AN ELEMENTARY MATHEMATICS TEACHER'S PEDAGOGICAL REASONING IN SELECTING LEARNING ACTIVITIES

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ABSTRACT

AN ELEMENTARY MATHEMATICS TEACHER'S PEDAGOGICAL REASONING IN SELECTING LEARNING ACTIVITIES

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The purpose of this study was to explore an elementary mathematics teacher's pedagogical reasoning on selection of learning activities. For this purpose, a teacher's decisions and judgments while selecting activities for her mathematics lessons were examined.

Qualitative case study was performed where; data was collected in the spring semester of 2008-2009 and in the fall semester of 2009-2010 academic year. The case of the study was a teacher who was known by using activities in her mathematics lessons.

Results revealed that the teacher had two main groups of considerations in her pedagogical reasoning on selection of activities. The first group is considering how activities will affect students' learning and the second group is considering how to organize her teaching. Considering how activities will affect students' learning is related to characteristics of the tasks within the activities, students' understanding concepts: their conceptions and misconceptions, and student motivation. On the other hand,

considering activities in organization of activities is related to objectives of the lesson, lesson flow, purposes of the activities; time use for an activity, sources and materials to be used in the activities.

Keywords: Mathematics education, pedagogical reasoning, learning activity

ÖZ

BİR İLKÖĞRETİM MATEMATİK ÖĞRETMENİNİN ETKİNLİK SEÇİMLERİNE İLİŞKİN PEDAGOJİK AKIL YÜRÜTME SÜREÇLERİ

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Bu çalışmanın amacı, bir ilköğretim matematik öğretmeninin dersleri için etkinlik seçimine yönelik pedagojik akıl yürütme sürecinin incelenmesidir. Bu amaçla öğretmenin matematik dersleri için etkinlik seçerken verdiği karar ve vardığı yargılar, bu karar ve yargıların arkasındaki nedenler incelenmiştir. Nitel durum çalışması yapılmış olup, ilgili veriler 2008-2009 bahar dönemi içinde ve 2009-2010 sonbahar dönemi içinde toplanmıştır. Çalışmanın durumunu derslerinde etkinlik kullanımıyla bilinen bir öğretmen oluşturmaktadır.

Çalışma sonunda, öğretmenin etkinlik seçimine yönelik akıl yürütme sürecinde göz önünde bulundurduğu hususların iki ana grupta toplantığı görülmüştür. İlk grup, etkinliklerin öğrencilerin öğrenme süreçlerini nasıl etkileyeceğinin göz önünde bulundurulmasıdır. İkinci grup ise öğretmenin kendi öğretim sürecini nasıl organize edeceğinin göz önünde bulundurmasıdır. İlk grupta, öğrencilerden etkinliklerde beklenen işlere ait özellikler; öğrencilerin kavramları nasıl anlayacakları, kavrama

biçimleri ve olası kavram yanılgıları; ve öğrenci motivasyonuna ilişkin hususların dikkate alındığı görülmüştür. Diğer taraftan ikinci grupta ise, etkinliklerin ait olduğu derslerin kazanımları, ders akışı, etkinliklerin amaçları; etkinliklerdeki zaman kullanımı, etkinliklerde kullanılacak malzeme ve kaynaklara ilişkin hususların dikkate alındığı görülmüştür.

Anahtar kelimeler: Matematik eğitimi, pedagojik akıl yürütme süreci, öğrenme etkinliği

To my family: Uğurcan, Doğa, Meral, Ali and Emine.

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TABLE OF CONTENTS

LIST OF TABLES

TABLES

LIST OF FIGURES

FIGURES

CHAPTER I

INTRODUCTION

> *Regardless of the way teachers plan, one persistent decision faces them: what activities or experiences will they provide for learners? Before instruction begins, teachers need to decide whether they will have a class discussion, show a film, take a field trip, read textbooks, make murals, or engage pupils in some other learning activity.*
>
> (Zahorik, 1976, p.50)

Decision making is regarded as one of the most of important teaching skills by the educational researchers. Shavelson (1973) underlines the importance of decision making by introducing it as the basic teaching skill and adds that "any teaching act is the result of a decision, either conscious or unconscious" (p.1). Teachers are viewed as rational and thinking individuals who attain instructional goals through decisions. Teachers make numerous decisions regarding mathematics instruction on a daily basis such as what questions to ask, what ideas to pursue, when to provide information, how to encourage students to participate in class (Casa, 2004).

There are two distinctions made related to teachers' decision making literature (Wohlhuter, 1996). The first one is between decisions made before classroom instruction which are known as preactive decisions and decisions made during classroom instruction which are known as interactive decisions. The second one is between interactive decisions and decisions made after classroom instruction which are

known as postactive decisions. Preactive and postactive decisions are collectively labeled as planning decisions. Wohlhuter (1996) informed that planning decisions and interactive decisions determine what happens in the classroom since planning decisions such as what content to teach, what instructional approach to use, what questions to ask, and how much time to spend on an activity; and interactive decisions made during instruction about such details whether to implement the lesson as planned, how to respond to students' questions, whether to provide an alternative explanation, and when to pursue a student-generated discussion.

Shulman (1987) argued that teachers draw upon their knowledge base of teaching to help them make this kind of decisions. According to him, the teacher knowledge base describes what teachers profess, understand and do. He categorized a knowledge base for teachers that at a minimum would include the knowledge of the content, general pedagogy, curriculum, learners, educational contexts, educational purposes and values, and subject specific pedagogy. Shulman (1987) stated that a teacher's knowledge base is put into operation in the classroom through a process defined as pedagogical reasoning and action.

Shulman's pedagogical reasoning and action model is a cyclic process. He states that teaching necessarily begins with a teacher's understanding of what is to be learned by the students and how it is to be taught. Then it proceeds through a series of activities during which the students are provided specific instruction and opportunities for learning. Finally, teaching ends with new comprehension by both the teacher and the

student. He describes the stages of this cyclic model as comprehension, transformation, instruction, evaluation, reflection, and new comprehensions.

The first two stages of the model, comprehension and transformation, are in close relation with a teacher's planning decisions. Shulman believes that teachers begin with the *comprehension* of the purposes, structures, and ideas. Then in the *transformation* stage, they make various decisions in three sub processes. Those are stated as the preparation and segmenting of the text, representation of the material, selection of methods for teaching, and adaptation to student characteristics.

Teachers' pedagogical reasoning process describes how teachers put experience and knowledge in to operation to make their decisions regarding teaching. Teacher planning and teachers' planning decisions have great importance for better instruction. Considering the complex nature of teaching, it is important to pay attention how teachers make their planning decisions for instruction. Decisions in the process of selecting activities and adapting them to student characteristics are a part of planning decisions; and understanding the reasoning behind those decisions may be helpful for planning instruction in a better way, designing activities by more focusing on the needs of teachers and learners.

1.1 Statement of the Problem

The practice of planning is as important as the practice of teaching, since an important component in teachers' decisions is about planning, which involves decisions regarding activities to be used in class. Teachers' planning decisions influence the

content, materials, social climate, and activities of instruction; and activities are the focus of teacher planning (Shavelson, 1983).

Much research has been accomplished on teacher planning and the factors influencing teachers' planning decisions. Research findings indicated that one of the factors was activities. For instance, Zahorik (1975) underlined that the teachers' planning decisions were mainly influenced by activities, content, objectives, and materials. Moreover, he reported that most of teacher decisions were related to the activities and content. Similarly, Yinger (1980) reported that instructional activities were the most important and the most frequent concern for the teacher in her planning process. Decisions about the content and materials were found as the most frequent activity-related decisions teachers make in their planning. Brown (1993) stated that the need to master content, the school schedule, and the textbook were found to be the main factors influencing teachers' planning decisions.

Learning activities are the means by which teachers bring students into contact with subject matter (Zahorik, 1982). Zahorik described two points of view for the function of activities: One is the objectives-achieving function. In this view, an emphasis is made to the learning outcomes and it is believed that activities must be directly related to objectives. In the other view, objectives are used to justify learning activities, but it is believed that activities have additional functions such as helping students to find their own objectives.

Activities have a variety of purposes (Price & Nelson, 2002). They are mainly designed to provide motivation for students before beginning a series of lessons;

background information, experience, or an opportunity to recall prior knowledge before a series of lessons; ongoing practice toward objectives; opportunities for students to apply skills they have previously learned; and opportunities for students to integrate a variety of knowledge and skills they learned in different subject areas.

Activities are known as one of the factors influencing teachers' planning decisions. However, less is known about the details of those decisions and the reasoning behind them. In the process of selection and adaptation of activities, a teacher may take several issues into consideration. Those issues are of great importance regarding the information they can provide about the classroom environment, student characteristics, teacher's organization of instruction, etc.

Reasoning process is special to each teacher. Therefore, understanding reasoning behind the activity selection of a mathematics teacher, especially of a successful teacher, how she adapts the activity plans for her students and for her classroom may give some idea about the teacher's point of view. Considering the importance of teachers' planning decisions for better instruction and considering selection and adaptation of activities as one component of the decisions teachers make in their planning processes; the purpose of this study is to explore an elementary mathematics teacher's pedagogical reasoning in selecting learning activities. Therefore, the study aims to answer the following question:

What is the nature of an elementary mathematics teacher's pedagogical reasoning process while selecting activities for her mathematics lessons?

- What pedagogical decisions does an elementary mathematics teacher make while selecting activities for her mathematics lessons?

- What are the reasons behind an elementary mathematics teacher's pedagogical decisions regarding her activity selection?

1.2 Significance of the Study

The literature indicates that early research on teacher decision making focuses on teacher planning decisions and teachers' interactive decisions during instruction. The early planning decisions are mainly about what teachers do in planning and related time allocations (e.g., Shavelson, 1983; Yinger, 1980; Zahorik, 1976, 1982). With Shulman's introduction of the pedagogical reasoning and action model, teachers' reasoning processes are explored by other researchers too (Casa, 2004; Richardson, 2009; Sanchez & Llinares, 2003; Smith, 2003; Starkey, 2009). In recent years, some researchers have examined how teachers incorporate certain ideologies of teaching like teaching for understanding and teachers' thinking in planning and during instruction (Edgington, 2009; Li, Chen & Kulm, 2009). Moreover, there is a trend in educational research to explore how teachers use curricular materials and how they enact their lessons using these materials. However, the recent literature indicates limited information about teachers' selection of learning activities and how they adapt activities for their teaching.

In addition, several studies on teachers' planning have been conducted in Turkey (Aytunga & Bayındır, 2009; Eskiocak, 2005; Yıldırım, 2003). Yıldırım (2003) studied the basic components of teachers' daily plans, and teaching/learning activities were assigned a medium level of importance. Eskiocak (2005) analyzed the factors affecting primary school teachers' decision making process in their planning. Aytunga and

Bayındır (2009) explored how elementary school teachers prepare their lesson plans. However, the studies conducted in Turkish school contexts are very limited in terms of specifically exploring the process of selection of activities and their use for instruction. In this sense, this study can provide some insights into process of selection of activities and their use in teaching.

Considering the emphasis on the use of learning activities in Turkish national mathematics curriculum; a better understanding of teachers' process of activity selection and use in teaching may provide insight into the implementation of the national curriculum. Such information is especially valuable for teacher educators and content developers, since it provides a teacher's perspectives for the quality of learning activities. Teacher educators may want to consider an experienced teacher's point of view for their students in teacher education programs. Learning about a teacher's decisions regarding activities, the context in which those decisions are made may also be useful for other teachers. The study can give feedback of teacher opinions about teaching mathematics to design better learning activities to meet teachers' and learners' needs.

Finally, I want to express my personal motivation for the study. I've been working as a content developer for several years; and designing activities for students is an important part of my job. However, I believe that no content developer can do this as it needs to be done unless s/he is a teacher at the same time. Thus, understanding the activities from the perspective of a teacher means a lot to me. This study may help content developers and elementary mathematics teachers to understand a teacher's view

of point while they select or design learning activities for their mathematic lessons. It may make some recommendations to decision makers for choosing learning activities in mathematics.

1.3 Definition of Important Terms

The research questions and the findings consist of several terms that need to be defined.

Decision

Decision is a choice or judgment that you make after thinking and talking about what is the best thing to do (Oxford Advanced Learners Dictionary, 2010). This study focuses on the decisions that a teacher makes in the context of her profession. Therefore, for the current study, decisions are taken as the choices or judgments made by the teacher about the selection, organization, and implementation of the activities to be used in the classroom.

Learning Activity

Learning activities are the means by which teachers bring students into contact with subject matter (Zahorik, 1982). Beetham and Sharpe (2007) defined a learning activity as an interaction between a learner or learners and an environment (optionally including content resources, tools and instruments, computer systems and services, 'real world' events and objects) that is carried out in response to a task with an intended learning outcome.

