teacher centered classrooms with the lack of any use of technology. Cho added that teachers did not show any desire to change the traditional instructional approach that they had experienced as students. He also emphasized that when each instructor presented new material in lecture style, their students sat quietly without any participation. He continued his interpretations as; students engaged in copying down what was written on the board, lecture did not stimulate their interest, and classroom discussions were limited to closed-ended questions that asked for a specific piece of information.

After presenting his findings, Cho recommended that the teaching practices need to be organized as students engage with their own learning. He added that

teachers need to listen as much as they need to speak; teachers' role should include those of consultant, moderator, and interlocutor, not just presenter and authority; and technology needs to be more fully utilized.

In their study, Nicol and Crespo (2004) reported a prospective teacher's investigation of teaching practice by recording and analyzing her own mathematics teaching. They indicated that the "participated prospective teacher moved from not seeing what she could learn from her students to attending to their mathematical dispositions, to noticing parallels between her own learning and that of her students" (p.423). They also suggested that novice teachers need not only opportunities to analyze the practices of more experienced teachers, but also need opportunities to study their own practice through analyzing their teaching. It is the observations of teaching practices that give teachers the opportunity of analyzing their teaching.

Demuth (2005) provided a detailed qualitative and quantitative description of instructional environments that characterize first-grade classrooms, with particular emphasize on description of mathematics instruction. Demuth summarized her findings as; characteristic mathematics instruction was 40-50 minutes in duration, consisting of teacher directions, limited problem exposition, and the majority of the time spent in unsupervised or supervised seatwork; the predominant teaching method was direct instruction, with limited expository teaching; instructional decisions by teachers were very limited, and controlled by curriculum.

The reviewed literature indicated essentially that classroom observation is very crucial for being aware of the practices and experiences in mathematics classrooms. However, there is no detailed descriptive/qualitative literature on what is going on Turkish elementary mathematics classrooms. But it is possible to reach some statistical/quantitative research for the case of Turkey. Following section will describe and summarize two quantitative studies on practices in Turkish elementary mathematics classrooms.

2. 2 Practices in Turkish Mathematics Classrooms

Şahin (2005) examined teachers' and students' perception of teaching-learning practices in elementary mathematics lessons. 50 elementary mathematics teachers and 200 elementary students participated in this survey study. A four point Likert-type questionnaire was used to allow students and teachers to rate their activities in the classroom. The questionnaire was divided into teacher-related and student-related parts. The teacher related part mainly examined the teachers' perception of how they assign and assess homework, what the reasons of limitations in classroom activities are, what they want students to do related with mathematics content in mathematics classrooms, and how they use the assessment results. The student-related part examined the students' perception of classroom activities they participated and activities in the beginning of the new content.

According to the findings of the study, teachers thought that most of the time they control students whether they do or not do their homework, and they allowed students correct their homework with giving explanatory information. They also thought that they less frequently collect, correct, and keep the homework. Examining how teachers assign homework showed that they assign homework from textbook and worksheets most of the time, and they, less frequently, wanted students to work on long term projects and take a diary.

Teachers mostly saw the students who need extra care (with disabilities in seeing, hearing, talking, with emotional problems and etc.), indifferent/disinterested students and crowded classrooms as major limitations for classroom activities.

Teachers thought that they more frequently want students explain the logic behind a concept, and practice for computation ability. They rarely wanted students work on problems which have unknown/undetermined solution method and use computer or calculator for solving problems.

In addition, according to students' perceptions, teachers almost always let students note what is on the board, show how to solve a mathematics problem, assign homework, and let students work on the board. On the contrary, students thought that they rarely work on mathematics projects, use calculator, overhead projector or computer, and discuss on assigned homework.

Another important finding of the study was related with activities in the beginning of new content. Students thought that introduction of a new content mostly consisted of teachers' explanations of definitions and rules and working on an example related with new content. They thought also that teachers very rarely let students work with groups on a problem or a project and discuss on real life situations.

Kızıloğlu and Konyalıoğlu (2002) examined the secondary mathematics teachers' behaviors in mathematics classrooms. The data of the study was gathered through the observations of mathematics teachers from 12 high schools by 110 prospective mathematics teachers. Prospective mathematics teachers had been informed about how they observe mathematics teachers. After the 14 weeks period, prospective teachers' observations related to teacher's behavior were examined by a questionnaire. The questionnaire had three main questions related with the practices in the beginning of a lesson, in the development of a lesson and in the end of a lesson. Each main question was divided into yes-no questions related with expected behaviors of teachers. For example, did teacher summarize the previous topics in the beginning of the lesson?

According to the findings of the study, 46 (% 42) of 110 observers indicated that the observed teacher summarize the previous concepts, and 42 (% 38) of them indicated that teacher explain the objectives/goals of the lesson in the beginning of the lesson. For the development segment of a mathematics lesson, 38 (% 35) of the observers stated that observed teachers used necessary materials for their lectures, 43 (% 39) of them stated that teachers get students' interest by giving interesting examples, and 47 (% 43) of them stated that teachers give a variety and plenty of examples. For the end of a mathematics lesson, 41 (% 37) of prospective teachers indicated that teachers assess students according to objectives, and 40 (% 36) of them indicated teachers use suitable measurement tools properly.

The findings of these studies would be very beneficial for organizing the discussion on the findings of this study. Having an idea related with teachers' and students' perceptions on mathematics classroom practices made valuable contributions to examine and criticize the findings of this study.

2. 3 Lesson Pattern from Different Countries

After summarizing a couple of studies related with Turkey on practices of elementary mathematics classrooms, it will be helpful to give information about studies on mathematics classroom practices from some other countries. Such information will help organize the findings of this study, and create chances for putting this study in a conceptual framework.

Reviewing the related literature showed that examination and comparison of practices in mathematics lessons became more popular after the TIMSS Videotape Classroom Study (1995). The TIMSS study was an 'exploratory research project' examining eighth-grade mathematics classroom in three countries, Germany, Japan, and the United States (National Center for Educational Statistics, 2000). Stigler et al. (1999) emphasized that the study was not only the first large-scale study that videotaped mathematics classroom practices from different countries but also it is the first attempt to observe instructional practices in a "nationally representative sample". Teaching practices from 231 eighth-grade mathematics classrooms were recorded for the study: 100 classrooms in Germany, 50 in Japan, and 81 in the United States. These selected classrooms were also participated in the 1994-95 TIMSS assessments.

In the TIMSS Videotape Classroom Study, certain recurring features that typified many of the lessons within a country, Germany, Japan, or the United States, and distinguished the lessons among three countries were identified as "lesson patterns" (Stigler & Hiebert, 1999). 'Single lesson periods' were used as the unit of analysis while constructing these patterns.

The following sub-sections summarize the general characteristics of mathematics classrooms and describe the lesson pattern of each participated country.

2. 3. 1 The general characteristics of mathematics classrooms and lesson patterns of Germany

As mentioned above, 100 eight grade mathematics lessons from Germany were videotaped for the study. The videotaped lessons (observations) were

analyzed to examine the practices throughout a single mathematics lesson. The findings of the study are summarized briefly in Table 2.1.

Table 2.1. Practices in German Mathematics Classrooms

The goal of the lesson	The attainment of a skill or procedure for solving a mathematical problem
	Understanding the rationale for the procedure
Organization of the lesson	Working as a whole class
	Guiding for the development of required skill or procedure
	Presenting a related task
	Working with problem on the board (teacher or students)
	Monitoring the works on the board (students)
	Moving the next steps of the problem with questions related with rationale for the steps
	Working on similar problems
End of the lesson	Emphasizing the principle that guides the development of the procedure or skill
	Practicing the procedure/skill on similar problems

According to findings of the study, acquiring required skills for solving mathematical problems was the main objective of a German mathematics lessons. Understanding why such skills and procedures were required was also important. The practices were mostly done as a whole class. Instead of lecturing, teachers tried to let students develop the required skills or procedures. Asking short-answer questions to students mainly served as a guide for skill development. This development generally was done by working on a task. If the students were unfamiliar with the task, the teacher worked on it, if they are familiar, then a student worked. All students were responsible for monitoring and helping the solution of the task. It was also expected from students to explain the rationales for the steps of task solution. After similar tasks were worked by students, the principles and procedures for the solution of the task were summarized. The lesson ended with students' practices on similar problems.

Stigler and Hiebert (1999) conclude their findings as a typical pattern for the German mathematics classrooms. According to them, German mathematics classrooms consist of a sequence of four phases:

1. Reviewing previous material, commonly by checking homework or by a brief lecture.
2. Presenting the topic and the problems (for the day).
3. Developing the procedures to solve the problem, typically in a whole class activity guided by the teacher.
4. Practicing, usually by the assignment of a set of problems similar to those in the previous phase, which are solved by the students in seatwork. If not finished, it can become homework to finish the problems. (Stigler & Hibert, 1999, pp. 79)

2. 3. 2 The general characteristics of mathematics classrooms and lesson patterns of Japan:

The following results were based on the observations from 50 Japanese mathematics classrooms. The findings related to flow of the mathematics lesson reported by Stigler et al. (1999) is summarized in Table 2.2

Table 2. 2. Practices in Japanese Mathematics Classrooms

The goal of the lesson	Develop mathematical thinking
Organization of the lesson	Selecting a challenging mathematical problem Introducing the selected problem Students work on the problem at their seats individually or in groups Monitoring the students work and noting the different methods that students are constructing. Sharing constructed methods and solutions Brief lecture on these methods
End of the lesson	Summarizing the methods Relating current tasks with the previous ones

Instead of acquiring a skill for solving a mathematical problem, the goal of a Japanese mathematics lesson was set as developing mathematical thinking. This mathematical thinking could be developed through a mathematical proof or working on challenging mathematical problem and sharing solution methods for the problem. Firstly, the selected problem was introduced to students. Students worked on the problem individually or in groups, and tried to construct solution methods for the problem. The constructed methods, then, shared with the classmates. Lastly, a brief lecture related with these methods was provided. This procedure was repeated several times in a lesson period. At the end of the lesson, the solution methods and relations between these methods was summarized.

The following sequence of five activities has been described as the Japanese pattern by Stigler and Hiebert (1999):

1. Reviewing the previous lesson;
2. Presenting the problems for the day;
3. Students working individually or in groups;
4. Discussing solution methods;
5. Highlighting and summarizing the main point. (Stigler & Hibert, 1999, pp. 79-80)

2. 3. 3 The general characteristics of mathematics classrooms and lesson patterns of United States:

The flow of the U.S. mathematics classrooms was described according to observations from 81 eighth grade classrooms in the same study. The basic characteristics of a mathematics classroom are described in Table 2.3

Table 2. 3. Practices in Unite States Mathematics Classrooms

Goal of the lesson	Attainment of a skill or procedure for solving a mathematical problem
Organization of the lesson	Controlling assigned homework, collecting them, and working on some of the homework questions Presenting definitions, properties or principles in the form of procedural rules Demonstrating of a new procedure or a reminder of how a procedure is used in the situations presented in this lesson. Working on several examples as a whole class Guiding the students through the procedure by asking short-answer questions
End of the lesson	Similar problems assigned as homework Students work on homework

Similar with the German mathematics lessons, the goal of the United States mathematics classroom was determined as acquiring required skills for solving mathematical problems. Nevertheless, the rationale for the required skills and procedures was not emphasized unlike a German mathematics classroom. A typical lesson began with controlling students' homework. Assigned homework was collected and some of the homework problems that students had difficulty were solved by teacher. After this control, definitions, principles, and procedures related with new content were presented by teacher. Then, how these definitions and principals would be used for solving a mathematical problem was demonstrated. Students worked on similar problems which were mainly presented in textbook or worksheets. In this problem solving periods, teacher' short answer questions served as a guide for required procedures. Assigning similar problems as a homework and allowing students work on them were the last practices of United States mathematics classrooms.

The following sequence of four activities drawn from 81 videotaped classrooms has been described as the lesson pattern for United State:

1. Reviewing previous material
2. Demonstrating how to solve problems for the day
3. Practicing
4. Correcting seatwork and assigning homework (Stigler & Hibert, 1999, p. 80)

2. 3. 4 Some Similarities and Differences between Three Countries

While highlighting the results of TIMSS 1995 Videotape classroom study, the U.S. National Center for Education Statistics (NCES) (2000) indicates the similarities and differences among three counties in terms of students' role throughout a mathematics lesson. The eighth-grade mathematics lessons of United States and German were very similar in terms of students' role. Students had two basic roles in German and United States mathematics lessons. Firstly, students were expected to watch and pay attention teacher's or their peers' demonstration so as to acquire how to deal with particular types of problems. Secondly, after observing the demonstrations, students are expected to exercise on similar problems. However, students' roles in Japanese eighth grade mathematics lessons were very different than the students of United States and Germany. Instead of observing and practicing, students, firstly, are expected to work on problems, and then share their methods and solutions in teacher-directed discussions.

In addition, NCES (2000) also indicated the difference across countries in terms of delivery of the mathematical content/concepts. There are two main ways of delivering a mathematics concept; stating it or developing it. For example, a mathematic concept might simply be stated, as in "the area of a rectangle is equal to multiplication of its length and width" or it might be developed and derived over the course of the lesson. NCES states the difference as "More than three-fourths of the topics presented in the German and Japanese lessons contained concepts that were developed, compared with about one-fifth of the topics presented in U.S. lessons" (p. 4).

Another important inference that NCES (2000) makes was related with the constructing proofs as a part of the mathematics lessons. NCES stated the importance of constructing proof and differences across countries in terms of occurrence of it. A greater percentage of the Japanese lessons include proofs than either the German or U.S. lessons. According to findings, "10 percent of the German lessons include proofs while 53 percent of the Japanese lessons include proofs. None of the U.S. lessons included proofs" (p.4).

2. 3. 5 Hypothesized Classroom Patterns from TIMSS 1999 Video Study

The findings of TIMSS 1995 Videotape Classroom Study enhanced the emphasize on lesson pattern of countries. Hiebert et al. (2003) designed a similar international study, Third International Mathematics and Science Study Video Study (TIMSS 1999 Video Study), to reach more detailed information from more countries. Similar with the purpose of TIMSS 1995 Videotape Classroom Study, the aim of TIMSS 1999 Video Study was to "investigate and describe teaching practices in eighth-grade mathematics and science in a variety of countries" (Hiebert et al., 2003, p.1). 7 countries, Australia, the Czech Republic, Hong Kong SAR, Netherlands, Switzerland, United States, and Japan, were participated the study. 87 mathematics classrooms from Australia, 100 mathematics classrooms from Czech Republic, 100 mathematics classrooms from Hong Kong SAR, 78 mathematics classrooms from the Netherlands, 140 mathematics classrooms from Switzerland, 83 mathematics classrooms from United States, and 50 mathematics classrooms from Japan (the videotapes of TIMSS 1995 Videotape Classroom Study was used as Japanese sample) were filmed for the study. The final sample is composed of videotapes from 638 eighth-grade mathematics classrooms.