In this study, learning activity refers to activity plans which consist of a set of tasks students to perform in a particular context to achieve an intended purpose. Price and Nelson (2002) underlined that activities have a variety of purposes. They are mainly designed to provide motivation for students before beginning a series of lessons, background information, experience, or an opportunity to recall prior knowledge before a series of lessons; ongoing practice toward objectives, opportunities for students to apply skills they have previously learned, and opportunities for students to integrate a variety of knowledge and skills they learned in different subject areas.

Pedagogical Reasoning

Shulman (1987) states that a teacher's knowledge base is put into operation in the classroom through a process defined as pedagogical reasoning and action. This process is cyclic and; it cycles within the stages of comprehension, transformation, instruction, evaluation, reflection, and new comprehensions. In this study, pedagogical reasoning concept has been used in the way as it was described by Shulman (1987).

Task

Stein and Smith (1998) defined a task, in the context of mathematics, as "a segment of classroom activity that is devoted to the development of a particular mathematical idea" (p.2). They also emphasized that mathematical tasks give students the opportunity to think conceptually, and encourage them to make connections and provide context for students to think about, develop, use, and make sense of mathematics.

In this study, a mathematical task refers to the expected work in the activities which demands students to think about a mathematical idea. This demand can be at a low-level such as performing an operation, or can be at a high-level such as formulating an alternative solution to a given problem.

CHAPTER II

REVIEW OF THE LITERATURE

The purpose of this study was to examine an elementary mathematics teacher's pedagogical reasoning while selecting or designing activities for her mathematics lessons. More specifically, the decisions and the considerations she made were examined. Shulman's Model of Pedagogical Reasoning and Action structured the conceptual framework for this study. Even though this single model did not state a reasoning process special to selection of activities, it provides the conceptual framework for the study by explaining the fundamentals for the concept of pedagogical reasoning. Shulman theorizes a six-stage cyclical process for pedagogical reasoning: comprehension, transformation, instruction, evaluation, reflection, and new comprehension.

Theoretical background and related research studies were stated throughout the chapter. The literature indicates that early research on teacher decision making focuses on teacher planning decisions and teachers' interactive decisions during instruction. The early planning decisions are mainly about what teachers do in planning and related time allocations. With Shulman's introducing the pedagogical reasoning and action model, teachers' reasoning processes are explored by other researchers too. In recent years, some researchers have examined how teachers incorporate certain ideologies of teaching

like teaching for understanding and teachers' thinking in planning and during instruction. The literature does not indicate any recent study which specifically explores the interaction between the learning activities and the teacher. However, curricula like our national mathematics curriculum rely on and suggest use of learning activities, and there is a trend in educational research to explore how teachers use curricular materials and how they enact their lessons using these materials.

Based on the indications of the literature, first literature on *teacher decision-making* is given under two subsections which are *research on teacher decision-making* and research on teacher decision making in Turkey. Second the conceptual framework, *pedagogical reasoning and action*, is introduced with stating the *previous research on pedagogical reasoning*. Then learning activities and previous research on selection of learning activities are given. Finally, *research on use of curriculum materials* is given.

2.1. Teacher Decision-Making

A dictionary definition of "decision" is given as a choice or judgment that you make after thinking and talking about what is the best thing to do (Oxford Advanced Learners Dictionary, 2010). This study focuses on the decisions that a teacher makes in the context of her profession. Therefore, for the current study, decisions are taken as the choices or judgments made by the teacher about the selection, organization, and implementation of the activities to be used in the classroom.

Yinger (1980) stated that decision making has gained cognition as the most important teaching skill by the educational researchers. Wohlhuter (1996) pointed out

the existence of two distinctions made related to decisions in teachers' decision making literature. The first one is between decisions made before classroom instruction which are known as preactive decisions and decisions made during classroom instruction which are known as interactive decisions. The second one is between interactive decisions and decisions made after classroom instruction which are known as postactive decisions. He noted that collectively preactive and postactive decisions are labeled as planning decisions. Wohlhuter (1996) informed that planning decisions and interactive decisions determine what happens in the classroom by giving examples for each kind of decisions. Planning decisions are about what content to teach, what instructional approach to use, what questions to ask, and how much time to spend on an activity; and examples for interactive decisions are about such details whether to implement the lesson as planned, how to respond to students' questions, whether to provide an alternative explanation, and when to pursue a student-generated discussion.

Similarly Casa (2004) stated that teachers make numerous decisions such as what questions to ask, what ideas should be pursued, when provide information, how to encourage students to participate in class regarding mathematics instruction on a daily basis. Shulman (1987) argued that teachers draw upon their knowledge base of teaching to help them make this kind of decisions.

Shulman (1987) reported that the existence "knowledge base for teaching" was first introduced by the advocates of professional reform who held many discussions on how to improve teaching both as an activity and a profession in 1986. He examined the sources of that knowledge base, provided a model describing what knowledge base is,

and then he explored the processes of pedagogical reasoning and action in which such teacher knowledge is used. According to him, the teacher knowledge base described what teachers profess, understand and do.

Shulman (1987) categorized a knowledge base for teachers that at a minimum would include the knowledge of the content, general pedagogy, curriculum, learners, educational contexts, educational purposes and values, and subject specific pedagogy. *Content knowledge* includes the understanding of the subject, for instance mathematics. *General pedagogical knowledge* describes common ways in which teachers manage and organize the classroom. It is related to broad principles and strategies of classroom management and organization regardless of subject matter. *Curriculum knowledge* is about how teachers make sense of the curricular program and the materials. *Knowledge of learners and their characteristics* is directly related to teachers' understanding student needs and *knowledge of educational contexts* is related to the contexts in a range from group or classroom, the district, to the community and cultures. Knowledge of educational values and purposes allows teachers to have complete view of education. Finally, the subject specific pedagogy, namely *pedagogical content knowledge* represents teachers' own special form of professional understanding. Shulman described it as a blending of content and pedagogy into an understanding of how particular topics, problems, or issues are organized, represented and adapted to the diverse interests and abilities of learners, and presented for instruction. According to him, a teacher's knowledge base is put into operation in the classroom through a process defined as pedagogical reasoning and action (1987).

2.1.1. Research on Teacher Decision-Making

According to the literature, mostly known studies on teachers' decisions made prior to classroom instruction are conducted by Zahorik (1975), Clark & Elmore (1981), and Yinger (1980). The common aim in three of these studies was identifying the factors affecting teachers' planning decisions.

Zahorik (1975) aimed to investigate how teachers plan their lessons and one component of his study was the determination of what planning decisions were made by teachers. He was also interested in the order in which the teachers made their planning decisions. 194 teachers participated in the study. Teachers were asked to list in order the decisions they made before teaching a class. Eight categories were used to analyze the list given by the teachers. Those categories were: objectives, content, activities, materials, diagnosis, evaluation, instruction, and organization.

The results of Zahorik's study showed the teachers' planning decisions were mainly influenced by activities, content, objectives, and materials. The data analysis showed that most of their decisions were related to the activities (81%) and content (70%). Objectives (56%) and materials (56%) were the third most frequently reported type of decisions. Moreover, content (51%) and objectives (28%) were the two most frequently reported initial decisions.

Different from Zahorik, Clark and Elmore (1981) studied with one teacher. They examined the yearly planning completed by one elementary teacher in think aloud sessions. The aim of one component of the study was identifying factors affecting teachers' planning decisions. Three 2 hour-sessions were conducted to obtain the data.

The data indicated that in first step of her planning, the teacher listed each of the math unit topics and refered to the teacher curriculum guides for each unit. She also referred to the calendar for the upcoming school year.

Second, she did a mental review of each topic taught during the past year. This addressed the content, duration, the reasons why it was long or short as it was, the method of instruction used for each unit, and remembered outcomes of each unit in terms of student mastery and teacher satisfaction with the process. Also the relationship between each unit and the topics that followed it were considered. The teacher made decisions about the sequence of units and the duration of each for the coming year. Those decisions seemed to be based on teacher's memory of how these lessons had proceeded during the previous year. For instance, she decided to change the sequence of first three units in order to provide some relief for students from the heavy use of numbers.

Third, parallel with mental review of each topic, sequencing and duration decisions, adjusting instructional methods proceeded. Some examples were use of group instruction instead of independent instruction for some units, integration of one math unit into the science curriculum, and use of optional activities suggested in the teacher's guide by students who finish their daily work early.

Mathematics was an important subject matter for this teacher and she had some clear ideas about which topics within the curriculum were most vital for students to learn. She felt pressure to complete all of the units that the curriculum developers

identified as appropriate. To sum up, the results of the study showed that the teacher's guide, her memory of classroom interaction during the previous year, calendar for the upcoming school year, knowledge of incoming students' prior experiences, and her beliefs and values about the relative importance of the subject matter were the factors influencing the teacher's yearly planning.

In addition to planning decisions, Yinger (1980) also studied teachers' interactive decisions. In his study, he examined one elementary teacher's planning decisions over a five month period. The study focused on description of the mental processes in which the teacher engaged while making planning decisions. Data was collected through 12- week observation prior to classroom instruction and during classroom instruction and 8-weeks additional observation and interviews.

As a result of Yinger's study, two factors were defined to be influencing teacher planning decisions. The first factor was instructional activities and the second factor was routines.

Yinger (1980) reported that instructional activities were the most important and the most frequent concern for the teacher. It was found that as the teacher made decisions about her instructional activities, she made decisions regarding seven features of the activity. Those features are location, structure and sequence, duration, participants, acceptable student behavior, teacher's instructional moves, and content and materials.

According to Yinger's findings (1980), the most common locations for activities were the students' seats. Activities used by the teacher usually were made up of three phases: set-up, lesson, and take down. Time allocations were made when the teacher set up her weekly schedule and it was arranged so that adequate set-up and take-down time was given. The participants in an activity were determined largely by decisions about grouping. Some activities included the whole class and some included only a few students. Students were grouped for math units, workbooks, and for math quizzes.

Finally, Yinger (1980) concluded that decisions about the content and materials were the most frequent activity-related decisions when the teacher made in her planning. He identified eight cues that were frequently used when the teacher judged the usefulness of materials. Those were the format of materials (e.g. text, workbook, games), the attractiveness of the materials, whether or not the materials were consumable (using a worksheet or working on the book), whether they could be easily modified or adapted to serve her purposes, the clarity of the instructions for the students, whether an evaluation system was provided with the material, set-up time for her, whether or not there would be enough materials for a group or the whole class, and content.

The second distinctive characteristic of teacher planning was reported by Yinger (1980) as the use of routines. He described routines as routines the mechanisms that the teacher used to establish and regulate activities and to simplify planning, and the teacher's planning was described as decision-making about the selection, organization,

and sequencing of routines. The routines used by the teacher were activity routines, instructional routines, management routines, and executive planning routines.

The teacher routinized many of the activity features when to conduct an activity as a result of her experience with a large amount of activities. Instructional routines were described as strategies for teaching that were developed over a period of time, which occurred in established patterns and sequences. The teacher used instructional routines for questioning, for monitoring, for giving instructions, among other purposes. Management routines were controlling and coordinating classroom organization and behavior such as transitions between activities, passing out or collecting materials, leaving the room, cleaning the room, and starting school in the morning or after lunch. Finally, executive planning routines were described as established patterns which result from the teacher's experience in many similar situations. The teacher repeatedly approached specific planning decisions in consistent and regular ways. For example, unit planning was always conducted in an established pattern, but the routine for unit planning was different from the routine for daily or weekly planning.

Different from the above studies, Brown (1993) examined two novice secondary teachers' planning descriptions. Data were gathered using tape-recorded interviews, questionnaires, an analysis of written plans, and think-aloud tape recordings of unit, weekly, and daily planning. The need to master content, the school schedule, and the textbook were found to be the main factors influencing their planning decisions. The teachers told that toward the end, they planned the content to be covered in much less

detail. They also added that when they did not have the textbook they felt incompetent to plan.

Decker and Ware (2001) studied how elementary teachers used planning time available to them, and the congruence between use of that time and teachers' perception of use of that time. Their study included 30 teachers. Data were gathered through interview with teachers, observation of their lessons, and questionnaires to survey teachers. The results indicated that in terms of frequency, interactions with teachers, interactions with specialists, grading papers, preparing materials, and interaction with parents were the most frequently observed tasks. They noted that in fact those tasks were mainly related to "preparation for lesson".

John (2006) emphasized that the practice of planning is as important as the practice of teaching. He exemplified the important questions that a teacher might ask while planning as: "What do I want the children to learn? What teaching and learning styles might best bring this about? What knowledge and skills are worthwhile and how might they be best learned? How might curricular objectives and learning outcomes best inform my planning? What resources and tools might help me to engage my pupils so that learning might take place? And what are the classroom management implications of my chosen strategy?" (p.11)

Edgington (2009) criticized that literature on the nature of teacher planning is not specific to mathematics nor does it address how teachers attend to aspects of teaching and learning or what teachers need to do promote learning mathematics for understanding. He also added that research has not addressed how teaching mathematics

for understanding can be incorporated into teachers' planning practices. In this light, he examined the lesson planning practices of two teachers and their enacted lessons with the aim of exploring how they incorporated the ideology of teaching for understanding in to their planning practices and enacted lessons. Lesson planning interview, observation of a lesson planning session, video recordings of two consecutive math lessons, and a post-lesson reflection session were the data sources of his study. The teachers were specifically asked what they attended when planning their math lessons.