Different from the TIMSS 1995 Videotape Classroom Study, the findings of the TIMSS 1999 Video Study were organized in the title of "hypothesized country model" or "hypothesized classroom patterns". Hypothesized country model is defined as "holistic representations of a typical mathematics lesson in each country" (Hiebert et al., 2003, p.204). Similar with TIMSS 1995 Videotape Classroom Study, 'single lesson periods' was used as unit of analysis in the TIMSS 1999 Video Study. Hypothesized classroom patterns for six participant

countries are summarized below (Hypothesized classroom pattern for Japan was not reported in Hiebert et al.'s study).

Hypothesized classroom pattern for Australia;

1. Review; review of relevant material previously worked on, check/correct/review homework; reinstruct
2. Introduction of new material; presentation of new material-providing information with asking some questions and examples
3. Assignment of task; assignment of task-teacher describes textbook/worksheet task
4. Practice/application and re-instruction; working individually or in pairs on task, assigning new task and practicing
5. Conclusion; summary of new material; assignment of homework (Hiebert et al., 2003, p.205).

Hypothesized classroom pattern for the Czech Republic;

1. Review; evaluating with oral exams and homework, securing old knowledge, re-explaining procedures
2. Constructing new knowledge; activating old knowledge by demonstration and solving problems, constructing new topics with step by step solutions, formulating the new information by writing definitions
3. Practice; solving similar problems and using knowledge in different real life situations (Hiebert et al., 2003, p.206).

Hypothesized classroom pattern for Hong Kong SAR;

1. Review; reviewing previous material in order to preparation for the present lesson, going over relevant material learned in the past, sometimes through asking questions
2. Instruction; introducing and explaining new concepts and/or skills with showing worked examples
3. Consolidation; practicing the skills learned, teacher assigns seatwork and students work on it, assigning and doing on homework (Hiebert et al., 2003, p.207).

Hypothesized classroom pattern for the Netherlands;

1. Re-instruction; going over old assignment with emphasizing the procedures
2. Instruction; presenting new material-teacher verbalize the text presentation or students read from the text
3. Assignment of task; writing and verbalizing the assignment for the day
4. Students attempt problems; working on assignment especially in pairs (Hiebert et al., 2003, p.208).

Hypothesized classroom pattern for Switzerland with introduction of new knowledge;

1. Opening; Collecting homework, informal talk
2. Construction of new cognitive structure; presenting 'real action' and modeling problem solving with asking questions
3. Working-through; working as a whole class for problem solving
4. Practice; individual, group or pair work at desks related with new content/tasks (Hiebert et al., 2003, p.209).

Hypothesized classroom pattern for the United States;

1. Review of previously learned material; giving quiz, checking homework, warm-up activity
2. Acquisition of knowledge; presenting new material with asking short-answer questions
3. Practice and re-instruction; solving problems, providing assistance while students work individually or in small groups at their seats (Hiebert et al., 2003, p.212).

These classroom patterns provided an understanding of alternative classroom practices and alternative organizations of these practices. This understanding will help researcher to interpret his findings more accurately. In addition, being aware of classroom traditions from different cultures allow

researcher discuss his findings from different point of views by comparing his findings with the other cultures.

2. 4 Discussion on Lesson Pattern

The findings of TIMMS Video Studies resulted in important discussions on drawing lesson pattern of mathematics classrooms. The main focus of these discussions is that the usage of 'lesson' as a unit, both of data collecting and analyzing while constructing pattern of mathematics classrooms. Especially, the capability of the single lesson periods as the unit of national characterization and international comparison is critically examined and alternative units of analysis, such as, classroom events, sequences of consecutive lessons, were considered by further researches (Clarke, 2003; Shimizu, 2003; Mesiti, Clarke & Lobato, 2003 Clarke & Mesiti, 2004; Jablonka, 2003).

The Structure of Mathematics Lessons in United States was one of these studies that examined the use of single lessons as a unit of analysis conducted by Clarke, Mesiti and Lobato (2003). The study was based on the observations of ten conesecutive single lessons from three mathematics classrooms so that it would be possible to question whether 'single lesson patterns' is observed across a number of consecutive lessons. In this study, Stigler and Hiebert (1999)'s description of lesson pattern for United States mathematics lessons (which was reported as reviewing previous material, demonstrating how to solve problems for the day, practicing, and correcting seatwork and assigning homework) was used for classification of classroom behaviors. The classroom behavior for each minute of every observed lesson was classified according to these four activities so that the occurrence of constructed lesson pattern was examined/tested. According to results of this study, the lesson pattern reported in the TIMSS Classroom Videotape Study did "not appear as the complete lesson structure" (Clarke, Lobato and Mesiti, 2003, p.7) in any lesson for two of the three mathematics classrooms.

Researchers also emphasized that the structure in a single lesson can be radically different in structure from other single lessons; for example, some lessons were spent only for explaining and correcting the students' seatwork or spent only for practicing (Clarke, Lobato & Mesiti, 2003; Clarke & Mesiti, 2004).

Opposed to works on lesson pattern with single lessons, they argued that "there is evidence to suggest that a single lesson pattern could not capture the essence and variety of lesson structure within an individual teacher's classroom capability and practice nor describe the typical lesson structure of all three classrooms in a satisfactory manner" (Clarke, 2003, p.4).

The researchers continued their analysis with suggesting an alternative method to the characterization of lesson practices (Clarke, Lobato & Mesiti, 2003; Clarke & Mesiti, 2004). They argued that 'specific lesson events' instead of the lesson itself could be used as the unit of analysis. They defined the specific lesson event as a specific event that had been observed every lesson or most of the lessons and had been composed of particular practices. Lesson event could be more understandable through an example.

According to their observations of mathematics classrooms, guided development could be an example of specific lesson event in the observed lessons. Guided development was an event that students and teacher worked together to construct an understanding of a concept. Following practices were described as characteristics of guided development event; the works were done as a whole class, interactive works between teacher and students were essential, instead of stating or demonstrating the concept, the stress was on development of it, teacher's guidelines were critical for developing the concepts. Since this development was observed frequently in observed lessons and it was composed of particular practices, it could be concluded as a specific lesson event.

Clarke, Lobato and Mesiti (2003) summarize their approach as;

> Under this alternative approach, the unit of analysis is no longer the lesson; it is the events through which lessons are constituted, which have their own integrity and character and which a teacher may employ differently within the various lessons that in combination constitute a content "topic" or "unit." One hypothesis suggested by our analysis is that the deployment and specific form of enactment of such lesson events is a more distinctive, revealing, and useful characteristic of mathematics lessons in a particular school system, country, or culture, than the lesson itself. (Clarke, Lobato and Mesiti, 2003, p.14)

Shimizu (2003) also critically examined and discussed the methodology of studying the structure of mathematics lessons. With emphasizing the need of more complex view on the structure of mathematics lessons than the lesson pattern described by Stigler and Hiebert's (1999) analysis of single lessons, he suggested the need to explore the "lesson structure in the sequence of lessons" in more details. In the light of this suggestion, he gave particular attention to the lesson pattern of a series of single lessons as embedded in the teaching unit of the topic to be taught. He argued that "the lesson pattern can be varied within the instructional sequence for teaching a topic, depending on the teacher's intentions" (Shimizu, 2003, p.3). He noticed that each lesson in a Japanese mathematics classroom had a different role for teaching an entire unit. Consecutive lessons were organized as a phase of the unit. For example, the lessons in the beginning of a unit could be spent for demonstrations, or statements of definitions, while the lessons in the end of a unit could be devoted for practicing.

Instead of Japanese lesson pattern described by Stigler and Hiebert (1999) (reviewing the previous lesson, presenting the problems for the day, students working individually or in groups, discussing solution methods, and highlighting and summarizing the main point), Shimizu (2003) identify thirteen categories for analyzing Japanese lesson pattern;

1. Reviewing the Previous Lesson (RP)
2. Checking Homework (CH)
3. Presenting the Topic (PT)
4. Formulating the Problem for the Day (FP)
5. Presenting the Problems for the Day (PP)
6. Working on Sub-problem (WS)
7. Working on the Problem Individually or in Groups (WP)
8. Presentation by Students (PS)
9. Discussing Solution Methods (DS)
10. Practicing (P)
11. Highlighting and Summarizing the Main Point (HS)
12. Assigning Homework (AH)
13. Announcement of the Next Topic (AN). (p.6)

After this categorization, he classified the classroom behaviors to conclude a lesson pattern. The analysis of ten consecutive Japanese mathematics lessons according to this classification is shown in Table 2.4.

Table 2. 4. Categories Found in the 10 Japanese Mathematics Lessons

Lesson	JP1	JP2	JP3	JP4	JP5	JP6	JP7	JP8	JP9	JP10
Categories	CH	CH	RP	PT	RP	CH	RP	RP	PT	P
	FP	RP	PP	FP	PS	RP	PP	PT	WP	WP
	PP	PS	WP	PP	WP	PP	PS	PP	PS	PS
	WP	WP	PS	WP	PS	WP	DS	PS	DS	DS
	PS	PS	DS	PS	DS	WS	HS	DS	HS	HS
	DS	DS	WP	AH	AH	DS		P	HS	P
	AN	AH	PS			HS		AH	DS	WP
	AH		HS			P				PS
			P			AH				AN
			AN							

Source: Shimizu, Y. (2003). Capturing the Structure of Japanese Mathematics Lessons as embedded in the Teaching Unit. (p.6)

Based on the findings of his study, Shimizu concluded that the Japanese lesson pattern drawn from single lesson periods could not represent the teaching and learning practices of mathematics classrooms. There were two main reasons for this inadequate representation; first, the role of a lesson could be varied through the teaching of entire unit because of teachers' intention; second, the role of pattern elements could be varied in the chain of lessons. He also added that "if each lesson is analyzed as "stand alone", it is not possible to capture the dynamics of teaching and learning process" and emphasized that "the value of a sequence of consecutive lessons as the preferable unit" (p.10) of data analyzing instead of single lesson periods.

Furthermore, after emphasizing the classroom as a sensible place to look for explanations and consequences of curriculum, teaching practice, and student achievement, Clarke and Mesiti (2004) discussed the ways of interpreting lesson

structures in national and international studies. They argued that lesson structure can be interpreted in three senses:

(a) In the sense of whole lesson – the practices throughout single lesson periods should be regular, ordinary and frequently observed;

(b) In the sense of the topic – the practices throughout a teaching a curriculum topic (which can last several lessons) should be regular, ordinary and frequently observed

(c) In the sense of the specific lesson events – the practices through the events of single lessons should be regular, ordinary and frequently observed

Each of these senses could be useful for different goals. For example, one of these senses could be more useful for national representations while other one for international comparisons. To derive a structure for mathematics classroom practices in a country, they indicated the importance of addressing the question "is a mathematics classroom practice, most usefully characterized at the level of the whole lesson, in the manner in which a topic is constructed, delivered and experienced, or in the form and function of the specific activities from which lessons are composed?" (p.5). The findings of this study could also serve for examining which of the lenses (or is an another lens) appropriate for constructing lesson pattern of Turkish mathematics classrooms.

2. 5 Summary

As a consequence, the reviewed literature showed the importance or role of observing mathematics classrooms' activities for making national decisions in general or giving spontaneous classroom decisions in specific. Organizing these observations in a conceptual framework is also critical. Some studies argued that "lesson pattern" (TIMSS 1995 Videotape Study) or "hypothesized classroom pattern" (TIMSS 1999 Video Study) could be useful for such conceptualization. These studies used the single lesson as a unit of analysis. On the contrary, some other researchers (Clarke, Lobato and Mesiti, 2003; Shimizu, 2003) emphasized the deficiencies of "lesson pattern" conceptualization and of using single lessons as a unit of analysis. There were also suggestions of alternative units of analyses,

such as, specific lesson event (Clarke, Lobato and Mesiti, 2003), sequence of consecutive lessons (Shimizu, 2003), and teaching a topic (Clarke and Mesiti, 2004). Although there is a search for conceptual framework and there are beneficial discussions on these frameworks, it is not possible to face with such attempts in Turkey. Although the practices in elementary mathematics classrooms were examined through quantitative studies and there are some statistical findings, qualitative research on these issues is deficient.

Based on these reviewed literature, this study aim to interpret detailed observations from three 6^{th} grade elementary mathematics classrooms throughout a unit, to conclude pattern for participated three mathematics classrooms by examining the sequence of activities throughout mathematics lessons, and describe frequently observed teaching features throughout observations.

CHAPTER III

METHOD

This study examined the practices in elementary mathematics classrooms by investigating the teacher's and students' actions, and the flow of these actions, and determining frequently occurring activities in a mathematics lesson. In this chapter (a) design of the study, (b) participants of the study, (c) methods and procedures used to gather data, (d) methods used to analyze the data, (e) trustworthiness of the study, and (f) limitations of the study will be described.

3.1 Introduction

A qualitative approach was employed for the data collection and the analysis of the data in this study. Multiple case studies were used for the descriptive analysis of the data. The analysis involved two stages; first a within-case description, then the whole case description. For the within-case analysis, each case was first treated as a comprehensive case in and of itself. Consequently, once the analysis of each case was completed, the cases were analyzed together for the whole case description in order to develop more sophisticated descriptions and more powerful explanations (Merriam, 1998).

Given the discussion on identifying nationally representative lesson pattern with using single lesson periods as a unit of analysis, cases consisting of teaching a mathematics unit were examined in an attempt to describe teaching practices in mathematics classrooms and identify a possible pattern for observed elementary mathematics lessons.

A case study could be defined as an intensive, detailed description and analysis of a project, a program, an event, an activity, a process, or one or more individuals in the context of its environment in which the case(s) are bounded by

time and activity (Creswell, 2003). The case was determined as teaching a mathematics unit in this study. The observation period for each case was determined by the time devoted for teaching the unit. The observed activities were bounded with teaching and learning practices in mathematics classrooms.

In discussing the differences between qualitative and quantitative designs, Creswell (2003) stated that the quantitative approach maintained that "the researcher should remain distant and independent of that being researched" (p.6). The primary focus of my study was to make a detailed description of mathematics lesson practices; it was not possible to remain distant and independent in data collection.

Patton (1990) emphasized the importance of the length of the observation period in descriptive studies. Patton indicated that there is no optimal observation duration, on the contrary, the observation period is directly related with the purpose of the study. The important point for this study is to observe elementary mathematics classroom throughout the teaching of a unit. Therefore, instead of determining an ideal number of lessons for observation in each classroom, the number of observed lessons was changed according to the observed unit.

Patton (1990) suggested that qualitative methods permit the researcher to study selected issues in-depth and detail. The fact that data collection is not constrained to the predetermined categories of analysis, it leads to depth and detail in qualitative data analysis. On the other hand, quantitative methods require the use of a standardized approach so that the experiences of people are limited to certain predetermined response categories.

Qualitative methods typically produce detailed data about a much smaller number of cases, so the researcher had to limit the number of classrooms to be observed. The study was conducted in 3 public elementary schools from the same district of Çankaya, Ankara. The three schools were chosen based on the ease of communication and access. The main data collection procedure was direct observations of classrooms, where the observations were supported with informal interviews. Pseudonyms were used for these three schools and the three instructors in order to protect their privacy.

3.2 The Participants

Three sixth grade elementary mathematics teachers from three different public elementary schools in an urban district of Çankaya, Ankara participated in this study. In the selection of participated schools, convenient sampling approach was used where the criteria of convenience was ease of communication. Convenience sampling also involved the use of volunteers and the use of existing groups simply because "they are there" (Gay & Airasian, 2000). The participated teachers from these schools were identified through a criterion based purposeful sampling approach (Gay & Airasian, 2000) in that they met the criteria of having an adequate experience of mathematics teaching with current curriculum so that they have their tradition of teaching a mathematics unit and having regular practices in their classrooms.

The criteria on which the selection of participated schools and teachers were made could be presented as;

1. Teaching experience of teachers; since the aim of the study is to describe the teaching procedures and examine the pattern of mathematics lessons, observing an experienced teacher who is familiar with current curriculum and have common practices in teaching is more appropriate for the aim of this study
2. Convenience of time; since the researcher was working at a university, the programme/schedule of teacher and researcher must fit into one another.
3. Convenience of location; since the researcher visit the schools at least two day in a week throughout one or two month, the transportation to the school should be easy
4. Voluntary participation; participation to this study was on voluntary base. Not all contacted teachers wanted to participate in the study.

In addition, if the selected teachers were teaching more than one 6th grade groups, one of these groups were chosen to be observed on the base of convenience.

Demographic data was collected on each participating teacher. Table 3.1 describes the participating teachers for each case study by gender, age, teaching

experience, years in Ankara, and years in the current school they worked at the time of the study.

Table 3.1 Teachers Demographic for the Three Classrooms

Description	Teacher A	Teacher B	Teacher C
Gender	Female	Male	Female
Age	49	45	46
Years in Teaching	27	22	23
Years in Ankara	20	14	12
Years in Current School	5	4	2

3.3 The Settings

The three elementary schools that the researcher visited were public schools located in Ankara, the capital city of Turkey. The schools were located in Çankaya district in central Ankara. The populations that each school served were economically middle class. Each participating school had similarities in many ways, such as, school environments, socio economic make-ups, and classroom size. In addition, teachers staffed in three schools were composed of experienced teachers. The average years of teachers' teaching experience were nearly 20 in the participating schools. Moreover, all three teachers had over 20 years of experience in teaching.

The participant classrooms and their teachers were called as Classroom A and Teacher A, Classroom B and Teacher B, and Classroom C and Teacher C throughout this report so that the privacy of the instructors was protected.

3. 3. 1 Classroom A and Teacher A

The first classroom that the researcher observed had 28 students. The classroom had a teacher desk, a blackboard, student desks, and a board. The

seating plan of classroom is shown at Figure 3.1. Two students were sitting on each desk. The board was used for students' works, such as pictures, and term projects. As seen in the Figure 3.1, there were 3 columns, each having 5 rows of desks in the classroom and students were seated in pairs.

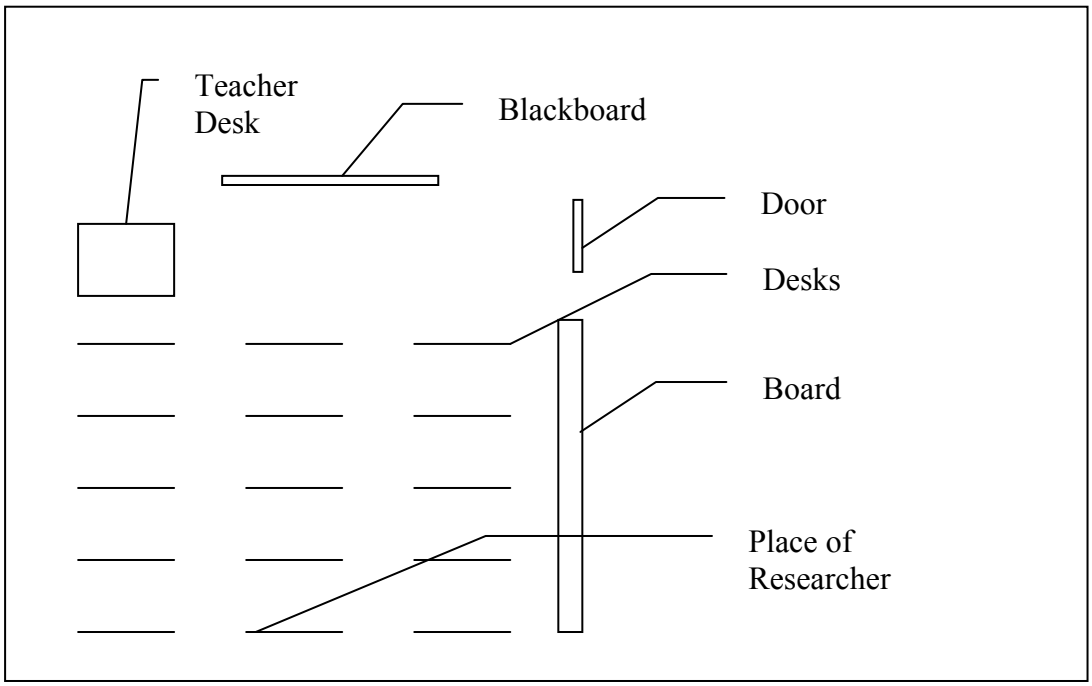


Figure 3. 1 The Seating Plan of Classroom A

As shown in Figure 3.1, the researcher sat at the behind raw of desks to minimize interference with the classroom during the observations. The mathematics teacher of Classroom A was Mrs. A. She was a 49 years old mathematics teacher. She had been a mathematics teacher for 27 years and she had been working in Ankara for 20 years at the time of the study. Moreover, she had been working in the current school for the last 5 year.

3. 3. 2 Classroom B and Teacher B

The second classroom that the researcher observed had 32 students. The classroom had a teacher desk, a blackboard, student desks, and a board. The seating plan of classroom is shown in Figure 3.2. Two students were sitting on each desk. The board was used for students' works, such as pictures, term projects.

As seen in the Figure 3.2, there were 3 columns, each having 5 rows of desks in the classroom similar to Classroom A.

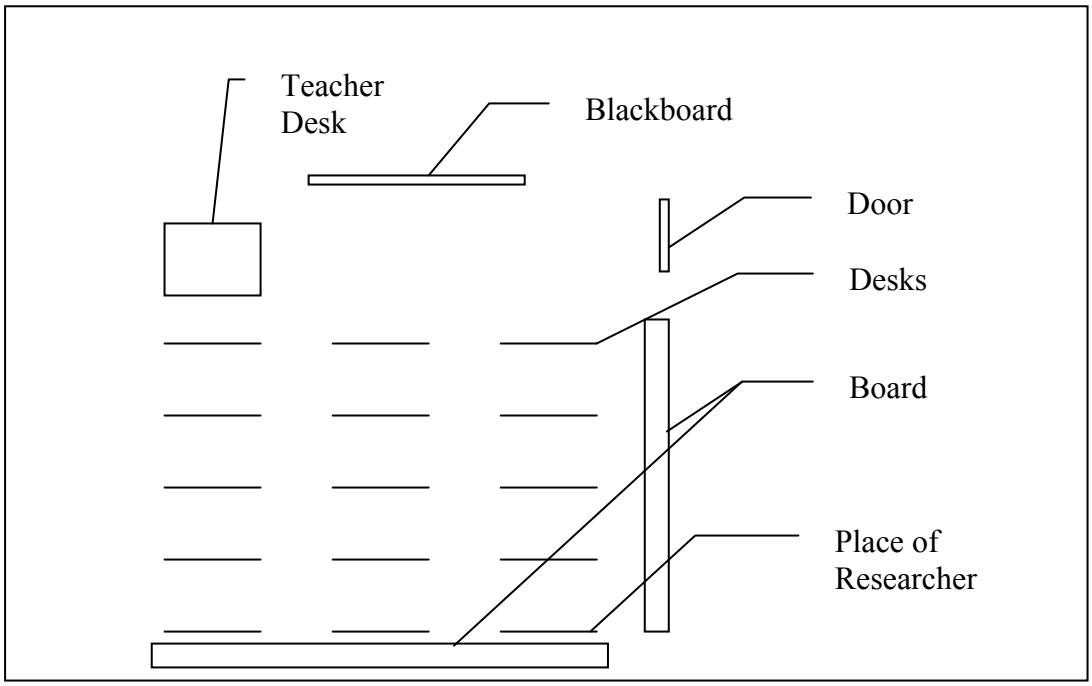


Figure 3.2 The Seating Plan of Classroom B

The mathematics teacher of Classroom B was Mr. B., who was 45 years old. He had been teaching mathematics for 22 years and he had been working in Ankara for 14 years Moreover, he had been working in the current school for the last 4 year at the time of the study.

3.3.3 Classroom C and Teacher C

The last classroom that the researcher observed had 25 students. The classroom had a teacher desk, a blackboard, student desks, and a board. The seating plan of classroom is shown at Figure 3.3. Two students were sitting on each desk. The board was used for students' works, such as pictures, term projects. As seen in the Figure 3.3, there were 3 columns, each having 5 rows of desks in the classroom.

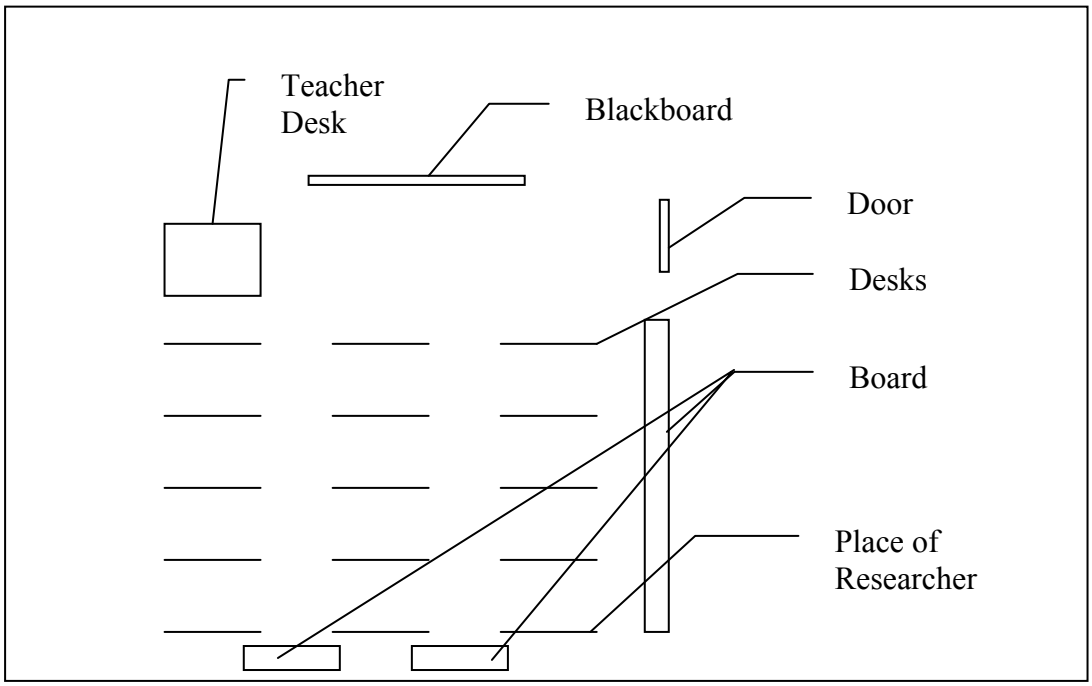


Figure 3.3 The Seating Plan of Classroom C

The mathematics teacher of Classroom C was Mrs. C and she was 46 years old. She had been a mathematics teacher for 23 years and she had been working Ankara for 12 years. Moreover, she had been working in the current school for the last 2 years at the time of the study.

3.4 Observed Units and Observation Duration

Teacher A was observed throughout the unit of "Prime Numbers and Factorization", teacher B "Angles, Triangles, and Their Types", and teacher C "Measurement". The concepts that these units cover and the number of lessons that should be devoted for teaching these concepts were stated in Table 3.2. These concepts and number of lessons were stated in Elementary Mathematics Curriculum (2002) that was published by the Ministry of National Education.

According to Elementary Mathematics Curriculum (2002), Prime Numbers and Factorization unit was mainly composed of four concepts; divisibility by 2, 3, 5 and 9, prime numbers and factorization, greatest common divisor (gcd), and least common multiple (lcm). 15 lesson periods should be devoted for teaching these concepts. Angles, Triangles, and Their Types unit was mainly composed of two

concepts; angles and its types and triangles and its types. 9 lesson periods should be devoted for teaching these concepts. Measurement unit was mainly composed of seven concepts; measurement and measures, measures of length, measures of area, measures of volume, measures of capacity, measures of mass, and measures of time. 26 lesson periods should be devoted for teaching these concepts. (Elementary Mathematics Curriculum 6th, 7th and 8th grade, 2002, p.34, 54 & 58)

The number of lessons that participant teachers spent for teaching these units were very similar with the numbers of lessons stated in curriculum. Teacher A spent 15 lesson periods for teaching prime numbers and factorization. Teacher B spent 8 lesson periods for teaching angles and triangles. Teacher C spent 22 lesson periods for teaching measurements.

Table 3.2. The Content of Observed Units Stated in Elementary Mathematics Curriculum

	Participants	Number of Lessons Devoted to Teaching
Prime Numbers & Factorization (Classroom A)	- Divisibility by 2, 3, 5 and 9	4
	- Prime Numbers and Factorization	2
	- Greatest Common Divisor (GCD)	3
	- Least Common Multiple (LCM)	3
	- Problems about GCD & LCM	3
Angles & Triangles (Classroom B)	- Angles and type of angles	6
	- Triangles and type of triangles	3
Measurement (Classroom C)	- Measurement and measures	4
	- Measures of length	5
	- Measures of area	5
	- Measures of volume	4
	- Measures of capacity	2
	- Measures of mass	2
	- Measures of time	4

3.5 Data Collection

The data for this study was gathered through classroom observations and informal interviews. The ways observation and interviews were conducted are explained here.

3.5.1 Classroom Observation

Each participated classroom was observed throughout all mathematics lessons of teaching related unit. During observations, field notes were taken describing the classroom environment and atmosphere, teacher's actions, students' actions, the content covered, the questions asked, and the interactions occurred in the context of teaching. The observation sheet used for noting teacher's and students' actions throughout a lesson is presented in Appendix A. This sheet was organized for 3 minute-periods so that the teaching practices were not only recorded in an order but also the time devoted for each practice could be noted. Separated columns for teachers' and students' actions gave chance to record the role of teachers and students throughout a mathematics lesson.

The researcher observed each classroom as a non-participant observer. The researcher was located on one of the desks at the backside of the classrooms and took notes about the teaching/learning practices of teachers and students.