The findings of Edgington indicated that the teachers started their planning by stating the objective they wanted to cover. They considered previous activities where the students struggled with the same concept: equality. Through their discussions, they talked about how their students would learn and how to emphasize the idea of equality. During enacted lessons, the teachers emphasized finding students' own strategies. They encouraged each student to find his own strategy, however they did not reflect on any idea offered by their classmates. Edgington (2009) concluded that teachers can choose appropriate classroom activities or tasks when they have information about how students may think about concepts and how those concepts can be developed over time.

Another recent study was conducted by Li, Chen and Kulm (2009). They examined mathematics teachers' daily lesson plans and their associated practices and thinking in lesson plan development. Their study included six elementary mathematics teachers from different schools of China. The teachers provided four lessons plans, and also an interview was made with each teacher. The results indicated that Chinese

teachers placed a great consideration on several aspects of lesson planning, including content, process, and their students' learning.

Regarding content, the teachers considered instructional objectives, important content points of teaching, difficult content points of teaching, and materials/tools to be used. For instance, they all thought that understanding the meaning of fraction division and correctly doing the algorithm of a fraction divided by a whole number are major objectives in the first lesson. The teachers indicated the meaning of fraction division was important because it helps students solve word problems using the quantitative relationship. The computation of a fraction divided by a whole number was stated as a ''teaching difficulty'' by three of the teachers. Four teachers mentioned using materials beside the textbook, which were using multimedia and using concrete materials.

The process aspect of their planning focused on the question of "how to teach?", in what order and which instructional strategies to use. In particular, all lesson plans except one were outlined as containing four steps: reviewing previous knowledge, introducing the new knowledge, exercises and practicing, and summary and assigning homework. It was found that teachers used different methods for the reviewing step like using word problems for whole number division, using pictorial representations to relate the fraction multiplication with the fraction division for introducing the inverse idea, and using mental computation exercises to help review the meaning of whole number division.

Regarding considering student learning, knowing and predicting students' responses difficulties was an issue. The teachers tried to predict situations like students'

answer, problems, and confusions and prepare their lesson accordingly. The teachers mentioned that lesson planning considering students meant to plan lessons from the student's perspective: what students have already learned and what the teachers need to teach this lesson based on students' previous knowledge, providing students a good learning approach, letting students learn through inquiry, involving students actively in classroom instruction activities.

2.1.2. Research on Teacher Decision Making in Turkey

One of the important studies on teacher decision making in Turkey was conducted by Yıldırım (2003). He describes instructional planning as one of the teachers' the most complex and important tasks, and adds that this planning requires a wide variety of decisions. Yıldırım (2003) states that instructional planning is generally achieved through three types of plans which are yearly, unit, and lesson plans. In yearly plans long term decisions like curricular priorities, time allocations, integrations and sequence of learning experiences, materials of instruction and evaluation are made. Unit plans are more specific than yearly plans and they provide information about objectives, content, implementation and evaluation. Finally, lesson plans specify the elements and process of a lesson.

Yıldırım (2003) assessed teachers' instructional planning practices by carrying out a study in terms of influences on daily and unit plans, and the problems faced by teachers in planning. His study involved 1194 teachers working in primary schools participated in the study. Data were collected through a questionnaire which was

designed to explore teachers' perceptions of their planning. The results of his study indicated that the main influence on daily and unit plans were teachers' experience, the national curriculum and the course textbooks. The gap between the national curriculum and the classroom needs, difficulties in using the standard format for preparing plans, shortage of time and resources, insufficient support from principals and inspectors, and lack of cooperation among teachers were found to be the main problems faced by teachers in planning. Teachers were also asked to rate the importance they assigned to the basic components of daily plans. The results indicated that student characteristics and availability of learning materials were assigned the highest level of importance (mean = 4.34 and 4.10 over 5). Content coverage (3.27) and teaching/learning activities were assigned a medium level of importance. Open-ended responses indicated that teachers had the flexibility to align the content and the activities according to students' background.

A similar study was conducted by Eskiocak (2005). She conducted a study with the aim of analyzing the factors affecting primary school teachers' decision making process in their planning for education. In total, 305 teachers participated in the study. The data was gathered through a questionnaire, interview forms, and philosophy preference assessment. The results of Eskiocak's study provided similar results to Yıldırım's study. The findings of her study indicated that elementary school curriculum, books used in the class, subject that will be studied, and the levels of the students were determined as the factors that teachers consider the most.

A recent study was conducted by Aytunga and Bayındır (2009) with the aim of determining how elementary school teachers prepare their lesson plans. Namely the resources they use when planning the lessons, how they prepare their lesson plans, any problems faced were investigated. Their study involved 174 teachers and the data were collected through a questionnaire. Nearly half of the teachers stated that they prepared their lesson plans depending on the learning outcomes in the curriculum. Regarding how they prepare lesson plans, the findings indicated that 41 % of the teachers stated that they used "exercise" type of activities most of the time. 41 % of the teachers stated that they made changes in the activities suggested in the program. 34 % stated that they added new activities into the lesson plan. Regarding the faced problems, they were mostly about activities (26 teachers), materials (23 teachers), students (21 teachers) and time (15 teachers). The existence of many activities to be applied and need of much time to apply them, inadequacy of class hours were stated as the problems faced about activities during instructional planning by teachers.

Different from Yıldırım (2003), Eskiocak (2005), and Aytunga and Bayındır (2009), Şire (2004) studied the decisions made by the teachers in the class. In her study, she investigated the instructional decisions English language teachers make in the class. What teachers are thinking about when they make a particular interactive instructional decision was the focus of the study. Four experienced and four novice teachers participated in the study. Data were collected through videotaping, semi-structured interviews, and examining lesson plans. The findings indicated that complexity of teachers' thinking process change in regard to their expertise level. For instance,

experienced teachers were observed to be more aware of the routines they employed in the classroom. Another example is that experienced teachers were observed to employ a set of instructional actions in response to the student performance cues whereas novices were observed to be more linear in their responses. Another finding indicated that the novice teachers were much more concerned with the classroom management related issues.

2.2. Conceptual Framework: Pedagogical Reasoning and Action

In describing teachers' decision-making practices, Shulman (1987) formed a cyclical process which he called "pedagogical reasoning and action". He defined pedagogical reasoning and action as the process in which a teacher puts his knowledge base into operation in the classroom.

Shulman explains the source which brought him to describing pedagogical reasoning as the attempts to understand how teachers commute from the status of learner to that of a teacher. He states that teaching necessarily begins with a teacher's understanding of what is to be learned by the students and how it is to be taught. Then it proceeds through a series of activities during which the students are provided specific instruction and opportunities for learning. Finally, teaching ends with new comprehension by both the teacher and the student. He describes the stages of this cyclic model as comprehension, transformation, instruction, evaluation, reflection, and new comprehensions. The model of pedagogical reasoning and action is summarized in Table 2.1.

Table 2.1. A Model of Pedagogical Reasoning and Action (Shulman, 1987)

Comprehension
Of purposes, subject matter structures, ideas within and outside the discipline
Transformation
Preparation: Critical interpretation and analysis of texts, structuring and segmenting, development of a curricilar repertoire, and clarification of purposes.
Representation: Use of a representational repertoire which includes analogies, metaphors, examples, demonstrations, explanations, and so forth.
Selection: Choice from among an instructional repertoire which includes modes of teaching, organizing, managing, and arranging.
Adaptation and Tailoring to Student Characteristics: Consideration of conceptions, preconceptions, misconceptions, and difficulties, language, culture, and motivations, social class, gender, age, ability, aptitude, interests, self concepts, and attention.
Instruction
Management, presentations, interactions, group work, discipline, humor, questioning, and other aspects of active teaching, discovery or inquiry instruction, and the observable forms of classroom teaching.
Evaluation
Checking for student understanding during interactive teaching
Testing student understanding at the end of lessons or units
Evaluating one's own performance, and adjusting for experiences
Reflection
Reviewing, reconstructing, reenacting and critically analyzing one's own and the class's performance, and grounding explanations in evidence
New Comprehensions
Of purposes, subject matter, students, teaching, and self
Consolidation of new understandings, and learnings from experience

Comprehension

When planning a lesson, Shulman believes that teachers begin with the *comprehension* of the purposes, structures, and ideas. The teachers are expected to understand what they teach, understand how a given idea relates to other ideas within the same subject area and to ideas in other subjects as well. Shulman emphasizes the comprehension of purposes. He notes that although the educational purposes are given as texts, a text is only a vehicle and it must be comprehended well to achieve the goals of education.

Shulman underlines that comprehending both content and purposes does not distinguish a teacher from non-teaching peers. The key to distinguishing lies at the intersection of content and pedagogy. He describes this intersection as the capacity of a teacher to transform the content knowledge he has into forms that are pedagogically powerful and adaptive to the students with different abilities and different background.

Transformation

A *transformation* of the teacher's comprehension involves four sub processes. Those are stated as the preparation and segmenting of the text, representation of the material, selection of methods for teaching, and adaptation to student characteristics.

Preparation involves examining and critically interpreting the materials of instruction in terms of the teacher's own understanding of the subject matter. Detecting and correcting errors, structuring and segmenting the material into forms better adapted to the teacher's understanding, examining the educational purposes or goals carefully are included in the process of preparation.

Representation is described as thinking about the key ideas in the text or lesson, identifying the alternative ways of representing them to students. What analogies, metaphors, examples, demonstrations, simulations can help to transform the content are examined by the teacher. Shulman emphasizes the importance of a representational repertoire for the representation activity.

Selection of methods for teaching are described as to be used when the teacher moves from the content through representations to the embodiment of representations in instructional forms or methods. The teacher draws upon his instructional repertoire which may include lecture, demonstration, recitation, seatwork, cooperative learning, reciprocal teaching, discovery learning, and learning outside the classroom setting, etc…

Adaptation is described as the process of fitting the represented material to the characteristics of students. Ability, gender, language, culture, motivations, prior knowledge and skills need to be considered. What conceptions, misconceptions, expectations, difficulties, or strategies might influence the ways students' understanding are also included in the adaptation. Regarding tailoring in adaptation, it is described as fitting of the material to the specific students rather than to students in general. Shulman notes that a teacher needs to do this for a group of students.

Instruction

During *instruction*, the teacher makes decisions about management issues, interactions between students and the teacher, discipline, humor, questioning, and other observable components of active teaching. Shulman notes that instruction stage includes many of the most crucial aspects of pedagogy: organizing and managing the classroom;

presenting clear explanations; assigning and checking work; and interacting with students through questions, answers and reactions.

Evaluation

Evaluation includes assessing student understanding while teaching and at the commencement of a lesson or a unit. Teachers also evaluate their own performance and adjust for their experiences. In that sense, it leads to reflection.

Reflection

The *reflection* process involves grounding a critical review and analysis of the teaching and learning performances in actual evidence. Shulman describes it as a process through which a professional learns from experience. A teacher looks back at the teaching and learning that has occurred, and reconstructs, reenacts, recaptures the events, the emotions, and the accomplishments.

New Comprehensions

Finally, *new comprehensions* of the purposes of instruction, subject matter, students, teaching, and the self may arise as a result of the experience, consolidating into new learning and understanding about teaching. It is noted that new comprehension does not automatically occur, even after evaluation and reflection. Shulman reports that specific strategies are needed.

Although Shulman represented the stages in sequence, he notes that they are not meant to represent a set of fixed stages. According to him, many of the process can occur in different order. Some may not occur at all during some acts of teaching.

2.2.1. Previous Research on Pedagogical Reasoning

The studies in this section, Sanchez and Llinares (2003), Smith (2003), Casa (2004), Richardson (2009), Starkey (2009), addressed pedagogical reasoning. Sanchez and Llinares examined the influence of student teachers' subject matter knowledge for teaching on the process of pedagogical reasoning. Smith explored the nature of pedagogical reasoning for pre-service English teachers. Casa examined the processes of pedagogical reasoning and action with respect to discourse among elementary-level teachers teaching mathematics. Richardson focused upon teachers' lesson planning processes with respect to pedagogical reasoning. The last study in this section belongs to Starkey; he explored how pedagogical reasoning and action might occur in the digital age.

Sanchez and Llinares (2003) conducted a study with the aim of identifying the influence of student teachers' subject matter knowledge for teaching on the process of pedagogical reasoning. More specifically, their research problem was "How do the student teacher's ways of knowing and their images about school mathematics and mathematics learning/teaching influence the ways in which they think about presenting the subject matter to pupils?" The influence was studied through the way in which the concept of function is presented to pupils in teaching through the textbook problems. Four student teachers participated in their study.