Although multiple focuses is crucial for a powerful and rich data while observing classroom practices, researcher was also aware of the fact that it was not possible to observe everything (Merriam, 1988). Research questions provided focus for observing classrooms.

Corresponding to research questions, the main focus of the observations was the practices related with teaching and learning mathematics and flow of these practices. Teachers and students speeches, presentations and demonstration on related concepts, their works on board, and seatwork were some of these practices. Teachers and students behaviors were recorded separately for each practice. The active participant of a practice was in the center of attention. The actions or behaviors not related with teaching current mathematics concept and misbehaviors of students were not recorded.

Direct observation overcomes some of the limitations that can be identified for quantitative data gathering techniques (Stigler et al., 1999; Hiebert et al., 2003): Observations allow behavioral categories to be defined objectively by the researcher, not independently by each respondent. Teachers themselves may be unaware of their behavior in the classroom, yet this same behavior could be easily accessible to the outside observer. On the other hand, there are clear disadvantages of live observation as well. Observational coding schemes can act as blinders and may make it difficult to discover unanticipated aspects of instruction; therefore, while working in different cases, it may be impossible to achieve high levels of comparability.

3.5.2 Informal Interviews and Open Ended Written Comments

The researcher organized non-structured interviews with the participated three teachers. These interviews were conducted before lessons had started, during break time between two lessons, and after the lessons. These interviews were done for each observed session. These interviews were conducted in a room in the school and the researcher made sure that there was no body else in the room and there was no interruption. The main focus of these interviews was the regularity/normality of the practices in the lessons. In light of this focus, the following questions were asked to the participants teachers;

1. How did my being in the classroom affect your teaching practices/behaviors?
2. Were your practices in the observed lessons different than your usual/regular one? Did you do what you regularly do in these lessons?

The demographic data about participant teachers were also gathered by means of these interviews.

In addition, after the researcher had completed his analysis of observed lesson, the teachers were asked about their teaching practices during single lessons and through teaching a topic. Teachers' views on their practices were gathered through their written comments. Participated teachers provided written comments for following questions;

1. Can you summarize your teaching practices in a single lesson period? Is there a routine for your organization of teaching practices in of single lessons?
2. Can you summarize your teaching practices in the sense of teaching a topic? Is there a routine for your organization of teaching practices in the sense of teaching a topic?

3. 6 The Description of Data Collection Procedure

The data collection procedure started after getting necessary permission from the Ministry of National Education in 2005-2006 academic year. At first, among the elementary schools in Çankaya district, 15 schools were chosen as candidate for data collection site. Researcher visited each of these 15 schools at the beginning of the academic year and selected 3 of them for collecting data of this study.

After determining the participant teacher, researcher prepared an observation schedule for each classroom. Different mathematics unit for observation was determined for each teacher. The observed unit for each teacher stated below.

The observations had started nearly one week before the unit started to be taught so as to develop familiarity with the observed classrooms. All of the lesson periods in the process of teaching unit were observed. The observations concluded after the unit was taught and the next unit began. Teacher A was observed for 5 weeks, which is 20 lesson periods, which was 1 week more than the time devoted to teach Prime Numbers and Factorization. Teacher B was observed for 3 weeks, which is 12 lesson periods, which was 1 week more than the time devoted to teach Prime Numbers and Factorization. Teacher C was observed for 7 weeks, which is 28 lesson periods, which was 1 week more than the time devoted to teach Prime Numbers and Factorization.

3. 7 Data Analysis

The researcher used two methodologically linked strategies – extensive observation and informal interviews – to form a holistic analysis of the pattern of educational progress in mathematics classroom.

Field notes and informal interviews were analyzed for patterns of teacher and student behaviors, and recurrent features that were taking place in the mathematics classrooms.

The analysis of gathered data started with sorting out the field notes in order to observed case (classroom) and sequence of lessons in the unit. Each case was examined independently at first. The organization of teaching practices in Classroom A was examined separately whether these practices construct a pattern for teaching the unit, for teaching a concept, and for single lessons. Teaching and learning practices from beginning of the unit to the end of it were investigated briefly. The flow of the practices through the unit was examined. This examination provided a wide view of the practices and made researcher familiar with the flow of the practices. (Since the researcher realized that the teaching practices showed significant familiarities through teaching the concepts of unit) after drawing a wide picture of teaching a unit, researcher focused on the concepts that unit was constructed from. The practices throughout teaching concepts were examined separately. The flow of these practices were compared to examine the possible patterns for teaching a concept. The analysis continued with examination of single lesson periods. The flow of teaching practices through a mathematics lesson was studied and compared with each other. Each examination/analysis procedure was repeated for the other two classrooms.

After this separate examination, the findings of analysis of each case were also tested for other cases; for example, if the observation of the practices throughout exercising in Classroom A give enough evidence to construct a pattern, then this pattern was also searched in Classroom B and Classroom C.

After the examination of pattern in lessons and in teaching concepts case by case, the lessons from all cases were examined together. Teaching practices in mathematics lessons were categorized according to the activities seen in Table 3.3

so that facilitates the analysis of the data. This categorization was based on not only the related literature but also data from the observed classrooms.

The main activities in this categorization (review, checking homework, presenting the topic, demonstration, practicing, highlighting and summarizing main points, assigning homework, and announcement of next topic) was mainly drawn from the TIMSS Video Studies (1995, 1999) and Shimizu's categorization of classroom activities (2003). Review, presenting the topic, demonstration, practicing, highlighting and summarizing main points, and assigning homework were the main activities that used for describing lesson patterns of mathematics classroom from different countries in TIMSS Video Studies (1995, 1999). Addition to these, the activities included in Shimizu' categorization, checking homework and announcement of next topic were used for describing observed practices.

On the other hand, the categorization of specific features that construct the main activities was basically drawn from the researcher observations with some contributions from TIMSS 1995 Video Study. For example, reviewing could take place differently and serve for different goals in observed lessons. According to observations, participated teachers reviewed the previous concepts, or what is done in previous lesson, or the rules and procedures mentioned in current lesson. The features of checking homework, demonstrations and practicing were also drawn from the observations. For example, the observed practices that can be classified as 'checking homework' in related literature showed some differences in observed mathematics lessons, so 'checking homework' was divided into two related activities (Control only students do or not and solve unanswered questions) so as to better interpretation of observed activities. On the other hand, the features of presenting the topic were drawn from both of TIMSS 1995 Video Study and researcher observation. Although participated teachers did not use any warm up activity or did not draw a connection between current concept and previous ones, these features included in this categorization for emphasizing possible practices to present a concept.

Table 3.3 Teaching Activities and Their Features in Elementary Mathematics Lessons

ACTIVITIES	FEATURES
Review	Previous concept
	What is done in previous lesson
	Review the rule/procedure in practicing
Checking Homework	Control only students do or not
	Solve unanswered questions (review)
Presenting the Topic	Only mention superficially
	Warm up activity
	Relate with previous
Demonstration	Introduce the new topic, give definitions
	Introduce a sample problem
	Solve sample problem step by step
Practicing	Ask similar and different questions
	Let students do these questions
	Correct the wrong answers
	Let another students
Highlighting and Summarizing main points	
Assigning Homework	
Announcement of next topic	

The analysis was continued with examining the lessons from all cases in terms of some important characteristics of mathematics classrooms, such as, students' role in mathematics lessons, delivery of the mathematical content, and occurrence of constructing proofs.

3.8 Trustworthiness

Scientific research is valued by how researchers could demonstrate the trustworthiness of their findings. In all types of studies, reliability and validity of findings, which are the main determinants of the trustworthiness, are important (Shenton, 2004; Golafshani, 2003; Morse, Barrett, Mayan, Olson & Spiers, 2002;

Guba & Lincoln, 1981). Although there are contrasting views about the applicability of the quantitative research terminology and methods, such as reliability and validity, to the qualitative research; reliability and validity are generally not discussed separately in qualitative research but rather terms such as "rigor", "credibility" or "trustworthiness" are suggested in order to address both reliability and validity (Shenton, 2004; Golafshani, 2003; Morse et al., 2002).

Guba and Lincoln' used a comprehensive term, "trustworthiness", for substituting reliability and validity in qualitative studies (Guba & Lincoln, 1981; Lincoln & Guba, 1985). This concept is composed of four main criteria; credibility (in preference to internal validity), transferability (in preference to external validity/generalisability), dependability (in preference to reliability), and confirmability (in preference to objectivity). These four aspects should be considered by qualitative researchers in search of a trustworthy study (Shenton, 2004).

Based on the Guba and Lincoln's construct, Shenton (2004) summarized the ways of addressing these four important criteria. For addressing credibility, necessary efforts should be spent on describing phenomenon/events as they actually occurred. For addressing transferability, necessary efforts should be spent on describing the context of the fieldwork in detail so that the findings of the study become comparable for similar situations and transferable for similar settings. For addressing dependability, necessary efforts should be spent on describing the research process so that other researchers have chance to replicate the research, with "not necessarily to gain the same result". For addressing confirmability, necessary efforts should be spent to ensure that the findings of the study were drawn from the data of the study.

Firstly, credibility can be described as a substitute concept for internal validity in quantitative researches. Similar with internal validity in quantitative researches, credibility deals with the question "how congruent are the findings with reality? Are investigators observing or measuring what they think they are measuring?" (Merriam, 1998, p.201). Establishing the adoption of research methods, developing an early familiarity with the culture of participating organizations, ensuring honesty in participants, thick description of the

phenomenon, and examining the previous research findings are some of the tactics that could be used for increasing credibility (Shenton, 2004, p.64-65). What have been done in the context of these tactics was listed below.

- Establishing the adoption of research methods; throughout this report, the researcher explained both the reasons of conducting a qualitative study, the reasons of using classroom observation as a data gathering procedure, and why these methods are appropriate to aim of this study.
- Developing an early familiarity with the culture of participating organizations; the researcher had started to visit classrooms about one or two weeks before taking field notes.
- Ensuring honesty in participants; each teacher who was participated in this study was given opportunity to refuse to participate in the study so as to ensure that the data collection sessions involve only those who are genuinely willing to take part. As mentioned above, some teachers were not willing to participate the study, and so they did not.
- Thick description of the phenomenon under scrutiny; the teachers' and their classrooms' characteristics was described in detail as it helps to convey the actual situations that have been investigated and, to an extent, the contexts that surround them.
- Examining the previous research findings; the researcher tried to relate the findings of this study with reports of previous studies in discussion chapter.

Secondly, transferability refers to concept of external validity in quantitative studies. Similar with the external validity, transferability of a qualitative study is related with the generalization of the findings of the study. However, in qualitative researches, generalization does not serve as generalizing the findings of a smaller sample to the wider population. "Since the findings of a qualitative project are specific to a small number of particular environments and individuals, it is impossible to demonstrate that the findings and conclusions are applicable to other situations and populations" (Shenton, 2004, p.69). Nevertheless, generalization refers to construct relations between similar studies in

similar settings. “Sufficient contextual information about the fieldwork sites” should be provided so that researchers construct such relations (Lincoln & Guba, 1985).

Therefore, to addresses the transferability, the following contextual information was stated in this report;

- Number of schools taking part in the study and where they are based,
- Restrictions in the type of participant teachers,
- Data collection methods,
- Number and length of the data collection periods.

Moreover, Yin (1994) explained the external validity problem as,

> The external validity problem has been a major barrier in doing case studies. Critics typically state that single cases offer a poor basis for generalizing. However, such critics are implicitly contrasting the situation to survey research, in which a sample readily generalizes to a larger universe. This analogy to samples and universes is incorrect when dialing with case studies. This is because survey research relies on statistical generalization, whereas case studies rely on analytical generalization. In analytical generalization, the investigator is striving to generalize a particular set of results to some broader theory (p.36)

and suggest to use replication logic in multiple-case studies. Since this study is a multiple case design, the external validity problem tried to addresses by also using replication logic for each case of the study. The inferences that drawn for a case was tested through replications of the findings in the other cases; for example, pattern of teaching in the case A was tried to figure out for case B and C.

Thirdly, dependability which is an equivalent concept for reliability in quantitative researches requires that a researcher using the same methods can obtain the same results as those of a prior study. Yin (1994) indicated that “one perquisite for allowing the other investigator to repeat an earlier case study is the need to document the procedures followed in the earlier case (p.36)”. Shenton (2004) also emphasized the importance of providing sufficient information about the research designs for allowing future researchers replicate the study. In the light of these explanations, the reliability problem of this study was addressed by

providing detailed description about the research design and its implementation, and detailed documentation of the procedures followed in data collecting and data analyzing. This information was presented in previous sections of this chapter.

The last criterion for constructing trustworthiness of a qualitative study was comfirmability. This concept is the qualitative investigator's comparable concern to objectivity which means the use of instruments that are not dependent on human skill and perception (Shenton, 2004; Patton, 1990). Shenton (2004) indicates that to address comfirmability, "steps must be taken to help ensure as far as possible that the work's findings are the result of the experiences and ideas of the informants, rather than the characteristics and preferences of the researcher" (p.72). Shenton also emphasized the role of triangulation in promoting such confirmability. In the current study, the researcher tried to gather data from multiple source; the observations and interviews. After observing the lessons, the participant teachers were asked about their practices in the lessons and the regularity of these practices. While constructing the results of the study, researcher made conclusions from the composition of these sources of evidence.

In addition, Miles and Huberman (1994) pointed out that an important criterion for confirmability is the extent to which the researcher admits his/her bias. Therefore, the following section was devoted for explaining limitations of the study and researcher bias.

3.9 Limitations of the study

The number of observed classrooms was limited with three in this study. This limited number of cases make researcher not generalize his findings. The finding of this study is limited with observed three mathematics classrooms.

The researcher observed classroom as a non-participant observer; being in the classroom throughout observation would have some effect on the behaviors of teachers and students.

The teachers who participated in the study had about 20 years experiences in teaching. Novice teachers and relatively less experienced teachers were not observed and reported in this study.

The participant classrooms were selected from public elementary schools, the private schools were not in the scope of this study.

3.9.1 The researcher's Bias

The researcher's ideas on teaching mathematics or mathematics teachers could have unavoidable effects for designing this study, observing classrooms, and analyzing and reporting the findings. Therefore, exploring these ideas would be beneficial to better understand the purpose and findings of this study.

I think that teaching is an action of supporting students' (capabilities/abilities?) activities for learning. I try to differentiate teaching from lecturing in which students are told about a concept by teacher with a minimum participation. Teachers' speeches (or lectures), of course, is an important part of teaching but these speeches should not serve as an end but as a mean. Teaching should be the composition of actions of arranging peaceful environment for students, guiding them, lecturing, discussing, constructing, and working with them. I do not argue that teaching should be considered a proper combination of these actions. The role of teachers as a presenter of knowledge should be decreased, and the role of students as an investigator of the knowledge should be increased. Even, teaching can be defined as the act of setting students free from being passive listeners. Creating an environment in which students can or have to participate, relating the concept with the students' life (not the 'real' life), organizing the environment so as to allow students share and discuss their ideas, and constructing knowledge as a conclusion of these interactions can be described as crucial characteristics of this action.