In their study, pedagogical reasoning is used as a theoretical construct to portray the transformation of content knowledge for the purposes of teaching. More specifically when student teachers transform the subject matter for the purposes of teaching and give

arguments about it. Sanchez and Llinares (2003) stated that during this transformation a "critical interpretation" is made and it includes the characteristics of the concept which are identified, the type of problem chosen and the order in which the different aspects of the concept are presented by the student teachers.

In the transformation, the student teachers' representational repertoire in the sense of the different activities, assignments, examples were also examined. Those representations were used to transform the content for instruction.

Finally, the adaptation of the subject matter was examined. According to Shulman's model for pedagogical reasoning and action, adaptation involves fitting the transformation to the characteristics of the students.

Sanchez and Llinares collected the data through four stages. The first interview was a semi-structured one which was a general interview aimed at obtaining information concerning background related to mathematics and eliciting data regarding his/her images about mathematics, teaching and learning.

In the second interview: They were asked to classify 22 textbook problems and they were asked to analyze 10 textbook problems. Describing the problems in their own words, deciding whether the task in the problem necessary to teach the concept of function, deciding what mathematical content might be learnt with the problem, the objectives being tried to be achieved were the questions asked in the interview. They wanted to obtain information about the student teachers' reasons for using a specific problem in their teaching, and how they thought that a learner would solve it.

In the third interview: Student teachers were asked to use the textbook problems in the planning of a hypothetical teaching sequence for the concept of function and provide arguments that might justify their decisions. The aim was to identify what was behind the presentation of the mathematical content in the planning prepared by each student teacher.

In the fourth interview: Student teachers were given 4 different cases. Those cases were given as pupil responses which involves interpreting about misconceptions, difficulties, visual and analytical processing, and the role of images used. They were asked to identify the causes for the pupil's response and how the teacher could help the pupil.

Their findings indicated that for all four student teachers, their ways of knowing the concept of function as a teaching-learning object influenced what they considered important for the learner and affected their use of the modes of representation in teaching. Two student teachers emphasized the operational aspect of functions and the algebraic mode of representation. They considered the graphs as a complement of the algebraic mode of representation. On the other hand, the other two incorporated the use of graphs as an 'instrument' for solving real situations. These emphases influenced these student teachers' organization of content and the types of problems chosen in the teaching sequence.

On the adaptation side, level of difficulty of the problems and the idea of 'motivation' were took into account by the student teachers, but these ideas were always used in a general manner and without any more specification. Another idea that

influenced the adaptation of mathematical content to pupils was the meaning given by the student teachers to the pupils' 'prior knowledge'. The four student teachers saw the prerequisite knowledge needed to solve the problems as the prior content that the teacher should have provided earlier.

The textbook problems were seen as an application of mathematical content that had been explained in advance. The problems were seen as a means for the pupils to 'practice' the procedures provided beforehand by the teacher. In this study, none of the student teachers provided information regarding the pupils' mathematical understanding.

Another study in which Shulman's Model is taken as the theoretical framework was conducted by Smith in 2003. In this study, she aimed to explore the nature of pedagogical reasoning for pre-service English teachers. Four teachers participated in the study. The data was collected through interviews and classroom observations. Data collection was designed in such a way that it followed Shulman's instruction, evaluation, and reflection phases of pedagogical reasoning and action. The findings of the study indicated that pedagogical reasoning varied among pre-service teachers. The results indicated a continuum from a base point to the highest point for the pedagogical reasoning of the teachers participated in the study.

At the base point, conceptual categories in Shulman's model were thought as separate entities in the reasoning process by the teachers. For instance, students were observed during instruction but those observations were not linked with student understanding in the evaluation phase. The second characteristic of the base point was

limited content knowledge and lack of content knowledge affected teachers' ability to pedagogically to reason. Third characteristic was heavy relying on their beliefs in teaching. The last characteristic was teachers that at the base point had a narrow concept of learners. They saw their students in terms of motivation and work ethic only.

At the middle point, teachers began to think across the conceptual categories within a phase. For instance, the teachers altered their questioning based on what they observed. At this level teachers knew what the students were thinking while they observed them.

At the highest level, the teachers had the ability to think among conceptual categories within a phase, and to think among the phases themselves. For instance, a teacher at this level can answer student questions by considering how they understand the material, who they are as learners, and relative to the instructional category being used.

Different from Smith, Casa (2004) conducted a research to explore the nature of teacher decision-making with respect to discourse in the elementary level mathematics classroom. She described discourse, commonly referred as classroom communication, as including the ways of representing, thinking, talking, agreeing and disagreeing about mathematics. Casa examined the processes of pedagogical reasoning and action with respect to discourse among elementary-level teachers teaching mathematics.

Casa used Shulman's (1987) Teacher Knowledge Base and pedagogical reasoning and action processes as a conceptual framework. A novice teacher and two experienced ones (with at least one having a strong mathematics or mathematics

education background) participated in the study. They were teaching mathematics in grades 3-6. The data collection was parallel to the cyclical relationship in Shulman's mode for pedagogical reasoning and action involving pre and post interviews, as well as observations.

The results of Casa's study indicated that teachers' decisions with respect to discourse prior to, during, and after teaching followed their beliefs regarding the purpose of discourse. The first teacher believed that the purpose of discourse was to address significant mathematical ideas and uncover students' misconceptions. On the other hand, the second teacher thought that students should share their ideas to contribute different perspectives. The last teacher believed that discourse should be used to transmit information to students and have students explain their thinking to see if it matched his own view of mathematics.

Richardson (2009) conducted a study which focused upon teachers' lesson planning processes. 12 fifth, sixth and seventh grade content area teachers participated in her study. The processes they used to plan, how they determined which technologies might be used were observed and examined. As teacher planned and implemented lessons, Richardson found that they followed a reasoning cycle that was parallel to Shulman's (1987) Model of Pedagogical Reasoning and Action.

In another study, Starkey (2009) explored how pedagogical reasoning and action might occur in the digital age, comparing Shulman's (1987) model with the reality for a small sample of digitally able beginning teachers. It was a multiple case study of six teachers during their first year of teaching as they made decisions about using digital

technologies within their teaching practices. Open-ended interviews and observation were used to examine their pedagogical reasoning and action process. The research explored pedagogical choices the case study teachers made when integrating digital technologies into their teaching practice.

Transforming subject knowledge into teachable content is a key aspect of Shulman's model. On the other hand, Starkey (2009) found that teachers participated in his study did not transform their subject knowledge, instead they selected resources and teaching methods that they thought would be appropriate for their students to use to understand the specific concepts they were teaching. They needed to know how to teach the content so that students were able to create and critique knowledge through connections. This was one of the major two differences were found between the original model developed by Shulman in 1987 and the findings of the study which was summarized in Table 2.2. Starkey described that change from "transformation" to "enabling connections".

The second difference found between the original model and the findings of Starkey's study was the integration of "evaluation" and "instruction" phases into one "teaching and learning" phase. Starkey explained that finding as digital age thinking required that the teacher and students will be gaining new comprehensions or understandings together which could include creating knowledge as a result of the teaching and learning process.

Table 2.2. Model of Teacher Pedagogical Reasoning and Action for the Digital Age (Starkey, 2009)

Comprehension of subject (content knowledge) including:

- Substantive knowledge (concepts and principles) and
- Syntactic knowledge (subject methodologies)

Enabling connections – preparation for teaching (pedagogical content knowledge) including:

- Selecting appropriate resources and methods to enable students to make connections between prior knowledge and developing subject knowledge;
- Transforming existing knowledge into teachable content;
- Enabling opportunities for students to create, critique and share knowledge;
- Enabling connections between groups and individuals to develop knowledge of the subject;
- Adaptation and tailoring (personalizing) learning for the students being taught.

Teaching and learning – (knowledge of context) including:

- Formative and summative evaluations of student learning with feedback to the students (from a variety of sources), and modification of the teaching process where appropriate.

Reflection – reviewing and critically analyzing teaching decisions based on evidence

New comprehensions – about the subject, students and teaching

2.3. Learning Activities

The literature points that an important component in teachers' decisions were about planning, which involve decisions regarding activities to be used in class. Shavelson (1983) emphasized that decisions made during planning have a profound

influence on teachers' classroom behavior and on the nature and outcomes of the education children receive. To state differently, teachers' planning decisions influence the content, materials, social climate, and activities of instruction. Then, Shavelson introduced activities as the focus of teacher planning.

The importance of activities is also underlined by Zahorik (1976). He underlined the importance of activity selection for teachers as follows: “Regardless of the way teachers plan, one persistent decision faces them: what activities or experiences will they provide for learners? Before instruction begins, teachers need to decide whether they will have a class discussion, show a film, take a field trip, read textbooks, make murals, or engage pupils in some other learning activity.” (p.50)

Zahorik (1982) defined learning activities as the means by which teachers bring students into contact with subject matter. He described two points of view for the function of activities: One is the objectives-achieving function. In this view, it is believed that activities must be directly related to objectives. In the other view, objectives are used to justify learning activities, but it is believed that activities have additional functions. According to the second view, activities can or should build on previous experiences and prepare for new experiences, encompass a variety of ability and interest levels, and have educational significance of their own.

When the function of learning activities is to achieve objectives, the selection of objectives becomes the first decision and the major decision to be made and the selection of learning activities becomes a subordinate decision. Only after specific objectives are formulated defining what students are to learn can learning activities be

planned. The activities must bear a one-to-one correspondence to the objectives. They must provide experiences in which pupils practice the behaviors or confront the subject matter specified in the objective.

Taba (1962) noted that learning activities based on objectives can be classified into several types according to subfunctions they perform in the teaching-learning situation. She believed that teachers should design every activity with a definite prupose in mind and different kinds of activities are needed to promote different objectives. She identified three common types of activities: introduction, development, and application. Introduction activities were described as being used to diagnose pupils' learnings and to motivate pupils; development activities were described as providing factual material; and application activities were described as serving to apply, evaluate, and conclude learnings. Each of these types of activities has a specific subfunction, but their major function is still to achieve the teacher's predetermined objectives.

Jere and Janet (1990) stated that issues related to the design, selection, and evaluation of learning activities had been neglected in educational research until 1990. They offered a tentative list of principles that might be used as a tool for designing, selecting, or evaluating activities. The first principle is goal relevance which states that activities must be useful means of accomplishing curricular goals. The second is having appropriate level of difficulty which means being difficult enough to provide some challenge and extend learning but not so difficult as to leave many students confused. The third principle is feasiblity for implementation in terms of space, equipment, time, etc. Those are the primary principles. Accomplishing multiples goals and having a

motivational value are examples of secondary principles. Morover, there are principles suggested for a set of activities such as having a variety of formats, having progressive levels of difficulty, and including concrete examples.

Price and Nelson (2002) underlined that activities have a variety of purposes. They are mainly designed to provide motivation for students before beginning a series of lessons, background information, experience, or an opportunity to recall prior knowledge before a series of lessons; ongoing practice toward objectives, opportunities for students to apply skills they have previously learned, and opportunities for students to integrate a variety of knowledge and skills they learned in different subject areas.

Price and Nelson also emphasized the difference between lessons and activities. They noted that lessons are used to teach knowledge and skills whereas activities help students to further process, practice, and generalize knowledge and skills.

2.3.1. Previous Research on Selection of Learning Activities

In this section, two studies are summarized: Zahorik (1982) and Clark & Yinger (1982). Zahorik (1982) conducted a research study which focused on teachers' perceptions of the nature and function of learning activities. His study investigated the teachers' perceptions of successful and unsuccessful learning activities, and their reasons concerning why a learning activity is successful or why it is unsuccessful. The data were obtained by semi structured interviews and class observations with 13 teachers. Teachers were asked to describe a skill subject activity (reading or mathematics) and a non-skill subject activity (social studies or science) that they had

used and found to be successful and skill and non-skill subject activities that they had used and found to be unsuccessful. For each activity they were also requested to tell why the activity was or was not successful.

The typology used to describe the successful and unsuccessful learning activities consisted of six elements: cognitive level, student task, teacher role, materials, grouping, and evaluation. And the typology used to describe the reasons why the activity was successful or unsuccessful consisted of student motivation; student involvement; social learning; personal learning; academic learning (conventional subject matter); academic learning, unplanned learning; academic learning, use of (application of previously learned subject matter); individual differences; intellectual learning (critical thinking, creativity); teacher motivation; and immediate feedback.

The results of Zahorik's study showed that activities that were described as successful in a skill area most often operated at either or both recall and thought cognitive levels; involved students in games; placed the teacher in the role of a guide, participant, or monitor; used one or more of a range of materials; required total class organization; and relied on observation evaluation.

The primary reason given for successful activities was that they were motivational. They were interesting and attracted and maintained students' attention. Other reasons mentioned were that these activities actually involved students and that they contributed to social learning, personal learning, and several types of academic learning.

In a skill area most of the activities described as being unsuccessful emphasized recall or thought; involved students in reading, seatwork, or listening; had the teacher assume the role of monitor or information giver; employed textbooks; utilized one of several types of grouping; and evaluated through observation or tests.

The majority of the teachers believed that these activities were unsuccessful because they either failed to motivate, or insufficiently motivate students. In addition, task difficulty and teacher preparation were reasons that were given, mostly by primary teachers.

Zahorik emphasized that teachers do not talk about learning because it is such an obvious goal or such a remote goal. They are concerned with motivation because they see it as a prerequisite for learning and an indication that learning will follow naturally.

A similar study was conducted by Clark & Yinger (1982). In their study, six teachers participated. The teachers were asked to read and make judgements about the appropriateness, attractiveness, usefulness, and effectiveness of 32 short descriptions of language activities. The activity descriptions varied systematically on five features: amount of student involvement, difficulty for students, integration of multiple skills or subject matters, demand on the teacher, fit between the stated purpose and instructional process.

Their results showed that the features in their list were not enough to explain teacher judgment. More features were added by the teachers which were grouped as related to student, teacher and activity. Those features are given in Table 2.3.

Table 2.3. Features Added by the Teachers Participated in the Study

Student	Teacher	Activity
• Students' task related ability • Student interest • Student enjoyment • Individual differences	• Fit teacher's goals • Prerequisite Instruction • Fit with past practice • Fit with current practice • Enthusiasm	• Clarity of procedures • Fit with purpose and description • Internal consistency • Activity type • Terminolgy • Design/flow • Uniqueness • Age-level appropriateness • Expansion potential • Practicality

2.3.3. Research on Use of Curriculum Materials

Another trend in educational research is exploring how teachers interpret and adapt written curriculum materials. This interpreting and adapting activity is defined by the term "curriculum development" (Remillard, 1999). Remillard identified three arenas of curriculum development activity that teachers engaged in their teaching mathematics: the design arena, the construction arena, and the mapping arena (given in Figure 2.x).

The *design arena* involves selecting and designing tasks and activities for students. The *construction arena* involves the primary activity of task adaption. Remillard used the term task adaptation for adjusting of tasks in order to facilitate students' work with them". He reported that regardless of how the teachers use the

textbook to select tasks, enacting them requires both teachers to make on-the-spot decisions about how to adapt them in response to classroom events. The mapping arena involves making choices that determine the organization and content of the mathematics curriculum over the year. The mapping arena is not directly related to daily classroom events but affects and is affected by them.

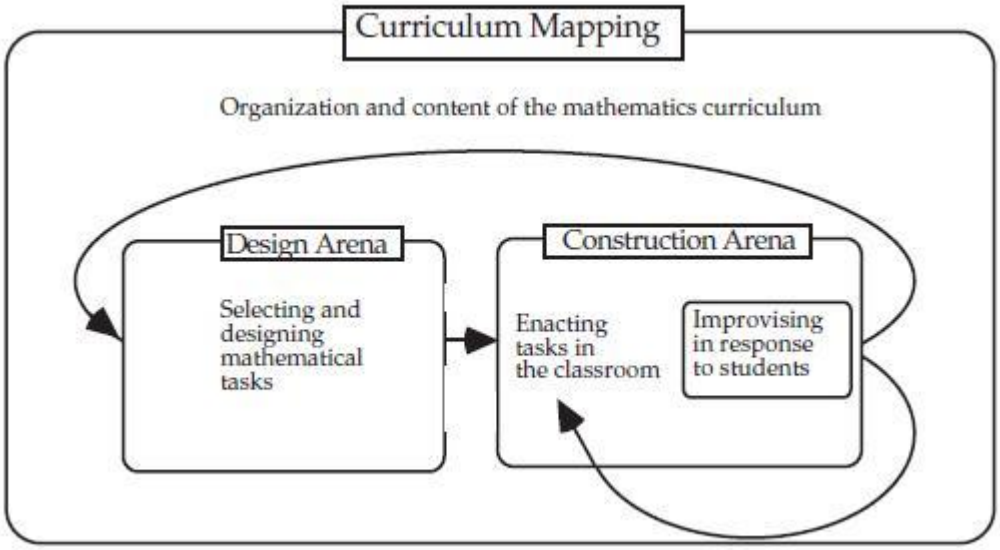


Figure 2.1. Remillard's Three Arenas of Curriculum Development (Remillard, 1999)

Within this trend in research, a study was conducted by Brown in 2002. He examined three middle school teachers' interactions with an inquiry-based science unit that was designed by education researchers in collaboration with public school teachers. The ways that teachers used the curriculum to design instruction were analyzed. Brown argued that teachers perceived and interpreted existing resources, evaluated the constraints of the classroom setting, balanced tradeoffs, and devised strategies; which was a complex activity.

Brown (2002) identified using curriculum resources as a process of design and he introduced the term pedagogical design capacity. Pedagogical design capacity was defined as a way to characterize a teacher's ability to perceive and starting to use existing resources to craft instructional contexts.

Another study was conducted by Shein and Drake (2004). They analyzed 10 elementary school teachers' use of curriculum. They examined how teachers engage with the materials at different phases of teaching: prior to, during, and after the lesson. In each phase, three key processes in which teachers engage as they use curriculum materials (reading, evaluating, and adapting) were examined. Each teacher's approach to these processes was analyzed and patterns were noted as curriculum strategies. An example of one teacher's curriculum strategy is given in Table 2.4.

Table 2.4. An Example of One Teacher's Curriculum Strategy (Shein & Drake, 2004)

	Read	**Evaluate**	**Adapt**
Before Instruction	Examines main activities in lesson. Examines new vocabulary introduced in lesson.	Considers own conceptual understanding of connections among activities in lesson.	Creates transitional activities.
During Instruction		Considers students' understanding of mathematics in lesson	Creates new explanations and new terminology.
After Instruction		Considers whethet students need more review. Considers whether she successfully managed activities in lesson.	

In teachers' examining the curriculum, Shein and Drake considered when the teachers read the materials and for what purpose. They identified three general approaches. These are reading for big ideas prior to instruction, reading for lesson details prior to instruction, and reading for big ideas prior to and for details during instruction.

2.4 Summary of the Literature Review

Teachers make numerous decisions regarding mathematics instruction on a daily basis and decision making is regarded as one of the most of important teaching skills by

the educational researchers (Shavelson, 1983). One group of decisions made by teachers is planning decisions. Much research has been accomplished on teacher planning and the factors influencing teachers' planning decisions. Research findings indicated that one of the factors was activities. (Brown, 1993; Yinger, 1980; Zahorik, 1976, 1982)

Similarly, several studies on teachers' planning have been conducted in Turkey indicated that activities are one of the components of teachers' daily plans (Aytunga & Bayındır, 2009; Eskiocak, 2005; Yıldırım, 2003). Those studied analyzed the factors affecting primary school teachers' decision making process in their planning, explored how elementary school teachers prepare their lesson plans. However, they are limited in terms of specifically exploring the process of selection of activities and their use for instruction. In the process of selection and adaptation of activities, a teacher may take several issues into consideration. Those issues are of great importance regarding the information they can provide about the classroom environment, student characteristics, teacher's organization of instruction,

Thus, in this study, my aim was to provide some details in the process of selection of activities and their use in teaching. How selection is made, how the activities are adapted was the focus of the study. Namely, my aim was to learn about the decisions made and the reasoning behind those decisions.

Shulman (1987) argued that teachers draw upon their knowledge base of teaching to help them make their decisions and a teacher's knowledge base is put into operation in the classroom through a process defined as pedagogical reasoning and

action. With Shulman's introduction of the pedagogical reasoning and action model, teachers' reasoning processes were explored by other researchers and its importance was emphasized (Casa, 2004; Richardson, 2009; Sanchez & Llinares, 2003; Smith, 2003; Starkey, 2009). However, teachers' pedagogical reasoning in selection of activities was not explored previously by other researchers.

Considering the importance of activities in teacher planning decisions and their role in teaching, the aim of this study was to explore an elementary mathematics teacher's pedagogical reasoning process in selecting learning activities for her lessons.

CHAPTER III

RESEARCH METHODOLOGY

The purpose of this study was to examine an elementary mathematics teacher's pedagogical reasoning while selecting or designing activities for her mathematics lessons. In this chapter, the research methodology was described in detail. The related issues concerning the context in which the study took place, the participant of the study, the data collection techniques that were used, the procedures of data collection and data analysis were included in this description. In addition, the issues related to the quality of the study were addressed at the end of the chapter.

3.1 The Design of the Study

In this study, qualitative research methodology was used. Merriam (1998) stated that qualitative researchers are interested in understanding the meaning people have constructed, that is, how they make sense of their world and the experiences they have in the world. Words and pictures are commonly used instead of numbers. Merriam categorized qualitative research methodologies as basic or generic qualitative study; ethnography, phenomenology, grounded theory, and case study. She also added that five methodologies often can work in conjunction with each other.

The qualitative design used for this study was a case study. Ms. Defne (pseudonym) constitutes the "case" of the study. The context of the study was "process of selection of learning activities for the upcoming lessons" and "Ms. Defne's pedagogical reasoning" was the unit of analysis.

Merriam (2009) describes a case study as an in-depth description and analysis of a bounded system. She emphasizes that the defining characteristic of case study research is delimiting the object of the study, the case. She explains that the case, what to be studied, is a bounded system, a single entity, a unit around which there are boundaries. Depending on that explanation, Merriam states that the case then could be a single person who is a case example of some phenomenon, a program, a group, an institution, a community, or a specific policy.

Similarly, Yin (1994) used the concept of boundary in his description of case study research. Yin (1994) stated that "A case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are no clearly evident" (p.18).

The concept of boundary is also seen in Creswell's description of case study research. Creswell (2007) stated:

> A case study research is a qualitative approach in which the investigator explores a bounded system (a case) or multiple bounded systems (cases) over time, through detailed, in-depth data collection involving multiple sources of

information (e.g., observations, interviews, audiovisual material, and documents and reports) and reports a case description and case-based themes. (p.73)

From the descriptions of case study research in the literature, importance of a bounded system can be deduced. In addition to concept of boundary, Stake (2000) emphasized that in case study research, there is something to be described and interpreted. He further added that the purpose of case study is not representing the world, but to represent the case.

Stake (2000) categorized the case studies into three as intrinsic, instrumental, and collective. He called case studies where case itself is of interest as intrinsic. The purpose of intrinsic case studies is not to understand some abstract construct, or not to build a theory. They take place because of intrinsic interest. He called a case study as instrumental if a particular case is studied to provide insight into an issue or to redraw a generalization. Here, the case is in secondary interest where it plays essential role in understanding of something else. Researcher examines the case, context in depth, to trail an external interest. Stake, used the term collective case study where; the researcher may jointly study a number of cases in order to examine a phenomenon or context.

Similarly, Merriam (1998) categorized case studies into three with respect to overall intent of the study. Namely, these categories are descriptive, interpretive and evaluative case studies. She stated descriptive case studies in education concentrate on detailed account of the phenomenon under study. They are useful in presenting basic information on the topic they are studied. On the other hand, interpretive case studies contain thick rich descriptions. These descriptions are used to develop conceptual

categories to support theoretical assumptions held by before the data gathering. However, evaluative case studies involve description, explanation and judgment.

Based on the categorizations made by Stake (2000) and Merriam (1998), it can be said that this study was an instrumental and interpretive case study. It was instrumental in the sense that since a particular case, namely Ms. Defne was studied to provide insight into her pedagogical reasoning. On the other hand, it was interpretive since the purpose was to provide an insight and get rich and thick description about Ms. Defne's pedagogical reasoning while selecting or designing activities for her mathematics lessons.

3.1.1 The Participant of the Study: The Study Case

In this part, Ms. Defne, the "case" of the study, was described. Since the generalization in statistical concern was not the goal of qualitative research, non-probabilistic sampling was chosen as suggested by Merriam (1998) and the most common form of non-probabilistic sampling, purposeful sampling was used in this study.

Merriam (1998) states that purposive sampling was based on the assumption that the investigator wants to discover, understand, and gain insight and therefore must select a sample from which the most can be learned. In this study, Ms. Defne was chosen by purposive sampling since she is known by using learning activities in her lessons and the

researcher felt that she could learn most, she could most access, and she could spend the most time with potential for learning.

At the beginning of the study, a list including the names of the teachers who work with mathematics education lecturers or who are graduate students was made. They were asked whether they were able to use learning activities in their lessons. As a result of meeting each teacher in the list, three teachers who work at private schools were determined. The researcher met again each teacher to learn about their thoughts about activity use in detail and whether they wanted to participate in the study. Preparation of the activity plans by the researcher based on the teachers' requirements was an important criterion for the design of the study. One of the teachers did not accept to participate in the study since the school administration was not comfortable with lesson observations. The other two teachers accepted to participate in the study.