How I experienced teaching in my elementary or secondary schools as a student was not more than teachers' lectures. What teachers had said was identical to what we needed to learn. The contradiction between what I experienced and what I think about teaching may be one of the driving forces for conducting this study. The beliefs and experiences mentioned above may have some inevitable effects on observing and analyzing the classroom practices. However, I have worked as a mathematics teacher in a public elementary school for 6 months and I am aware that teaching practices in a classroom is not only determined by

teachers' ideas. Other factors, such as, curriculum, schools' and classrooms' physical conditions, and students' behaviors are also important determinants of classroom practices. Therefore, while observing teaching practices in the participated classrooms, I tried to avoid criticizing the observed practices. Instead of reflecting negative or positive feelings about the practices, I only recorded them.

In addition, I had no formal or informal relation with the participated teachers before conducting the study. I had never been in their classrooms. I met them for the purposes of the study. We had a formal relationship throughout the observations. Therefore, I did not have negative or positive lenses while observing their practices in classroom settings.

Lastly, the purpose of this study was not to determine better teaching practices or the worse ones, but to describe the routines of ordinary classroom practices. Therefore, teaching practices were not reported according to their worthiness but according to their commonness.

CHAPTER IV

RESULTS

The results of the data analysis will be introduced into three main sections; first, an overall description of teaching practices in mathematics classrooms throughout a unit will be presented. Second, the 'pattern' of participated mathematics classrooms in the context of teaching a unit, a topic, and single lesson period will be drawn. Third, certain recurring features that typified many of the observed mathematics lessons will be presented. Participated teachers' views about their teaching practices and regularity of the observed lessons were also reported through this chapter

4. 1 Overall observation of mathematics classrooms

The teaching practices of the three teachers from School A, B and C will be presented here.

4.1.1 Classroom A and Teacher A

As mentioned in the previous chapter, the school A that teacher A works as a mathematics teacher is a small school in Çankaya district. The school has a new building and a large garden. Teacher A is the only mathematics teacher in the school. The school has a total of six upper elementary classrooms, two for each upper elementary grade (6^{th}, 7^{th}, and 8^{th} grades). She is the mathematics teacher of all of these six classrooms. One of her 6^{th} grade classrooms was observed throughout 5 weeks, 20 lesson periods for this study. The observations of 15 lesson periods devoted to teach 'prime numbers and factorization' were used as data of this study.

The beginning of the unit can be composed of relationships between unit's concepts and other school subjects, other mathematics concepts, and daily life problems so to emphasize the importance and usage of mathematics concepts. Warm up activities or challenging daily life problems can be useful for such effective introduction. Teacher A started the unit with stating the first concepts of the unit as "New title: Prime numbers and factorization. Our first subject is divisibility by 2".

Mathematics concepts in prime numbers and factorization, with their own importance, are also very important for both better understanding of and computations in other school subjects and other mathematics units. Neither in the beginning nor the following of the unit, data was observed indicating any attempt to relate the topic of 'prime numbers and factorization' either with another mathematics unit or with another school subjects.

A mathematics unit defined in curriculum is naturally composed of related concepts. The relationships between these concepts are as important as the concepts itself. Although the concepts of the unit have important connections, for example, prime factorization is a very useful tool for calculating GCD or LCM, the relationships between concepts of the unit were not stated.

The sequence of concepts throughout teaching prime numbers and factorization is determined and suggested by mathematics curriculum. While teaching the whole unit, Teacher A used the same separation of the concepts of the unit represented in elementary mathematics curriculum. First, she taught the rules of divisibility by 2, 3, 5, and 9. Then, she taught the concepts prime numbers and factorization. Later, she presented the greatest common divisor (GCD) and least common multiple (LCM). Lastly, she worked on the problems related with GCD and LCM.

Teacher A followed a similar pattern for teaching the concepts; stating the rules of divisibility by 2, 3, 5, and 9, and practicing these rules; defining prime numbers and prime factorization, and practicing the procedures of prime factorization; defining greatest common divisor, stating the procedure for its calculation, practicing this procedure, and applying the definition and procedure in daily life problems; defining least common multiple, stating the procedure for its

calculation, practicing this procedure, and applying the definition and procedure in daily life problems; applying the definitions and procedures of GCD and LCM in mixed and more complex problems.

Although a pattern can be drawn for teaching concepts with including recurrent teaching actions such as, defining rule, and exemplifying it, then practicing it (a detailed description of these pattern will be mentioned in the following parts of this chapter), single lesson periods showed no such recurrence. Some of the single lesson periods were a composition of recurrent teaching practices. On the other hand some of them were composed of only practicing. Teacher devoted four lessons period for teaching divisibility by 2, 5, 3 and 9. Two lesson periods of four is composed of a combination of teaching practices; a simple question was asked, the rule of divisibility was stated with the help of this example, an example was solved with emphasizing the rule, and a question was asked to let students practice the rule (first two lessons of teaching divisibility). The other 2 lesson periods continued with exercising and solving homework questions. The exercise processes were composed of repeated cases. Firstly a volunteer student came to board, and wrote the solution to the board. After student had finished his/her solution, Teacher A checked it. If the solution was right, Teacher A explained the solution to the whole class and the student went back to his/her desk. Teacher A repeated the explanation of solution process with emphasizing the rules. If the solution was wrong, she reminded the rule which will be used for solution and corrected student's works. The solution procedure for homework questions was very similar to the exercises procedure. Throughout these solutions the rules were repeated by teacher A. Teacher's and students' classroom conversations in the context of teaching/learning prime factorization are presented in Table 4.1. The expressions in italics describe the actions of Teacher A and students. The other 2 lesson periods continued with exercising/practicing and solving homework questions.

Table 4.1 Observed Teaching Practices in Prime Factorization

Teacher (T): What is the meaning of prime number?

Student 1 (S1): The number that can not be divisible by other numbers

T: It is a little missing, the number that can be divisible by only itself and 1. 2, 3, 5, 7, 11, 13, 17, 19, and 23 are the examples of prime numbers because these numbers are divisible only by 1 and by themselves.

After waiting students note taking the definition,

T: Is 57 a prime number?

Students (Ss): No

T: Why? Which numbers can divide it?

Ss: 3

T: Yes, 57 divided by 3 is 19, so it is not a prime number. All numbers can be written as a multiplication of prime numbers. The process of writing a number in terms of prime numbers is called prime factorization. Let's factorize 60.

60	2
30	2
15	3
5	5
1	

T: 60 divided by 2? Ss: 30
T: 30 divided by 2? Ss: 15
T: Is 15 divided by 2? Ss: No T: 15 divided by 3? Ss: 5
T: 5 divided by 5 is 1

T: (*While writing board 148, 164 and 112*) Now, factorize these numbers.

T: (A*fter waiting a minute*) Is 148 divided by 2?".

Ss: Yes, 74.

T: 74 divided by 2?

Ss: 37

T: Is 37 divisible by another number?

Ss: No

T: So, we can write that 148 = 2 x 2 x 37.

T: Ahmet, come to board and factorize 112. Özge, factorize 164. (*Ahmet and Özge were two volunteer students*)

Table 4.1 (Continued)

(*Ahmet write the solution to the board and turn back his desk, Özge was trying to divide 164 into two at the corner of the board*)

T: what is 164 divided by 2, Özge.

Ö: (*After completing her work*) 82.

T: 82 divided by 2?

Ö: (T*hinking*)

Ss: 41

T: Any number that can divide 41?

Ss: No.

Teacher let Özge to write these answers.

The observation data given in Table 4.1 clearly demonstrate a sequence of teaching acts during a lesson. Teacher first focused on the formal definition of 'prime numbers' through questions. The observation data indicated that during such questioning, teacher tended to collect the ideas of only a few students or satisfied with a choir response. After demonstrating a sample mathematical algorithm (prime factorization) to class, teacher then solved a sample question. Finally, asked similar questions to class. For each questions, teacher called a student to the board to solve it.

The number of lessons that Teacher A devoted for teaching prime numbers and prime factorization were three that is, one hour more than stated in the yearly plan. Similar to the divisibility concept, one lesson period of three is composed of a combination of teaching practices; defining the prime numbers, asking a simple question about prime factorization, stating the procedure of factorization with the help of this example, solving an example with emphasizing the procedure; asking similar questions to let students practice the procedure.

The number of lessons that Teacher A devoted for teaching greatest common divisor and least common multiple were eight same with the yearly plan. Two lesson periods of eight were composed of a combination of teaching practices were devoted for explaining the calculation of GCD and LCM; the GCD of two number were asked, three ways of calculating GCD was presented by teacher, a

similar question related with finding GCD was solved by teacher, teacher asked students some questions for exercising, and repeated the necessary procedure while students were solving questions. This procedure was also followed for LCM. The other 6 lesson periods were devoted for exercises, problems, and homework questions.

It is crucial for the researcher to share an observation related with students' understanding of concepts here. After teaching the calculation of GCD and LCM separately, Teacher A asked mixed daily life problems. The conversations between Teacher A and students were presented in Table 4.2.

Table 4.2 Moments from Teaching GCD and LCM

Teacher A: There are bricks with dimensions 20cm, 12cm and 8cm, it was wanted to construct smallest cube with using these bricks, how many bricks are needed at least?,
(*after a while*)
T: What will we use?
Ss: LCM (*some of them*), GCD (*some of them*)
T: Why GCD? (*ask to one of the students saying GCD*)
S1: We had used LCM in previous problem. Let's use GCD in the current one.
T: No. To find the number of bricks, firstly, the length of cube's one dimension should be found, and to find the dimension length, we should calculate the LCM of 20, 12, and 8

As seen in the conversation, students had difficulty in deciding whether to calculate GCD or LCM to solve these problems. One of the students indicated his rationale for deciding to use GCD as "We had used LCM in previous problem. Let's use GCD in the current one". This sentence showed that students did not understand the logic behind these concepts. For each problem, students needed teacher's explanation on which procedure (GCD or LCM) to be used.

4.1.2 Classroom B and Teacher B

The school B that teacher B works as a mathematics teacher was relatively a crowded school of the Çankaya district. It has two building and a large garden. Teacher B is one of the two mathematics teachers at school. School has four classrooms for each elementary grade – 4 classes for 6^{th}, 7^{th}, and 8^{th} grade, totally 12 elementary classrooms. He is the mathematics teacher of four 6^{th} grade and two 7^{th} grade classrooms. One of the 6^{th} grade classrooms was observed throughout 3 weeks, 12 lessons period for this study. The observations of 8 lesson periods devoted to teaching 'angles and triangles' were used as data of this study.

Similar to the case of Classroom A, no warm up activities or challenging problems were observed in Classroom B. Teacher started the unit with only stating the first concepts of the unit, "We started the new subject, angles".

Throughout the unit, the teacher did not relate 'angles and triangles' either with another mathematics unit or with another school subjects. The relationships between angles and triangles also were not indicated throughout the unit.

The sequence of concepts throughout teaching angles and triangles is completely determined by mathematics curriculum as in the case of Classroom A. The unit was taught with being divided into its sub-concepts; the angles and its types; and triangles and its types.

Teacher B also followed a similar pattern for teaching the concepts. He defined the angle, drew a sample, and let students gave example from daily life. Then, he explained the regions that constructed by an angle in a plane and drew a sample figure, defined the each type of angle, drew a sample, and explained the sample with asking yes-no questions. Finally, he defined the each type of triangle, drew a sample, and repeated the definition on the sample.

The number of lessons devoted to teaching angle and its types were six same with the yearly plan. The first three lesson periods were devoted to explaining the definition and types of angle- acute angle, right angle, obtuse angle, straight angle, whole angle, adjacent angle, supplementary angle, adjacent supplementary angle, complementary angle, and adjacent complementary angle. The practices and the flow of these practices through explaining these concepts were very similar to each other. As an example of demonstrations of these

concepts, teacher and students' classroom conservations in the context of teaching/learning adjacent supplementary angle were reported in Table 4.3.

Table 4.3 Teaching Practices in Adjacent Supplementary Angle

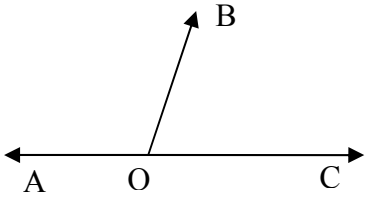
T: What is adjacent supplementary angle?

S1: If the sum of two angles' measures is 180 degrees, then they are adjacent supplementary angle.

S2: The adjacent two angles with the sum of their measures 180 are called adjacent supplementary angle.

T: Okay, they are right. Let's write the definition. If the two supplementary angles are adjacent then they are called as adjacent supplementary angle.

(*While he was defining the angle, he drew a sample adjacent supplementary angle*)



T: "Is the corner O common in the angle AOB and BOC?"
Ss: Yes
T: "Is the ray BO common?"
Ss: Yes
T: "Is the sum of the degree of angle AOB and BOC 180?"
Ss: Yes

T: Then, we can say that AOB and BOC are adjacent supplementary angle.

T: Did you understand?

T: What is complementary angle?

(*The conversation continued in a similar way on the concept of adjacent supplementary angle*)

The observation data given in Table 4.3 clearly demonstrate a sequence of teaching acts in Adjacent Supplementary Angle. Teacher first wanted students the formal definition of 'adjacent supplementary angle' through a question. The observation data indicated that during such questioning, teacher tended to collect the ideas of only a few students and let students write his definition. While defining the concept, he drew a sample figure. He explained the figure by asking

yes-no questions. These questions emphasized the properties of the concept. After these explanations, teacher continued with the definition of next concept.

The following two lesson periods were spent for the exercises. Teacher B let one of the volunteer students come to board, the student wrote the solution, teacher explained the solution again and again. This explanation included restating the main rules or procedures used in the solution. In some cases, when the question was somehow different from the previous ones, teacher solved the question by himself with asking short answer and yes-no questions. The last lesson was devoted to solving homework questions, in which the procedure was very similar to exercising procedures.

The second sub-concept was triangle and its types. The number of lessons devoted to teaching triangle and its types were two, which was one lesson less than the yearly plan. All of these lesson periods were devoted for explaining the definition and types of triangle; teacher wrote the title, gave the definition of the concepts, and drew a sample of it by repeating the important point of definition.
Nine lesson periods were devoted to teaching angles and triangles in elementary mathematics curriculum. However, teacher spent eight lessons periods for teaching the unit. The number of lessons devoted to teaching triangle and its types were one less than that of defined in the curriculum.

4.1.3 Classroom C and Teacher C

The school C that teacher C works as a mathematics teacher was an old school of the Çankaya district. It has an old building and a large garden. Teacher C is one of the two mathematics teachers in the school. School has 3 classrooms for each elementary grade – 3 classes for 6^{th}, 7^{th}, and 8^{th} grade, totally 9 elementary classrooms. She is the mathematics teacher of 6^{th} grade and one 7^{th} grade classrooms. One of the 6^{th} grade classrooms was observed through 7 weeks, 28 lessons period for this study. The observations of 22 lesson periods devoted to teaching ‘measurements’ were used as the data of this study.