The data collection started with the first teacher: Ms. Deniz. To design the activity plans based on the teacher's requirements, examining the activity plans, and updating them took nine weeks. However, when the first lesson observations were made; it was seen that the activities were not actually being implemented. The teacher used the questions or problems in an activity plan rather than implementing the whole activity plan. The third teacher was Ms. Defne, and she volunteered to participate in the study. After meeting with Ms. Defne about her thoughts about activity use in her lessons and examining some examples of activities used recently, Ms. Defne was chosen as the participant of the study.

Moreover, Yin (1994) identified one key characteristic of most informative case studies as being significant. According to him, cases that are significant are those that stand out as superior examples of the best in their class. In this study, Ms. Defne was taken as a significant case. Her working in a textbook writing project, which made her experienced on learning activities, was also important on this decision.

Ms. Defne is 30 years old and has been working at a private school in Ankara for six years. This school is her first work place. The school has all the facilities that a private school can have. One big and four medium sport halls, a dinning hall, a library, a health centre. Ms. Defne stated that her school was also a candidate school for international baccalaurate programme. When it becomes an authorized school, it will be able to give diplomas and certificates which are valid internationally. The International Baccalaureate offers high quality programmes of international education to a worldwide community of schools (International Baccalaureate [IB], n.d.). Reasoning, thinking, self-management, research, and socials skills of students are of primary concern in this programme.

The organization of instruction for each course is realized by the department [zümre] of each related course at this school. The mathematics department consists of four teachers, where Ms. Defne was one of them. This department is responsible for both preparing the yearly mathematics plans of all grades and providing them to follow the plans accordingly. They arrange some monthly activities parallel to the topics being studied such as handouts, video presentations. Competitions, presentations, knowledge contests, mathematics olympics, and project festival are some of the organizations that

the community makes in a year. The department also has the responsibility of informing parents about students' progress and development, and give them feedback. This is done periodically by an online school system and personal meetings with parents.

Three written examinations are prepared and applied by the mathematics department teachers in a semester. After each exam, student grades and the topics which they failed to answer related questions are delivered to the parents by the online system. In addition to regular written exams; students' attitudes in classroom, their notebook use, their performance in homework, short exams which are applied at the end of some lessons, their presentation performances, and their work at their portfolios are evaluated.

When the data collection started, Ms. Defne taught 4 fifth grade classes. This was the first time that she was the teacher of a fifth grade class. In the continuum of the data collection, she had 4 sixth grade classes. Her weekly program involved 24 hours teaching in total and she had an additional 2 hours as the guide teacher of a classroom. There were 20 students in a class on average.

Ms. Defne has a busy schedule, she is a PhD student at a highly respected university; she also got her bachelor and master degrees from the same university. Furthermore she works as a volunteered teacher in helping special students who have learning difficulties and need special care after school hours.

Ms. Defne has some points of major consideration for her lessons. First, she emphasizes that students' finding the topic relevant is important for her. Another point is that concepts and the logic behind them need to be understood well by the students. In

addition to that, developing certain skills of students such as problem solving, estimation is also a major consideration for her. Ms. Defne thinks that students should be allowed to perform something to be able to learn. Moreover, she believes that their interest is required for learning and they are more interested in visual topics like geometry.

3.2 Data Collection Procedures

The data was collected in two phases. The first phase was in the spring semester of 2008-2009 academic year and the second phase was in the fall semester of 2009-2010 academic year. After the first phase of the data collection was completed, the current situation of the thesis was evaluated at the thesis committee. In the first phase, Ms. Defne examined the activity plans developed by the researcher based on her requirements. However, it was seen that asking Ms. Defne to bring her own activity plans was necessary for a better understanding of her activity selection. Therefore, the study went on with the second phase of the data collection where Ms. Defne was asked to bring her own activity plans and those plans were examined to gather data on her pedagogical reasoning on selection of activities. This explains the time difference between two phases of data collection.

In the first phase, Ms. Defne had 4 fifth grade classes. In the second phase, she was the teacher of the same classes which were at fifth grade a year ago and at sixth grade at that time. A schedule indicating the order of events conducted for the data

collection is given in Table 3.1. Details about the each parts of the design are explained in the sections that follow.

Table 3.1. Timeline for Data Collection

Date	Event
December 2008- February 2009	Development of the interview protocol
April 2009 – June 2009	Data collection - Phase I
December 2009 – January 2010	Data collection - Phase II

3.3 Data Sources

This study investigated Ms. Defne's pedagogical reasoning process while selecting or designing learning activities for her lessons. To gather information, interviews with Ms. Defne were the main data sources. On the other hand, to triangulate information gathered, class observations were performed and sample documents provided by Ms. Defne were used.

3.3.1 Interviews with Ms. Defne

Merriam (1998) suggests that after deciding on what information will be needed to address the research problem, a researcher should decide on how best to obtain that information. Interviewing is often the major way of qualitative data collection and it is essential for this study since we want to find out what is in someone else's mind. Yin

(2003) describes interviews as one of the most important sources of information for the case studies.

Merriam (1998) categorized interviews as highly structured questionnaire-driven interviews at one pole and open ended, conversational formats at the other by determining the amount of structure desire. Semi-structured interviews are in the middle on this continuum. In this study semi-structured interview is used where the interviews were guided by a list of questions to be explored, but neither the exact wording nor the order of questions was determined before the interviews.

A set of interviews were made in the data collection process. For each interview, one master and one PhD student, and the supervisor of the study were asked to determine the face validity of the interview questions. They were asked to determine whether the interview questions were matched the research questions and the goal of the study. They were also asked to determine whether the questions were leading or biased. The interview questions were revised based on the comments given.

Before the actual interview protocol was constructed, the experience derived from the data collection process with the other teacher who was not a participant for the study was helpful. Data was gathered in four steps. First a general interview was made, then a set of activity plans were examined by the teacher in the second interview, after updating the activity plans on her suggestions a lesson observation made in which some of the examined activity plans were implemented by her, and finally an evaluation interview was made. Information from this piloting process led to the final form of the

interview questions. This experience also provided information about the time that can take to complete each step of the data collection.

The first interview with Ms. Defne was made with the aim of learning about her background and about the characteristics of her mathematics teaching and her lessons in detail. The interview questions addressed information which the researcher thought that would be helpful in interpreting Ms. Defne's pedagogical reasoning and in describing the case of the study in detail. For instance, the details of a typical mathematics lesson, priorities in her lessons, use of resources, and etc. The interview questions are given in Appendix A.

Besides the first general interview, the other interviews had the aim of either examining the activity plans or evaluation of how the activities went. Before arranging the interviews, the researcher met with Ms. Defne and got the basic requirements for the activity plans to be developed. Ms. Defne requested that the activity plans to be prepared based on the related learning objectives of the lessons she will perform. The researcher prepared the activity plans after examining the learning objectives and the textbook used. Ms. Defne examined the set of activity plans brought by the researcher or explained the reasons for choosing a set of activity plans which she brought herself. After updating the activity plans on her suggestions, a class observation was made regarding the chosen activity plan or activity plans. Finally, an evaluation interview was made about her thoughts regarding how the activities went. Information indicating the order and date of interviews and lesson observations made for the data collection is given in Table 3.2.

Table 3.2. The Order and Date of the Interviews and Lesson Observations Made

Interview/ Lesson Observation Code	Interview Type	Date	Duration
I-01	General	09 April 2009	30 min
I-02	Examining Activity Plans	16 April 2009	19 min
LO - 01	-	21 April 2009	2 hours
I-03	Evaluation	21 April 2009	21 min
I-04	Examining Activity Plans	29 May 2009	17 min
LO - 02	-	04 June 2009	2 hours
I-05	Evaluation	04 June 2009	22 min
I-06	Examining Activity Plans	08 January 2010	26 min
LO - 03	-	14 January 2010	2 hours
I-07	Evaluation	14 January 2010	12 min
I-08	Examining Activity Plans	17 January 2010	29 min
LO - 04	-	20 January 2010	2 hours
I-09	Evaluation	20 January 2010	12 min

Note. I is for interview and LO is for lesson observation**.**

The interview questions for examining activity plans were prepared to get deep information on choices and judgments made by Ms. Defne regarding her pedagogical reasoning. The interview questions are given in Appendix A. The list of activities Ms. Defne examined is given in Table 3.3.

Table 3.3. Activity Plans Examined by the Teacher

Activity Plan	Aim	Related Interview	Related Lesson Observation
1	Deriving the relationship between the lengths of a rectangle and its area (*)	I-02	LO - 01
2	Comparing the Area of Given Rectangles by Calculating Their Areas (*)	I-02	LO - 01
3	Deriving the relationship between the length of a square and its area	I-02	-
4	A Real-Life Question Which Involves Calculating the Area of Rectangles	I-02	-
5	Deriving the Rule for Calculating the Area of a Parallelogram (*)	I-02	LO - 01
6	Deriving the Rule for Calculating the Area of a Right Triangle (*)	I-02	LO - 01
7	Deriving the Rule for Calculating the Area of a Triangle (*)	I-02	LO - 01
8	Calculating the Area of Given Composite Shapes like a house, a robot, etc… (Composite shapes are made of square, parallelogram, triangle, rectangle)	I-02	-
9	A Real-Life Question Which Asked for How to Estimate the Result of Collected Money from a Concert	I-04	LO - 02
10	Identifying the Estimation Methods in Given Calculations (*)	I-04	LO - 02

Note. See Appendix B for the details of each activity plan.

(*) represents the activities for which the researcher conducted class observations.

The interview questions on examining the activity plans brought by Ms. Defne adressed getting deep information on choices and judgments made by her. The interview questions are given in Appendix A. The list of activities brought by Ms. Defne is given in Table 3.4.

Table 3.4. Activity Plans Brought by the Teacher

Learning Activity	Aim	Related Interview	Related Lesson Observation
1	Introducing Prime Numbers	I-06	LO - 03
2	Riddle of Eratosthenes	I-06	LO - 03
3	Problem Solving Involving LCM or GCD	I-08	LO - 04

Note. See Appendix C for the details of each activity.

In evaluation interviews, the aim was to learn her thoughts regarding how the activities went. Whether the activity was went as she expected or not, suggestions for the next use were discussed. The entire guide interview was given in Appendix A. All the interviews in the study were audio recorded and transcribed.

3.3.2 Lesson Observations

A total of four lesson observations were made with the aim of seeing whether Ms. Defne implemented the activities and how she implemented. In addition, lesson observations were necessary to gather the data for evaluating Ms. Defne's suggestions for the next use of the activity plans. In the lesson observations, the questions asked by

the students, the questions asked by Ms. Defne, any change or extension made in implementation compared to the activity plans were noted down.

Each observation took 2 class hours period.The lesson observations were helpful in understanding the context of the classrooms where the activity plans were implemented. There were 19, 15, 13 and 17 students respectively in the classroom. The students had their own desk and the desks were arranged in a u-shape which allowed the teacher to walk around the classroom. Before the implementation, the student copies of activity printouts were distributed to the students.

3.4 Data Analysis

Yin (2003) describes case study research as a challenging experience for the researcher because of the absence of routine formulas. He also adds that data analysis is one of the least developed and most difficult aspects of doing case studies. Yin (2003) states that "data analysis consists of examining, categorizing, tabulating, testing, or otherwise recombining both quantitative and qualitative evidence to address the initial propositions of a study" (p.109). Similarly, Merriam (1998) argues that data analysis is a complex procedure consisting moving back and forth between concrete bits of data, abstract concepts, between inductive and deductive reasoning. She categorized qualitative data analysis under six categories: ethnographic analysis, narrative analysis, phenomenological analysis, the constant comparative method, content analysis and analytic induction. In this study, the constant comparative method is used.

The constant comparison analysis is the most commonly used type of analysis for qualitative data (Leech, 2007) and was created by Glaser and Strauss (1967). Leech (2007) also adds that the term "coding" is used when referring to this type of analysis by some authors.

Glaser and Strauss (1967) proposed several steps in order to analyze data using the constant comparative method. The first step of this method is creating categories and codes. Glaser and Strauss (1967) state that "the analyst starts by coding each incident in his data into many categories of analysis as much as possible, as categories emerge or as the data emerge that fit an existing category" (p.105). In this method, in general the researcher first reads through the entire set of data or a subset of the data. After doing so, the researcher chunks the data into smaller meaningful parts and then, the researcher labels each chunk with a descriptive title or a "code." Leech (2007) emphasizes the importance of comparing each new chunk of data with previous codes, so similar chunks will be labeled with the same code. After all the data have been coded, the codes are grouped by similarity, and a theme/ category is identified and documented based on each grouping. The researcher continues the same procedure after finishing the coding of each new data set.

Merriam, (1998) mentioned that names of the categories come from three different sources: researcher, participant and literature. Similarly, Glaser and Strauss (1967) stated that researcher could construct the names for the categories from three different sources. The first one is the researcher's experiences with the data. The second

one is based on the framework or words from the participants' statements. Last one is using literature or coding from previously related studies.

In the second step of the constant comparative method of data analysis, "categories are related to their subcategories to form more precise and complete explanations about phenomena" (Strauss & Corbin, 1998, p. 124). At this stage, the researcher integrates the categories based on their properties. In the final step of the analysis, researcher discovers consistency among the categories and within their properties. Relationship and patterns among the categories gave light to the researcher to formulate the theory based on the data (Glaser & Strauss, 1967).

In this study, to explore Ms. Defne's pedagogical reasoning on learning activities, the semi-structured interviews and the lesson observation notes were analyzed. The analysis started with the first data set which belongs to the first interview made. Coding was made based on the statements of the participant and related literature framework. Based on the comparisons within the codes in the first data set, categories were generated.

After comparing the codes within the first data set, the code and category list was extended by working on the all of the data sets. This final list outlines the classification of the data gathered in the study which reflects the recurring patterns namely the categories or the themes.

In the analysis, words or phrases which indicated a decision or judgment regarding the activities were searched. These words, phrases were then used as coding

categories to synthesize and organize the data. To work more efficiently on the data, a data matrix was constructed. This matrix consisted of code title, code description, frequency of the related words or phrases, related chunk of the data. The final version of the matrix also included the categories and subcategories.

3.6 Trustworthiness

Ensuring trustworthiness in qualitative studies is important in judging the quality of them. Lincoln and Guba (1985) proposed four criteria that should be considered to ensure trustworthiness in qualitative studies. These are credibility, transferability, dependability, and confirmability.

Shenton (2004) addressed the same concepts, and he also connected these terms with the ones used in quantitative research. He noted that credibility corresponded to internal validity, transferability to external validity/generalisability; dependability to reliability; and confirmability to objectivity.

3.6.1 Credibility

Lincoln and Guba (1985) argued that ensuring credibility is one of the most important criteria in establishing trustworthiness. According to Merriam (1998), credibility deals with the question “How congruent are the findings with reality? Are investigators observing or measuring what they think they are measuring?” (p. 201). She suggested six basic strategies to enhance internal validity under six headings: Triangulation-using multiple sources, multiple investigators, or multiple methods,

member checks, long-term observation, peer examination, participatory or collaborative modes of research and researcher's biases.

Creswell and Miller (2000) describe triangulation as a procedure where researchers search for convergence among multiple and different sources of information to form themes or categories in a study (Creswell & Miller, 2000). Patton (2002) stated the role of triangulation as:

> "Triangulation strengthens a study by combining methods. This can mean using several kinds of methods or data, including using both quantitative and qualitative approaches" (p. 247)

There are four types of triangulation: data triangulation (the use of a variety of data sources in a study), investigator triangulation (the use of several different researchers or evaluators), theory triangulation (the use of multiple perspectives to interpret a single set of data, and methodological triangulation (the use of multiple methods to study a single problem or program) (Patton, 2002). Yin (1994, 2003) stated that when you really triangulated, the data facts of the case study have been supported by more than a single source. By this way, validity has been established since multiple sources of data provide multiple measures of the same phenomenon.

In this study, data triangulation and investigator triangulation were used for increasing the credibility of the study. Transcripts of the interviews with the teacher, lesson observation notes, the sample materials the teacher provided were the multiple sources of data and three coders (two doctoral students and one master student from the

Secondary Science and Mathematics Education Program at METU) took part in the analysis of data. In addition to triangulation, member checking was also used, where the participant teacher was given the research findings of the study and asked to comment on their accuracy. I asked her whether she agreed what was written or was there anything that she wanted to change or add. Besides member checking, the phrases that were very close to the teacher's wordings and verbatim were used in reporting the analysis of the research findings. In addition to these strategies, previous research findings were examined for increasing the credibility (Shenton, 2004). Moreover, after the coding of first interview was completed, I and a faculty member in mathematics education went over the codes, their descriptions, and whether they represented what the data meant through a discussion. We repeated our discussions at the end of the data analysis. His comments made me refine my codes and themes, and strengthen my arguments in completing the data analysis and reporting the findings.

In addition, two doctoral students and one master student from the Secondary Science and Mathematics Education Program at METU were asked for coding the transcript of one interview in order to have consensus of findings and reduce the researcher bias. They were informed about the aim of the study and data collection procedure. Then, they were trained about the interview questions, and the data matrix was explained in detail. They were asked to code the given transcript using the code titles and their explanations in the data matrix. It was also noted that they could be able to add any extra code in case the data matrix was not enough. The same coding by at least two coders was accepted as an agreement and codes which had disagreement were

refined. This comparison of my codes with their codes gave 74% agreement. After remeeting with each coder and discussing on the codes a full agreement was reached.

3.5.2 Dependability

Lincoln and Guba (1985) stressed the close ties between credibility and dependability, arguing that, in practice a demonstration of the former goes some distance in ensuring the later. They suggested thinking about "dependability" or "consistency" of the results obtained from the data instead of using the term reliability. Thus, the reliability refers to not finding the similar results but whether the results are consistent with the data collected. They mentioned that a demonstration of credibility is usually sufficient to establish the dependability. Thus, using multiple methods of data collection and analysis, as well as validity triangulation also increases the dependability of the study.

Merriam (1998) stated that researcher also should describe in detail how data were collected, how categories were derived, and how decisions made throughout the research study in order to increase dependability. Similarly, Shenton (2004) noted that in order to address the dependability issue more directly, the processes within the study should be reported in detail, thereby enabling a future researcher to repeat the work. In this study, in addition to data triangulation and investigator triangulation, the detail of the data collection, data collection tools, and details of data analysis were described in order to increase the dependability.

3.5.3 Transferability

According to Yin (1994, 2003) external validity, where the corresponding term in qualitative research is transferability, of the case study is related to the generalization of the findings beyond the given case studies. Merriam (1998) describes external validity as the concern with the extent to which the findings of one study can be applied to other situations. However, since the findings of a qualitative study 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). Stake (2000) suggested that, although each case may be unique, it is also an example within a broader group and, as a result, the prospect of transferability should not be immediately rejected. The investigator should ensure that sufficient contextual information about the fieldwork sites is provided to enable the reader to make a transfer (Lincoln & Guba, 1985).

In this study, in terms of transferability, a semi structure interview protocol was prepared to have consistency among the interviews. The specific procedures for coding and analyzing the data also increased the external validity of the case study. In addition, I tried to provide a thick description on the case that was Ms. Defne in order to associate my findings with the readers in an effective way. The generalization of the findings to all elementary school mathematics teachers was not concern of this study; however the findings of this study could easily be shared with the elementary school mathematics teachers having similar characteristics to further understand the pedagogical reasoning process of elementary mathematics teachers.

3.5.4 Confirmability

The last criterion to ensure trustworthiness is confirmability, where the corresponding term in quantative research is objectivity. Shenton (2004) suggests that researcher should ensure that findings are the result of the experiences and ideas of the informants, rather than characteristics and preferences of the researcher. He also emphasized the role of triangulation in promoting such confirmability and reducing the effect of investigator bias. Similarly, Miles and Huberman (1994) mentioned that a key criterion for confirmability is the extent to which the research admits his or her bias. They noted that methodological descriptions like how data were collected, how categories were derived, and how preliminary theories were supported by the data should be clearly described for the confirmability of the research study. In addition, the researcher should state his beliefs, reasoning regarding the choices made; admit the weakness of the techniques applied (Shenton, 2004). In this study, triangulation to reduce the researcher bias, in-depth methodological description, presence of multiple coders, and stating the limitations of the study were the evidences for the confirmability of the study.

CHAPTER IV

FINDINGS

This chapter starts with the introduction of Ms. Defne's general views about teaching mathematics and activity use in lessons. Then the findings of the research study are summarized under two main sections and related subsections. At the end of the chapter, a table is given to summarise the findings of the study.

The first section deals with Ms. Defne's general views about teaching mathematics and activity use in lessons, and the second section deals with reporting the decisions made and the reasoning behind them. For most of the decisions, the information given in the first section constitutes the reasoning behind the decisions mentioned in the second section. Each subsection in the second section deals with one aspect of Ms. Defne's pedagogical reasoning process while selecting or designing activities for her lessons. Those subsections were written as answers to both subproblems of the study where they ask for the pedagogical decisions made and reasoning behind ant decision made.

While the findings are reported, related parts of the transcripts belonging to the interviews were taken as reference. Those parts are represented both in Turkish and English not to loose some details due to the nature of the languages.

4.1 Ms. Defne's General Views about Teaching Mathematics and Activity Use in Lessons

Regarding Ms. Defne's pedagogical reasoning while selecting or designing learning activities for her lessons, the interview scripts were coded to identify her general views about teaching mathematics and activity use in lessons. One of the categories emerged from the data codes were related to her points of major consideration in planning her mathematics lessons.

Ms. Defne's Points of Major Consideration for Her Mathematics Lessons

The findings indicated that while talking about any lesson Ms. Defne had some points of major consideration about her decisions. The points were mostly related to students' understanding of the topics. A summary of her points of major consideration is given in the Table 4.1.

Table 4.1. Summary of Ms. Defne's Points of Major Consideration for her Lessons

Consideration
Making students find the topic relevant.
Making students should understand the concepts and the logic behind them.
Developing certain skills of students.

Ms. Defne emphasized that while planning the lessons she considered whether her students would find the topic relevant. She stated that:

"When I'm planning my instruction, I consider many things. Like I think of how I can answer if the students ask how they should suppose to use that subject in their lives." (Turkish version: *Derslerimi planlarken göz önünde bulundurduğum şeyler var. Öğrencilerden gelebilecek bu konu ne işime yarar sorusuna cevap arıyorum.*)

The data revealed that Ms. Defne realizes this point of consideration by making real life connections with the topic. Regarding an activity which was about solving problems involving finding the greatest common factor and least common multiple of numbers, her first consideration was choosing problems which really demanded finding the greatest common factor and least common multiple of numbers. Her emphasis is as follows in her own words: "*First I checked if the problems demand finding the greatest common factor and least common multiple of numbers. I make sure the problem has a real life connection to make the students realize that this is something that they may face in real life.*" (Turkish version: Problemlerin öncelikle ebob ve ekok kullanılmasını gerektirmesine baktım. Günlük hayattan bir problem olmasına dikkat ettim, çocukların gerçekte de böyle bir durumun olabileceğini algılayabilmesi için.)

The lesson observations indicated that not only while planning for the lesson but also during the instruction, making the topic relevant for students was a point of consideration for Ms. Defne. For instance, in the lesson about deriving formula for the area of a rectangle such considerations were observed. "Covering the floor of your bathroom with tiles" was introduced as a situation and students were asked to find the number of tiles needed.

Another major issue that Ms. Defne was considering was related to concentrating on concepts and the logic behind them. She summarized this point for her as follows: *"I try to focus on the concepts and their logic behind them."* (Turkish version: Kavramlara, onların mantığının ne olduğuna ağırlık vermeye çalışıyorum.)

The data confirmed this consideration is a major one for Ms. Defne. In most of the activities she examined and the activities brought by her, concepts were at the centre. For instance, the activity about deriving the formula for the area of a rectangle started with recalling the concept of area. In the same activity, the relation between the concept of square and the concept of rectangle was underlined. In the observation of this lesson, some more considerations also were made. Although Ms. Defne did not plan for explaining the difference between "a rectangle" and "a rectangular region", she asked her students about the difference between these concepts. In addition, some questions were asked to make clear the difference between the concepts of perimeter and area.

In the problem solving activity, the concepts of greatest common factor and least common multiple were emphasized. The logic behind them was explained on the problem statement. The problem asked for the re-meeting day of a nurse and a doctor, where the nurse is on duty every 6 days and the doctor is on duty every 8 days. The multiples of both numbers were written on the board and the least common multiple was used to find the solution of the given problem.

In the prime number activity, rather than just giving the definition of a prime number it was derived by using the relationship between the concept of divisibility and

the concept of being a factor. The emphasis of the activity was the meaning of a prime number.

The data revealed that in addition to students' understanding the concepts and the logic behind them, developing certain skills of students was also a major consideration for Ms. Defne. According to her teaching mathematics is a tool to teach concepts and skills: *"Concepts and skills are very important and actually mathematics teaching is a tool for that"*. (Turkish version: Kavramlar ve beceriler önemli, matematik öğretimi bunun için bir araç.) She stated that some skills are major for her:

> "There are some certain skills that I concentrate on like problem solving and estimation. Interpretation is also important. I actually like to focus on critical thinking but it's quite broad. Like I said, for me the important thing is to make the connection between the concepts and the skills." (Turkish version: *Üzerinde durduğum bazı beceriler var. Problem çözme ve tahmin önemli. Yorum yapma önemli. Eleştirel düşünme üstünde durmak istiyorum ama biraz kapsamlı bir beceri. Dediğim gibi önem verdiğim şey kavramlarla becerilerin ilişkisini kurmak.*)

The data confirmed that developing certain skills was a major consideration for Ms. Defne. For instance, in the activity about calculating and comparing the area of given rectangles she checked whether including estimation was possible:

> "Actually the learning objective does not require estimation but I think of including it before calculation to see if it can be included in the activity. An extra column may be added, first the estimation and then the calculation may be asked.