In the beginning of the unit, teacher stated the name of the unit and announced the new subject: “Our new subject is measurement”. Then, she wrote the title on the board and waited for students while they were taking notes.

Similar to the other two cases, the relationship between the context of the measurement unit and another mathematics unit or with another school subjects was not indicated. The relationships among units of measures were not emphasized, either. However, only in one case, while mentioning the stairs model in units of length, Teacher C indicated that the stairs model would also be used while studying the units of area and volume.

The sequence of concepts throughout teaching measurement is completely determined by the mathematics curriculum as was the case of the other two cases. The unit was divided into its sub-concepts; measure and measurement, units of length and circumference of triangle, square and rectangle, units of area and the area of square and rectangle, units of volume and volume of cube and rectangular prism, units of mass and units of liquid, and units of time.

Teacher C followed a similar pattern for teaching the concepts of measurement. The units of different measures were taught in a similar way. As an example, teacher and students' conversations in the context of teaching/learning units of length were reported in Table 4.4.

Table 4.4 Teaching Practices in Units of Length

T: We are moving to the new concept. (*while writing units of length to the board*)

T: What is the basic unit of length?

Ss: Meter

T: What are the submultiples and multiples of meter?

Ss: Decimeter, hectometer, millimeter, kilometer …

T: Where do we use the sub multiples of meter (*while drawing a stair to the board*)

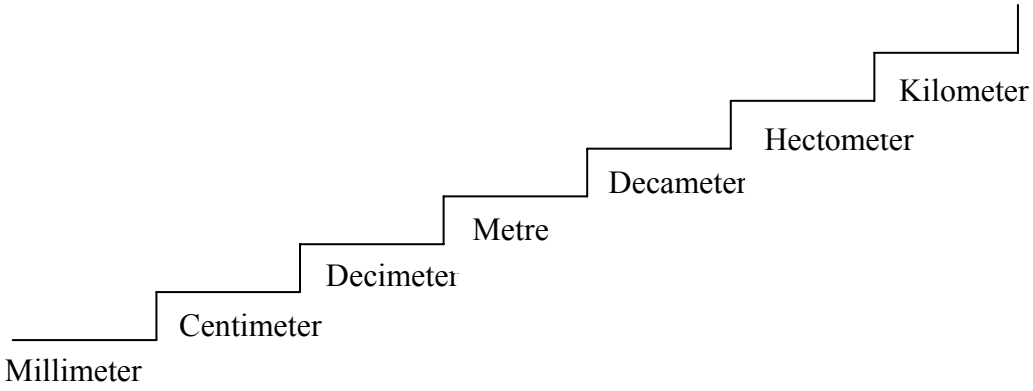
Ss: (*thinking*)

T: Think about the small things in surroundings

Ss: To measure length of pencil, length of speaker …

T: Right, where do we use multiples of meter?

Ss: While measuring the distance between cities,



T: Draw this stair on your notebooks.

T: How these units change when we move down or move up? Mehmet.

Mehmet: When move up, multiply with 10, when move down, divide by 10.

T: Right, the units of length are increase in tens, and decrease in tens

T: (*wrote three example to the board and let three students to solve them*)

As seen in the Table 4.4 when the case was units of length, the units of length were mentioned through giving examples from daily life. The relationship between these units was stated with the help of stair figure and exercises related to converting these units to each other were done.

Twenty six lesson periods were devoted to teaching measurement in elementary mathematics curriculum. Teacher C spent 22 lessons periods for teaching the unit. About 10 lesson periods of 22 were composed of introduction of concepts, defining the units with giving daily life examples, stating the relations between sub and multiples of the units, and letting students to solve simple examples about these relations. The other 12 lessons periods were devoted to practice these rules and relations.

Until now, a descriptive analysis of the observation of mathematics classroom was given. Below, the observation will be analyzed in the context of teaching a unit; the teaching practices in the beginning of the unit, in the development of the unit and at the end of the unit. The flow of these practices will also be presented.

4.2 The Lesson Practices in the Context of Teaching a Unit

For the three cases, teacher started the unit with the same way; by presenting the first topic of the unit. This presentation consisted of statement of the name of the topic. While Teacher A said “new title, prime numbers and factorization, our first subject is divisibility by 2”, Teacher B said that “We started the new subject, angles”, and Teacher C started by saying “Our new subject is measurement”.

The development of the unit was also similar in the three cases; the topics of the units were taught in the order suggested by the curriculum, and they were handled independently, without making any connections to other topics. The transition between topics were strictly sliced in a way which did not give impression of being related. For example, after allowing students to note the last exercises of divisibility, Teacher A asked students about what a prime number is and then defined the prime numbers. After explaining the last exercises of angles, Teacher B stated that “We pass the new subject, our title is triangles”. After declaring the end of exercises related to circumference, Teacher C asked students that where we use measurement of area in daily life. In these instances none of the teachers provided any relationship between the previous concepts and the new one.

Although there was no specific practice aiming to construct relationship between the topics, teachers' presentation of different topics showed similarities that might imply relationship in some cases. For example, the way of calculating GCD and LCM that Teacher A presented were similar; the way of stating the relationships between units of length, area, and volume that Teacher C presented were similar. These similarities might have implied the relationships between these topics despite the lack of explicit emphasize.

The practices at the end of units showed some difference as opposed to the similarities in the beginning and the development of the units. While Teacher A allowed students to do exercises related with the last topic of the unit, Teacher B re-explained the types of triangles, and Teacher C let students answer the test questions which covered the whole unit.

To sum up, teaching a unit was conducted as a composition of teaching separate topics. The following section was devoted for examining the teaching practices throughout these topics.

4.3 The Lesson Practices in the Context of Teaching a Topic

Examining units as a whole guided the researcher to focus on the practices in the context of teaching a topic because teaching a unit could be described as the combination of separately taught topics.

When teaching topics were separately examined for each cases, it appeared that each teacher had a tradition of teaching a topic, that is, the way each teacher organized the teaching practices were very similar across different topics. Table 4.5 presents the observation data of Teacher A in teaching two different topics in a comparative way.

Table 4.5 Teaching Practices throughout Greatest Common Divisor and Divisibility

divisibility	**greatest common divisor**
T: Write!, Divisibility by 2. Are 36 and 45 divisible by 2 without remainder?	T: Greatest common divisor
Ss(*most of them*): 36 is divisible, 45 is not …	GCD (24;36) = ? (*write to the board*)
T: How can you decide that?	T: which numbers can divide 24?
Ss: (*after a silence*) We divided!	Ss: 2, 6, 4 …
T: How can we decide without doing the division? Okay, if the last digit of a number is even, then the number is divisible by 2, if the last digit is odd, then it is not divisible by 2.	T: Is it divisible by 5?
T: Is 423 divisible by 2	Ss: No
Ss: No!	T: 24 = {1, 2, 3, 4, 6, 8, 12, 24} (wrote to the board)
T: Mehmet!	T: Which numbers can divide 36?
Mehmet: Not divisible by 2	Ss: 6, 9 …
T: Why? 3 is odd, is not it?	T: 36 = {1, 2, 3, 4, 6, 8, 9, 12, 18, 36} (*wrote to the board*) What is the greatest number common for both set?
Mehmet: Yes	Ss: 12
(*Teacher explained the divisibility by 5, 3, and 9 with solving a simple example and defining the rules of divisibility*)	(*Teacher presented two other method for calculating GCD similarly, and waited for note taking*)
T: 145, 210, and 183, which of them can be divisible by 2, 3 and 5?	T: GCD (8, 12, 16) (*wrote to the board*) (*explained these three method on this example*)
Ss: 210 (*after a while*)	T: 120 130 140 | (wrote to the board)
T: Right, last digit is 0 so divisible by 2 and 5, the sum of its numeral is 3 so divisible by 3.	Ss: Teacher, teacher, teacher …
	T: Osman!
	(*after Osman found the answer, teacher explained the solution*)

Table 4.5 (Continued)

(*In the following lesson, teacher allowed students to practice a variety of questions and assigned homework from textbook*) T: Which questions you could not solve? (*while controlling students notebook whether they do homework or not*) Ss: Teacher, can we do the third question T: Who solved it? (Teacher allowed volunteers to solve unsolved homework questions on the board)	(*Teacher asked some daily life problems in the following lesson*) T: We have 60lt, 84lt, and 96lt olive oil, and we want to fill them into cask, how much liter oil does the greatest cask hold? (After a waiting, let a volunteer to solve the question, and explained the solution) T: Since it was asked the greatest, we should find the GCD of these numbers. Your friend found GCD as 12, so the greatest cask holds 12lt olive oil. (*Teacher assigned homework from textbook*) (*In the following lesson, teacher let students to solve some of the homework question on the board, and continued to asked similar questions*)

The example given above clearly demonstrates the similarities in teaching practices of Teacher A in different topics. For example, when the processes of teaching greatest common divisor and teaching divisibility in Classroom A were compared, first, Teacher A wrote a sample question and then she solved it by explaining the procedure step by step. While solving, she also asked some short answer questions to the whole class. Second, she asked a similar example and solved it by emphasizing the procedure. Third, she let students to exercise a variety of related examples as a seatwork. And at last, she assigned homework and let students solve the homework questions in the classroom.

For the case of Classroom B, while teaching each type of angle, Teacher B followed a similar pattern. First, he gave the definition of the concept. Second, he

drew a sample of it and explained the sample with asking yes-no questions. And finally, he let students to practice a variety of related examples as a seatwork. Moreover, in Classroom C, while teaching the units of measurement, a common procedure was followed. First, the units of volume measure were mentioned by giving examples from daily life. Second, the relationship between these units was stated. And at last, variety of exercises related to converting these units to each other were done by students as a seatwork.

Examining teachers' traditions through teaching a topic separately gave a clue for constructing a pattern. Additional to this examination, describing the teaching activities that were observed in participated classrooms would help for concluding a pattern for teaching a concept. Therefore, the practices that typified many of the elementary mathematics lessons were presented in the following section.

4.3.1 Features that typified many of the elementary mathematics lessons

Table 4.6 shows the basic teaching activities that were categorized to code each elementary mathematics lessons, and the total number of occurrence of these activities over 45 elementary mathematics lessons.

Table 4.6 Occurrence of Teaching Activities in Elementary Mathematics Lessons

ACTIVITIES		**# of occurrence**
Review	Previous concept	4
	What is done in previous lesson	1
	Review the rule/procedure in practicing	25
Checking Homework	Control only students do or not	9
	Solve unanswered questions (review)	8
Presenting the Topic	Only mention superficially	7
	Warm up activity	-
	Relate with previous	-
Demonstration	Introduce the new topic, give definitions	22
	Introduce a sample problem	22
	Solve sample problem step by step	12
Practicing	Ask similar & different questions	35
	Let students do these questions	35
	Correct the wrong answers	15
	Let another student	8
Highlighting and Summarizing main points		3
Assigning Homework		10
Announcement of next topic		4

It can be easily seen from the Table 4.6 ‘practicing’ was the most occurred category in elementary mathematics lessons. Teachers asked similar and different questions and let students solve these questions as a practice of what they had thought in the 35 of 45 lessons. Moreover, they corrected the students’ wrong answers in the 15 of these 35 lessons and let the students who already found the correct answers to solve the question 8 of these 35 lessons.

In addition, the analysis of the data showed that ‘demonstration’ was the second most observed activity in elementary mathematics lessons. Demonstration is generally composed of, first, introducing new topic by giving definitions of

basic terms, second, introducing a sample question, and last, solving this sample question step by step, sometimes by asking students short answer questions. This procedure was observed in almost the half of the examined mathematics lessons.

'Assigning homework' and 'checking homework' were nearly at the same frequency. In the one fourth of the examined lessons, teachers gave homework to students and checked these homework

Teachers had presented the new topic in the 7 of the 45 lessons: This presentation was generally composed of only mentioning the name of the topic. Using a warm up activity for an interesting beginning of a new topic or relating the new content to the already taught content was not observed through the examined lessons.

'Highlighting and summarizing the main points' of taught topic and 'informing students about what will be done in the next lesson' were the least occurred activities among all categories. Teachers highlighted and summarized the main points of taught topic only 3 of 45 lessons, and they informed students about what could be done in the next lesson in only three of the lessons.

Although teachers did not spend much time for highlighting and summarizing the main points of the content, the rules and procedures were emphasized by teachers when students were practicing these procedures. Teacher reviewed/emphasized the related rules and procedures in 25 of the 35 lessons that included practicing.

4. 3. 2 The Concluded Lesson Pattern

After examining the traditions in teachers' practices and the common practices of the mathematics lessons, these observations can be combined as a pattern of teaching a topic. This pattern can be stated as following:

1. **Demonstrating the new content**: This demonstration was generally done in the following sequence; introducing the new content by defining the main terms, stating the rules and formulas and giving examples, asking a sample question and solving it step by step by emphasizing definitions, rules and formulas.

2. **Practicing the new content**: This practice was composed of asking a variety of questions about new content and allowing students to solve them. The questions from past national exams were asked frequently. This exercise processes were also composed of repeated cases: A volunteer student came to the board and wrote the solution on the board, and then teacher controlled the solution. If the solution was right, teacher explained the solution to the whole class and student went back to his/her desk. Teacher repeated the explanation by emphasizing the rules. If the solution was wrong, she reminded the rule which would be used for solution.

3. **Assigning and doing homework;** After sufficient practice, the teacher assigned homework. The control of whether students completed the homework or not were done by checking students' notebooks. In addition, many of the homework questions were solved in the classroom. This process was also described as practicing.

4.4 The Lesson Practices in the Context of Elementary Mathematics Lessons

At the initial phase of this study, the researcher aimed to seek for an answer to the question "What is the lesson pattern/lesson structure of elementary mathematics classrooms?" However, preliminary observations in the study lead the researcher to ask other questions: "Is it possible to draw a lesson pattern by using single lesson periods?", "Can single lessons be a base for drawing a whole picture of lesson pattern?"

It was not possible to draw a lesson pattern for elementary mathematics lessons by examining single lesson periods in this study. Because, some of the observed lessons were only composed of practicing procedure, while some of them only included solving homework questions.

When the teaching processes in the classrooms were examined, the single lesson periods did not have repeated procedures that can be figured out as a lesson pattern. The single lessons were not composed of common processes.

There were some recurring features that could be typified many of the lessons; however, the single lessons did not give a complete picture about the pattern of these features. While some lessons included only statement of rules, definitions, and formulas (for example, the lesson that was devoted for stating types of triangle in Classroom B), some lessons were composed of only exercising (for example, exercises about prime factorization in Classroom A).

In addition, when the whole unit was examined, it could be seen that most of the lesson were devoted for exercising. With the help of this inference, if it was tried to describe the lesson pattern of elementary mathematics classroom, it would be practice, practice, and practice.

4.5 Other characteristics of mathematics classrooms

Students' Role in mathematics lessons

The detailed examination of each mathematics lesson shows that students have two main roles throughout a mathematics lesson. First, to memorize the main facts and definitions about the presented content and to learn how to solve particular types of problems related to this content. This role can be described by the classroom activities, such as listening to the presentation of teacher carefully and following the steps of solution of sample problem attentively. Second, to practice what they have learned. This role can be described by the classroom activities, such as listening and noting the presented practice questions, trying to solve each question individually, and listening and comparing the solutions of other students.

Tasks of students during seatwork

Stigler et al (1999) defined three exclusive categories for student tasks during seatwork while describing students' performance in three counties (United States, Germany, and Japan) classrooms. These three categories and students works that can be coded into these categorizations were:

- Practice routine procedures: students apply previously taught procedures to similar problems and situations

- Invent new solutions/think; students discover their own solution methods for unfamiliar problems/situations
- Apply concepts in new situations; students apply previously taught procedures to new/unfamiliar situations (p.99-100)

The following table presents the number of lesson periods for each category and examples of teaching moments for each category from the observed lessons.

Table 4.7 Tasks of Students during Seatwork

Task	Number of task	Sample moments from observation data that exemplify the task
Practice routine procedures	31	- After describing the procedures for prime factorization by factorizing 148, teacher A allowed students to factorize 112 and 164. - Students in Classroom B used the definition of complementary angles for solving problems that are very similar with the example teacher had already solved. - After teacher C converted $0.43m^3$ to cm^3 with asking yes no questions to whole class, she let students to exercise with similar exercises.
Invent new solutions	-	-
Apply concepts in new situations	4	- solving daily life problems related with least common multiple and greatest common divisor, such as, “a wall with dimensions 60x90 is wanted to be covered with square tiles, have many tiles is needed at least

According to this categorization, from reported 45 lesson periods, 35 of them included seatwork. 31 of them can be categorized as 'practice routine procedure', none of them fall into 'invent new solution/think' and four of them were categorized as 'apply concepts in new situations'.

Delivery of the mathematical content

When presenting a concept, teachers could state the concept simply or they could let students develop the concept. A concept was coded as stated if it was simply provided by the teacher or students. For example, while teaching the circumference of circle, the teacher can state the relationship between circumference and Pi as circumference is the formula for finding the circumference of circle is Circumference =Diameter x Pi. Here, the focus of stating the concept is on the mathematical information itself rather than on the process of deriving it. A concept was coded as developed when it was derived and/or explained by the teacher or the teacher and students collaboratively in order to increase students' understanding of the concept. For example, students form groups to work with circular objects to measure the objects' circumferences and diameters. They then divide circumference by diameter and examine their answers. In a subsequent class discussion, the teacher uses the commonality across answers as a basis for defining Pi.

In the all of the examined lessons, teachers delivered the new mathematical content in the same way. First, they gave the definitions of important terms and facts: Then, they presented a sample problem about this content: And finally, they solved this problem step by step. This kind of delivery of mathematical content could be classified into 'state the content'. Therefore, concepts were stated in all of the examined mathematics lessons, and none of the observed lesson periods contained concepts which were developed and derived over the course of lesson.

Motivation for learning

The role of students was observed in this study as memorizing the facts and practicing. Related to this finding, teachers warned their students for only careful note taking and being silent. They motivated their students for only practicing.

While teachers motivated their students to learn a concept, the exams and grades were the only tools. Especially, reference to national exams was frequently used by the teachers as a motivating factor for their students to exercise/practice. Table 4.8 gives some of the examples for teachers' motivation statements.

Table 4.8 Teachers' Motivation Statements

Teacher	Motivation statements
Teacher A	"I have my grade book with me, follow the lesson if you do not want me to write 1…"
	"Who can do this problem? This is a question from the previous High School Entrance Exam"
Teacher B	"You are not paying attention to the problems. But you are complaining in the exam."
Teacher C.	"You had difficulty in these simple problems, what will you do in High School Entrance Exam"

4.6 Informal interviews with participant teachers

As mentioned in the methodology chapter, non-structured interviews were conducted with participant teachers. The main focuses of these interviews was teaching practices during lessons and regularity/normality of the practices in the lessons. The information related with their teaching careers was also gathered through these interviews. In this section, teachers views on their classroom practices in the context of teaching mathematics, and the regularity of these practices was described.

4.6.1 The regularity/normality of teaching practices

It is the case of valid researches that researchers measure what is intended to measure. The main aims of this study are to conclude pattern for participated three mathematics classrooms and to describe frequently observed teaching

features. What were intended to measure were the ordinary/usual/routine teaching and learning practices in mathematics classrooms. Therefore, it was crucial to ensure that the observed practices were the ordinary/usual/routine classroom practices. As a result, participated teachers were asked about regularity of observed classroom practices.

Teacher A stated that "I have been teaching these subjects for years, I have already memorized which activities would be done, I would not change my method for the reason that you are observing me". She also indicates that she did not behave differently to students when I was in classroom; she said that "If students understand that my behaviors are different, then they will misuse that".

Teacher B indicated that he was somehow excited in the first 3-5 minutes of the first observed lesson, but stated that "then I have forgotten that you were in the classroom." He added that some prospective mathematics teachers from universities also had observed his lessons so that he was familiar with being observed or reported.

Teacher C also emphasized her teaching experience about currently taught concepts and her familiarity with them. She added that the practices she used were what she had already used in previous semesters. She told that "teaching these concepts became a routine for me". Similar to Teacher B, she also mentioned about her excitement at the beginning of the observed lessons.

As a conclusion, participated teachers emphasized that their practices through observed lessons were not different than their usual. Although they mentioned about their excitement in the beginning of the lessons, they indicated that this excitement decreased through observations.

4.6.2 Teachers' views on their classroom practices in the context of teaching mathematics

Additional to ensure that observed practices were teachers' ordinary practices, it is important to provide evidence for that researcher's interpretation was the result of his observation, rather than his preferences. Being aware of teachers' own views about their classroom practices and their routines, the researcher had a chance to examine whether the findings derived from the

observations or not. Therefore, participated teachers were asked about their practices in a single lesson period and while teaching a topic.

Teacher A indicated that she started a lesson with controlling assigned homework and solving some of the homework questions. She pointed out that she reviews the important points of the concept through these solutions. She stated that if students understood the previous concept, she continues with the new one, if they do not, then she asks new problems. She emphasized also that she gives the necessary definitions and formulas in the beginning of the lesson, then, showed how to apply these formulas in a simple example and explained the solution methods step by step. She indicated that she repeated the necessary steps, since whether students understand these steps or not is very important. She said that she asks the questions that she prepared before the lesson and tries to ask as much questions as possible. Teacher description of her practices while teaching a concept was very similar to the ones in a single lesson period. She described her practices through teaching a concept as "I ask students about the new concept, then I explain briefly the concept and let students write the definitions. I give some related examples from daily life and I solve a problem with explaining. I allow students practice the concept. The practice continues until most of the students understand the concept".

Teacher B stated that he started a lesson with the summary of the previous lesson by asking some assessment questions. If most of the students had difficulty with these questions, then he re-explained the concept. He also gives importance to control assigned homework. He used these controls as an assessment tool. He summarized his practices through a teaching a concept as "firstly, I explain the concept until students comprehend it, some exercises follow this explanation, and lastly, I assign homework". He also indicated that while explaining a concept, he repeated the points which students had difficulty in comprehending. He emphasized that while teaching a concept, he gave priority to comprehension of the concept. Solving problems comes after the comprehension.

Teacher C indicated that what she does in the beginning of the lesson varies according to what she did in the previous lesson; if she assigned homework then she controls whether students did or not; if the exercises were not completed,

students continued to solve problems; and sometimes she started with introducing the new concept. She emphasized that the flow of the lesson also varies according to what she did in the previous lesson. She summarized her practices through a teaching concept as "I give necessary definitions at first. Occasionally, I want students give the definitions and sum up their definitions. I discussed with students the real life applications of the concept. I write some problems to the board and wait for students' solutions, then control their solutions". She added that she usually asks multiple choice questions so as to make students familiar with national exam questions.

As a conclusion, Teacher A described her practices through single lesson periods and teaching a concept as almost identical. According to her, the flow of her practices in a lesson or while teaching a concept could be summarized as reviewing the previous concept, introducing the new concept, giving some examples, solving a sample problem and allowing for exercising. Although this flow did not match with the researchers findings/observations related to single lesson periods, it was very similar to the findings related to teaching a concept. Teacher B's description of his practices through teaching a concept was consistent with the findings derived from the observations as in the case of Teacher A. From three teachers, only Teacher C emphasized that her practices in a single lesson vary according to what was done in the previous lesson. Although there was no one to one correspondence between teachers' description of their practices through teaching a concept and researchers' interpretations of these practices, they were not so different.

4.7 Summary of the findings

According to finding of this study; the following conclusions were drawn for teaching practices throughout a unit in three participated mathematics classrooms;

1. Teaching a unit could be described as the combination of separately taught topics,
2. The sequence of topics throughout a teaching unit is strictly determined by elementary mathematics curriculum,

3. Teaching practices while introducing the new unit only involved statement of the name of the first topic,
4. There was no specific practice aiming to construct relation between topics of unit,
5. There was no specific practice aiming to construct relation between unit's concepts and other school subjects, other mathematics concepts,
6. Students have two main roles throughout a mathematics unit; memorize the main facts and definitions and learn how to solve particular types of problems and practice what they have learned,
7. Most of the students' works during seatwork can be coded as 'practice routine procedures'; in which students were asked to apply known solution methods or procedures to the solution of routine problems
8. Concepts are stated, not derived or developed through mathematics lessons,

The following conclusions were drawn for teaching practices through a topic;

1. Each participated teacher had a traditional in teaching a topic. Although these traditional had some difference for each teacher, it can be summarized as;
   - Demonstrating the new content;
   - Practicing the new content;
   - Assigning and doing homework;
2. Most of the time that devoted for teaching a topic was spent for practicing the related rules and procedures,
3. Throughout practices, instead of themselves, teacher explained the students' works on the board,
4. The procedures while solving homework questions were very similar with the procedure while practicing.

The following conclusions were drawn for teaching practices throughout a topic;

1. It was not possible to draw a lesson pattern for elementary mathematics lessons by examining single lesson periods in this study,
2. 'Practicing' is the most occurred activity in elementary mathematics lessons,

3. It is difficult to observe two important teaching activities, ‘highlighting and summarizing the main points’ and ‘informing students about what will be done in the next lesson’, in elementary mathematics lessons,

CHAPTER V

DISCUSSION

The previous chapter documented the teaching practices in three 6th grade elementary mathematics classrooms, the inferences related to the 'pattern' of participated mathematics classrooms in the context of teaching a unit, a topic, and single lesson period, and teachers' views on these practices. The findings of the study provided important information about teaching practices in elementary mathematics classrooms and the patterns of these practices. These information and patterns will be discussed through this chapter.

5.1 Flow of Practices through Teaching a Unit

Examining teachers' practices through teaching a unit showed that teachers divided the units into its sub topics and taught these topics separately. There might be several reasons for this. First of all, the way the curriculum organized might be a reason for not relating the concepts. The separation of the concepts was based on the separation in the elementary mathematics curriculum. Teachers followed the curriculum while deciding not only on the content of the topics/practices but also the order of them. Although, the curriculum actually mentions about the importance of relationships between mathematics concepts (Elementary Mathematics Curriculum, 2002, p.7), there is no specific learning outcome related with constructing relationship between these topics in the curriculum. The curriculum might encourage teachers to let students construct these relationships by stating specific outcomes and presenting sample applications. In addition, other resources teachers use, such as textbooks and lecture notes, are not also mentioning about the connection between topics/concepts.

Another finding from the observation of teaching practices through teaching a unit was the lack of constructing relationships between the unit and other school lessons. Participated teachers did not attempt to relate a mathematics concept to a science or any other lessons' concept. There would be two important reasons of this deficiency. First, the curriculum does not include specific learning outcomes related with constructing these relationships as in the case of constructing relationships among mathematics concepts. Teachers might not want to spend extra time for these constructions/relations. The curriculum should present learning outcomes and useful activities for constructing these relations and devote necessary time to apply these activities. Second, teachers from different fields do not debate on organizing their lessons cooperatively. For example, a mathematics teacher can work together with a science teacher to organize the flow of their concepts so that students experience these relationships in their mathematics and science lessons.

5.2 Flow of Practices through Teaching a Topic

Exploring the flow of teaching practices through teaching a unit implied that similar practices were conducted through teaching unit's concept. Therefore, researcher focused on the teaching practices in the context of teaching a concept. The examination of these practices for each classroom exhibited enough similarities for constructing a pattern. The practices which the pattern was constructed from and features in the context of these practices were summarized in Table 5.1. This pattern of teaching a concept was usually composed of two or more lesson periods.

Table 5.1. The Pattern of Teaching a Concept

Activities	Features
Demonstrating the new content	Introducing the new content by defining the main terms Stating the rules and formulas and giving examples Asking a sample question and solving it step by step with emphasizing definitions, rules and formulas
Practicing the new content	Asking a variety of questions about new content and allowing students to solve them Students' solutions on the board and teacher's verification of solutions Repeating explanations by emphasizing the rules
Assigning and doing homework	Assigning homework Controlling whether students completed the homework or not Solving homework questions that students had difficulty

After presenting this pattern, it can be concluded that it is possible to use 'teaching a concept' as a unit of analysis while interpreting a classroom pattern. This conclusion is consistent with Clarke and Mesiti's (2004) argument on interpreting lesson structures. According to them, teaching a topic is one of the three senses for interpreting lesson structure.

The constructed pattern of elementary mathematics lessons can be described as an implication of 'direct instruction'. The flow of the lesson; demonstrating the new content, practicing the new content, and assigning homework, resemble a typical lesson in which direct instruction is the teaching method. This process/flow could be enriched by supplying visual demonstrations. Suitable manipulative could be used for gaining attention, concreting concepts and increasing students' understanding. However, these applications were somehow missing in observed mathematics lessons. Moreover, while introducing the new concept, teachers stated related definitions and rules. It is possible to let students developed these definitions and rules by organizing classroom practices as in the

case of Japanese mathematics classrooms (Stigler et al., 1999). The quality and effectiveness of the lessons decreased according to these deficiencies.

In concluding the report of the TIMSS Videotape Classroom Study, Stigler et al. (1999) indicates the steps common to most U.S. and German mathematics lessons as teacher instructs students in a concept or skill, teacher solves example problems with the class, and students practice on their own while the teacher assists individual students. They emphasize the difference in Japan by indicating typical steps in Japanese mathematics lessons; Teacher poses a complex, thought-provoking problem, students struggle with the problem and present ideas or solutions to the class, the teacher summarizes the class' conclusions, and students practice similar problems. When comparing the traditions in observed elementary mathematics classrooms with the lesson pattern of Japanese and United States, it can be easily seen that observed classrooms shows considerable similarities with United States but very different from the Japanese one.

5.3 Discussion on the Unit of Analysis in Interpreting Lesson Pattern

Researcher examination of teaching practices through single lesson periods did not provide enough similarity to draw a pattern. It was concluded from observations that the teaching practices and the flow of these practices in the single lessons varied according to teachers' intention from the lesson. Some lessons was only devoted to practicing or solving homework questions and some of them was devoted to stating related definitions, rules and formulas. While examining lesson structure of Japanese mathematics classrooms for example, Shimizu (2003) emphasized that the lesson pattern drawn from single lesson periods could not represent the teaching and learning practices of mathematics classrooms. The findings of this study also supported Shimizu's argument that the role of a lesson could be varied through the teaching of entire unit because of teachers' intention.

Researchers indicated the new and developing features of studies on structure of mathematics classrooms (Clarke, 2003; Shimizu, 2003). For example, while discussing the structure of mathematics lessons in Australia, Clarke (2003) indicated an interesting shift from discussion of "lesson scripts" (Stigler & Hiebert, 1998) to "lesson patterns" (Stigler & Hiebert, 1999) and via

“hypothesized country models” to “lesson signatures” as the means by which the classroom practices of countries might be usefully compared in the writings of Stigler, Hiebert and their co-workers. He emphasized that this trend signifies an increasing recognition that meaningful comparison of teaching practice across an international sample requires a multi-dimensional framework and a great sensitivity to variation.

Such discussions in international mathematics community let researcher ask following questions: Is it possible to draw a lesson pattern or lesson signature for elementary mathematics lessons? Is a single lesson period can be a base for drawing a nationally or internationally representative pattern of mathematics classrooms?

Based on the findings of this study, it was not possible to draw a lesson pattern of participated elementary mathematics classrooms with single lesson periods as a unit of analysis. When the lessons examined separately, there was no common steps for a single lesson periods.

While indicating the limitations of their study, Stigler and Hiebert (1999) also stated the bound of using single lessons as a unit of analysis for examining the traditions in mathematics classrooms. Since teaching involves not only constructing and implementing single lessons but also weaving together multiple lessons into units that stretch out over days and weeks, taping each teacher once limits the kinds of generalizations that can be made about instruction. If each teacher is taped once, it is not possible to study the dynamics of teaching over the course of a unit.

It can be concluded for the observed mathematics classrooms that using ‘teaching a concept’ (Clarke and Mesiti, 2004) instead of single lesson periods (Stigler et al., 1999; Hiebert et al., 2003), or sequence of consecutive lessons (Shimizu, 2003) as a unit of analysis could provide more accurate interpretations of lesson patterns.

5.4 Other Characteristics of Mathematics Lessons

It was interpreted from the data that students had two main roles in mathematics lessons; memorizing the related definitions and rules and solving

particular types of problems. These roles are an inevitable result of the lesson pattern that I have concluded. If teaching practices is organized as in the stated pattern (See Table 5.1), students will not take any responsibility other than memorization and practice. Such organization places students as passive listeners of teacher's presentations and problem solvers. The way teachers organized their lessons is directly related with what they expect from students. Assigning different roles for students requires suitable organizations so that they will achieve these roles. For example, if you expect students develop mathematical thinking, you should allow your students work on a challenging mathematical problem and share their ideas (as in the case of Stigler et al.'s description of Japanese mathematics classrooms). That is you should organize your lessons coherent with this aim.

Another interpretation drawn from the analysis of data is that 'practice routine procedures' is the main tasks of students during seatwork. One of the main reasons of such conclusion could be the importance of exams in our education system. Both of the teachers and students give priority to the preparation of High School Entrance Exam, therefore, discussing the topic, discovering the new content, understanding mathematics and thinking mathematically lose their importance contrary to practicing, or solving more questions.

Moreover, because of the extremely loaded curriculum and necessity of implementing it, teachers do not want to spend time to derive or develop the mathematical content and to construct proofs. The reason of lack occurrence of such kind of 'unnecessary' activities is not only the highly loaded curriculum but also teachers' preference of how to use the given time. Teachers prefer to let students to work as much problem as possible. On the other hand, this preference of much more practice is determined by external factors, mainly the national exams. The national exams such as High School Entrance Exam, assess only the products of educational progress, however, the process is also as important as the products. Such emphasize on product willingly or unwillingly causes the emphasize on practicing instead of understanding.

Furthermore, teachers warned their students for only careful note taking and being silent and motivated them for only practicing. Teachers' statements for motivating students to participate in classroom activities were an indicator of the

students' role in mathematics lessons. Careful note taking, being silent and participating in exercises emphasized the role of students as passive listener and problem solver.

One of the areas of science and mathematics education that has become increasingly aligned with quality of education is the use of hands on/manipulative activities, especially in elementary mathematics (Weiss, 1994). However, this study found that the use of these techniques is still very insufficient. The interviews with teachers emphasized an important reasons; the lack of time/highly loaded curriculum. Other barriers to use such activities can be lack of manipulative, lack of computers and appropriate software, and lack of money to purchase mathematics supplies.

As a conclusion, although the existing culture of the mathematics classroom seems to be quite stable, there is potential to change it. As Cobb (1995) indicated that an alternative classroom culture and alternative routines are needed.

5.5 Implications

Through this report, the observations from three 6^{th} grade elementary mathematics classrooms throughout a unit were interpreted, frequently observed teaching features in these classrooms were described, and the possible patterns of teaching practices in these classrooms were discussed. Predictably, the findings of the study hold some implications for teachers, teacher educators and policy makers. This section includes these implications.

The findings of the study implied that the organization of the concepts in observed mathematics classrooms is mainly determined by national curriculum. Therefore, the implications related with organization of concepts are directly related to curricula/policy makers. Elementary mathematics curriculum should include specific learning outcomes related not only with constructing relationships among mathematics concepts but also between mathematics and other courses, such as science. The curriculum should also include sample activities for constructing these relations and necessary time for conducting these activities. In addition, textbook and other curriculum materials should stress on making connections among different topics. Actually, the reformed elementary

mathematics curriculum stresses such relations and devotes time for useful activities. Well establishing the new elementary mathematics curriculum can help overcome this problem.

The findings of the study also indicates that the pattern of teaching practices through teaching a topic was composed of demonstrating the new content, practicing the new content, and assigning and doing homework. Teachers should also use different organizations, patterns or combination of practices while teaching a topic. Teachers should be aware of alternative instructional practices as much as their instructional traditions to implement different patterns. This awareness encourage them alter their practices (Borich, 2003; Stigler et al., 1999).

Teacher education programs should also aim to strengthen the awareness of mathematics classroom practices so that prospective elementary mathematics teachers will not stand far from the realities of classroom cases. Prospective elementary mathematics teachers should have enough chance to observe and discuss the traditions in the mathematics classrooms. They should also have enough chance to apply alternative teaching practices in real classroom settings. The observation of traditional cases and application of alternative practices can encourage prospective teachers to organize their lessons in their own way.

The examination of students' role in elementary mathematics classrooms showed that memorizing main facts and learning how to solve particular types of problems were the two main roles of students and most of the students works were composed of "practicing routine procedure". Teachers should organize classroom environments so that students have chance to participate variety of activities, such as, discussion of related tasks, doing investigation for related topics, and analyzing a real life problem. Students should be encouraged to take more responsibility of their learning. In addition, such activities make mathematics not only more meaningful for students but also more enjoyable.

Another conclusion drawn from the observations was that concepts are always stated by teachers, but never developed through mathematics lessons. Teachers should design different types of activities, rather than stating the facts, so that the concepts related to content could be developed through these activities.

Such activities will also be helpful for making students more active instead of being passive listener.

The observations indicated that most of the instructional time was devoted to practicing. This could be the results of importance of national exams. Therefore, the national exams that focused only on the products of educational progress should be revised so that the process will become as important criteria as products.

5.6 Recommendations for Further Researches

Results of this study offer some recommendations for further researches. These recommendations were presented in this section.

Field notes were used as an observation tool in this study. A similar study can be conducted by using technological devices, such as videotape for observing mathematics classrooms. Taking field notes would probably limit the researcher in what he could observe. Video-recording of classroom practices can help to overcome this limitation. Video record would be very useful for coding different dimensions of classroom process (Stigler et al., 1999).

This study analyzed mainly the classroom practices and teachers' views on these practices. A similar study can be conducted by investigating students' and teachers' perceptions of observed lessons to examine the difference in students' and teachers' perceptions and the difference between the perceptions and observations.

Longitudinal case studies can be performed to see the changes in teaching practices of a teacher in different mathematics unit. Teachers' practices through teaching a unit may varied according to the content of the unit or teachers' perceptions of the unit.

This study can be repeated by including the 7^{th} and 8^{th} grade elementary mathematics classrooms to see the changes in teaching practices according to grade levels. The practices in 7^{th} and 8^{th} grade classrooms may be more centered on the High School Entrance Exam.

This study was conducted only in public schools. Examining teaching practices from different types of schools, such as private schools, would result in interesting findings.

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APPENDICES

APPENDIX A

Observation Sheet for Lesson Structure

Observed Teacher	**Observed Class**
Observed School	**Observed Unit**
Observer Name	**Observed Topic**

Time	Teacher Action	Students' Action
0-2’		
3-5’		
6-8’		
9-11’		
12-14’		
15-17’		
18-20’		
21-23’		

24-26’		
27-29’		
30-32’		
33-35’		
36-38’		
39-41’		
42-44’		
45-47’		
48-50’		

The instructor

- Has just started the unit ( )
- Has already started the unit/is in the middle of the unit ( )
- Is at the end of the unit ( )
- Review the unit ( )

• **What kind of questions teachers asked? (explain briefly)**	
Open-ended or closed ended?	
Yes-no questions or short answers?	
Discussion question?	
• **What is the reason of asking question?**	
For warming up?	
For exemplification?	
For exercise?	
For critical thinking/discussing?	
• **How was the students' contribution to the lesson?**	
Any question?	
Any comment? (other than answering teacher' questions)	
Any discussion?	

What are the students' actions throughout the lesson?

Listen	
Repeat teachers explanations	
Give examples	
Exercise	
Discuss (about content)	
Analyze/criticize	
Discover	
Evaluate	
(others)	

What are the materials used in the lesson?

-
-

*This table is not to be filled by the observer it is just a guide for lesson observation

The Categories for Analyzing Lesson Structure

ACTIVITIES	
Review	Previous concept
	What is done in previous lesson
	Review the rule/procedure in practicing
Checking Homework	Control only students do or not
	Solve unanswered questions (review)
Presenting the Topic	Only mention superficially
	Warm up activity
	Relate with previous
Demonstration	Introduce the new topic, give definitions
	Introduce a sample problem
	Solve sample problem step by step
Practicing	Ask similar & different questions
	Let students do these questions
	Corrected the wrong answers
	Let another students
Highlighting and Summarizing main points	
Assigning Homework	
Announcement of next topic	

APPENDIX B

A sample of filled observation sheet

Observation Sheet for Lesson Structure

08.12.05-2

Observed Teacher		Observed Class	6-B
Observed School		Observed Unit	Asal Sayılar ve Ç. Ayırma
Observer Name	Oguzhan Doğan	Observed Topic	EBOB

Time	Teacher Action	Students' Action
0-2'	Sınıf D. doldurdu, Yoklama	Kendi aralarında konuşmalar
3-5'	-Anlamayan Ö'yi tahtaya kaldırdı. -Yaz, (12 ile 25) (14 ile 26) -"Çarpanlara Ayır" 12 25 14 26 -"Ortak sayı varmı?" 2 5 2 2 -"Ortak Yoksa Aralarında Asal" 3 5 7 13	-Bir ö, Aralarında asallık kavramını anlamamış "Bana anlatın" dedi. -Ö, açıklamayı tekrarladı
6-8'	Aralarında Asal'ı tekrar açıklıyor Evet. Yani konu, Yaz, En büyük Ortak B.	Dinliyorlar
9-11'	Tahtaya soruyu yazdı (24 : 36) EBOB = ? "24 hangi sayılara bölünür?" "2'ye bölünürmüş" "3'e", "5e" "6.ya"--- 24 = {1,2,3,4,6,8,12,24}	Yazıyorlar Sorulara toplucan cevap veriyorlar - 6,4 (soru kolay alınca çoğu - 12 cevap veriyor)
12-14'	36 için de yapt aynısını, 36 = {1,2,3,4,6,9,12,18,36} "İkisindede olan sayılar hangileri? En büyüğü"	Toplucan cevap veriyorlar (Evet-Hayır bölünür) -12
15-17'	Bi yol daha var 24 ile 36 yı asal çarpanları cinsinden yaz $24 = 2^3 \times 3$ $36 = 2^2 \times 3^2$ -Hangileri ortak $(24:36)_{EBOB} = 2^2 \times 3 = 12$	Dinlediler Kısa cevap sorulara cevaplar
18-20'	24 36 2 2 2 3 3 -Bu yöntemin daha kısa olduğunu söledi, "zamanla yarışıyoruz"	Not alıyorlar Bir anlamadım dedi, bir daha
21-23'	Yaptığını tekrar açıkladı, Anlamayanı tahtaya kaldırdı	Dinliyorlar, not alıyorlar Ö, yine anlamadım dedi
24-26'	"Yaz 30 'la 45" "Yaz yine" "30 'yu 2ye bölünür müş?" "15?" "3'e bölünürmüş? (Tüm sınıfa) soruyor	Öğrt dediklerin yapıyor Tahtaya yazıyor

1

27-29'	Anlamadım diyene yaptıklarını tekrar anlatıyor	Yazıyorlar, dinliyorlar
30-32'	Not almaları bekleyerek tekrar anlatıyor Bir soru daha yazdı 8, 12, 16 | Cözdü (anlatarak)	Yazıyorlar
33-35'	"Diğer yollardan da yapalım" Tahtaya yazdı, cözümleri	Biri ilk cözümün daha kolay olduğunu söyledi (Hoca doğruladı)
36-38'	120 130 140 | bu şekilde yazıp cözüm için zaman verdi	Sıralarda uğraştılar
39-41'	Birini tahtaya kaldırıp ders zil çaldı	Ayaklandılar.
42-44'		
45-47'		
48-50'		

The instructor

- Has just started the unit ( )
- Has already started the unit/is in the middle of the unit (X)
- Is at the end of the unit ( )
- Review the unit ( )

2

• What kind of questions teachers asked? (explain briefly)	
Open-ended or closed ended?	Closed
Yes-no questions or short answers?	(Ebob alırken sorduğu sorular)
Discussion question?	x
• What is the reason of asking question?	
For warming up?	
For exemplification?	
For exercise?	✓ (son soru)
For critical thinking/discussing?	
• How was the students' contribution to the lesson?	
Any question?	
Any comment? (other than answering teacher' questions)	Arkadaşlarının söyledikleri
Any discussion?	

What are the students' actions throughout the lesson?

Listen	x
Repeat teachers explanations	x
Give examples	
Exercise	x
Discuss (about content)	
Analyze/criticize	
Discover	
Evaluate	
(others)	
.	
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What are the materials used in the lesson?

- Board
-
-
-
-

3