But I see that the numbers are close to each other, and then it's no good for comparison after rounding off." (Turkish version: *Aslında kazanım bizden tahmin istemiyor ama hesaplama öncesi koysam nasıl olur diye düşündüm. Bir sütun daha eklenip, önce tahmin et sonra hesapla da olabilir. Ama bakıyorum ki sayılar birbirine yakın yuvarlama yapınca karşılaştırma için uygun olmuyor.*)

In another activity, Ms. Defne sugguested to include estimation such that students will compare the area of two fields by looking at their shapes. She stated that "*When you include differents skills in the activity, then students enjoy it more. For example, I suggested a change for this activity and ask the students to guess the areas just by looking at the shapes of the fields."* (Turkish version: Farklı becerileri de katınca keyif artıyor. Bu etkinlikte örneğin değişiklik önerdim, sadece şekillerine bakarak tahmin de yapmaları yönünde.) The activity in consideration is about calculating and comparing the area of two fields. One of them is a rectangle and the other one is composite of a rectangle and a square.

The findings indicated that in addition to estimation, developing problem solving skills of students was a concern for Ms. Defne. She stated her approach in developing problem solving skills of students as follows:

"I'd like the students to experience the process before problem solving as well. Understanding the problem, planning. To make them acquire a habbit of controlling which actually they always pass over." (Turkish version: *Öğrencilerden problem çözmeden önceki süreci de yaşamasını istiyorum.*

Anlama, plan yapma. Hep ihmal ettikleri kontrol alışkanlığı kazandırmak istiyorum.)

Ms. Defne stated that she used the template given in Figure 4.1 for problem solving activities: "*I use this template to observe the students' problem solving skills better. For example, if we have 5 problems to solve, I use this template for one or two problems and grade them. Then, I put their work into their portfolios."* (Turkish version: Bu şablonu ben problem çözme becerilerini daha iyi görebilmek için kullanıyorum. Örneğin 5 problem çözeceksek bir iki tanesini böyle yapıp puanlıyorum, dosyalarında bulunduruyorum portfolyolarında.)

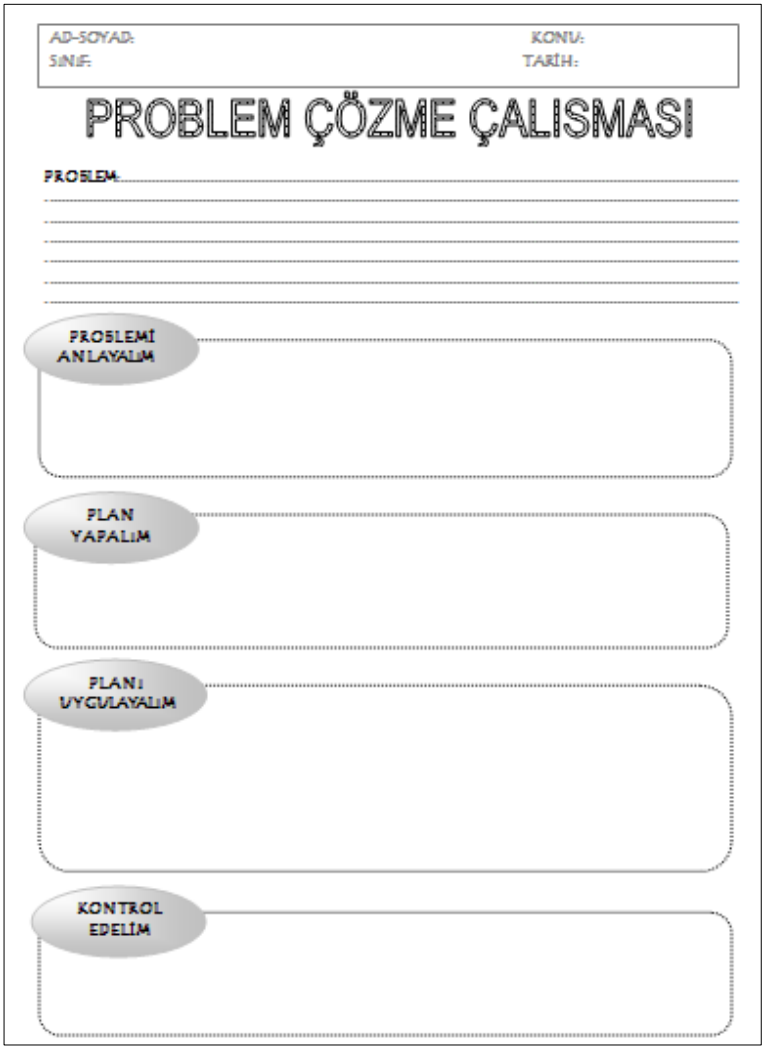


Figure 4.1. The Template Used for Problem Solving Activities by Ms. Defne

According to Ms. Defne, this template is a tool for observing the students' problem solving skills and for preventing them to skip the important steps like understanding the problem, making a plan and checking the result: *"I feel leading is necessary for them to follow each step without skipping any. They usually skip understanding the problem and planning. They jump directly to the execution of the plan. I really wanted to prevent this."* (Turkish version: Her aşamayı atlamadan

yapmaları konusunda yönlendirme ihtiyacı duyuyorum. Problemi anlama ve plan yapmayı genelde atlıyorlar. Doğrudan planı uyguluyorlar. Bunu engellemek istedim.)

To conclude Ms. Defne's considerations for certain skills, she tried to include estimation in activities where possible and for the activities about problem solving she had a specific template for developing problem solving skills. Ms. Defne stated that those skills were emphasized in the national mathematics curriculum and she enjoyed the lessons which focus on those skills: *"These are important skills for the students and they are also emphasized in the program. I really enjoy the lessons which these skills are focused on."* (Turkish version: Bu beceriler öğrenciler için önemli ve programda da vurgulanan becreriler. Bu becerilerin ön plana çıktığı dersleri keyifle işliyorum.)

Ms. Defne's Thoughts about when and how Her Students Learn Best

Analysis of the data from the interview scripts revealed that Ms. Defne also expressed her thoughts about how her students learn best. These thoughts may form a base for her pedagogical decisions while selecting or designing learning activities. She thinks that students should be allowed to perform something to be able to learn. Moreover, she believes that their interest is required for learning and they are more interested in visual topics like geometry. In the following conversation, some more details can be seen:

> "It sounds like a common expression but it is true that they learn better when they are a part of the lesson. They need to like it and to be interested in it. They

should be free to perform something. Visual topics like geometry are more engaging for them." (Turkish version: *Çok klasik olacak ama kendileri işin içinde olunca daha iyi öğreniyorlar. Sevmeleri, ilgi duymaları gerekiyor. Yapmalarına fırsat vermek gerek. Görsel konular, daha cazip geliyor, geometri gibi.*)

The common characteristic of the activities Ms. Defne used was that all involved students to perform something. This could be performing the given operation, calculating the area of the given shape, finding a pattern, etc. For instance in the prime number activity, Ms. Defne wanted her students the notice the prime numbers instead of directly giving the definition of a prime number. In this activity, students were asked to find the multiples of the given numbers in the table (1-99) one by one and at the end they were asked to identify the numbers which have no multiple except the number one. In the same activity, students were also asked to write their own definitions of a prime number. At the end of the lesson, they were asked to summarize what they had learned in that lesson in one sentence.

In another activity which was about problem solving involving finding the"least common multiple" of numbers, the activity asked for students to write the problem statement in the given situation. The problem was not given but a situation in which the problem statement can be driven was given. Ms. Defne stated that she especially designed this part of the activity in this way since she wanted her students to understand the problem better.

Researcher (R): I noticed that the problem statement is not given in the activity sheet and the students are asked to write it. (Turkish version: *Benim etkinlik kağıdında dikkatimi çeken bir şey oldu. Problem yazmıyor, onların yazması istenmiş.*)

Teacher (T): I did this on porpuse. Some students understand while they are writing. Reading, writing, so they will need shortening. Therefore, I prefer them to write. (Turkish version: *Bunu özellikle istedim. Bazıları yazarak da anlıyor. Yazarak, okuyarak, kendileri kısaltma ihtiyacı duyacaklar. Kendilerinin yazmasını tercih ediyorum.*)

To sum up Ms. Defne's thought about when her students learn best, she thinks that her students learn best when they are allowed to perform something and using activities is a way of doing this. The lesson observation notes also confirmed Ms. Defne's this consideration. In all the activities Ms. Defne applied in the observed lessons, she was guiding her students to complete the steps in the activities and asking them to perform the given tasks.

Ms. Defne's Understanding of an Activity

Ms. Defne's understanding of an activity may form a base for interpreting about her pedagogical decisions while selecting or designing activities. Regarding that need, she was asked about her understanding of an activity. She stated that:

> "An activity should have a purpose at the first place. When the teacher looks at it, s/he should sense what the target to be reached is. It should fulfill the learning objective, and cover some skills. Perhaps, not every activity may be like this but I feel a better quality will be reached if this will be the way. It should have directions and steps, and definitely it should come to a conclusion and reach a result." (Turkish version: *Bir etkinliğin bir kere bir amacı olması gerekli. Neye ulaştırmak istediğini öğretmenin görünce sezmesi gerekli. Kazanımla örtüşmesi gerekli. Bazı becerileri de içine alan bir şey olması gerekli. Her etkinlik böyle olamayabilir belki. Böyle olursa daha kaliteli olacak gibi hissediyorum. Yönergeleri, aşamaları olmalı. Bir sonuca bağlanmalı.*) The components of Ms. Defne's understanding of an activity are given in Table 4.2.

Table 4.2. Components of Ms. Defne's Understanding of an Activity

Components
Having a purpose.
Being aligned with the learning objective of the lesson.
Having directions & steps.
Being connected to a result.
Covering some skills (not necessarily).

4.2 Ms. Defne's Pedagogical Reasoning

The purpose of the research is to explore Ms. Defne's pedagogical reasoning process while selecting or designing activities for her lessons. More specifically, the kind of decisions she made are examined. In doing so, she was asked to examine a set of learning activities in the interviews. Following these interviews, the researcher conducted class observations for three of the lessons for which Ms. Defne applied the activities she adapted from the given list. All activities were applied by her. Finally, Ms. Defne evaluated how the lessons went. All these interviews were transcribed and coded.

Moreover, Ms. Defne was asked to bring her own set of activities for the interviews. After the interviews with her on these activities, the researcher conducted class observations for these lessons. Finally, Ms. Defne reflected about the activities.

The analysis to explore Ms. Defne's pedagogical reasoning process was based on available literature, her statements, and the researcher's own experiences with the data. Ms. Defne's each decision and each consideration regarding activities was coded. When those codes were analyzed, some recurring patterns and themes were recognized. The data analysis revealed that most of Ms. Defne's decisions and considerations were focused on how the activities will affect students' learning and some of Ms. Defne's decisions and considerations were focused on how to organize her teaching. These represent two main groups of Ms. Defne's considerations in her pedagogical reasoning process while selecting or designing activities for her lessons. The groups of Ms. Defne's decisions and considerations are given in Table 4.3.

Table 4.3. Categorization of Ms. Defne's Decisions and Considerations

No	Focus of the Teacher's Decisions and Considerations
1	How the activities will affect students' learning
2	How to organize teaching

4.2.1 Considerations based on Students' Learning

Regarding Ms. Defne's pedagogical reasoning while selecting or designing activities, the interview transcripts were coded to identify her decisions which take "the student" into consideration. Each decision which takes the student into consideration was coded and the findings indicated that the decision and considerations were mostly related with students' learning. More specifically, those considerations were related to characteristics of the tasks within the activities, students' understanding concepts: their conceptions and misconceptions, and student motivation.

4.2.1.1 Considering the Characteristics of the Tasks within the Activities

The findings indicated that while talking about each activity, Ms. Defne had some considerations about the tasks within the activities. Each activity examined by Ms. Defne or brought by her had one or more tasks for the students to perform. It may be calculating the area of the given shape, writing the answer of a question or matching the given two sets of information, performing a multiplication, solving a problem, drawing a shape which satisfies certain conditions, comparing two numbers, etc. The data revealed

that Ms. Defne considers various issues related to a task or tasks within an activity. (A summary of her considerations are given in Table 4.4.)

Table 4.4. Ms. Defne's Considerations Related to a Task

Consideration

Difficulty level of a task
• Is the difficulty level of the task appropriate for the students?
  ○ Do the tasks proceed from easy to difficult?
  ○ What is easy/difficult for my students?
  ○ Have my students previously worked on a similar task?
  ○ Do I want to use this task to recall although it is easy?
  ○ Should I provide examples for this task for low achievers?
• How can I increase the level?
  ▪ Check the appropriateness of the numbers for the grade level.
  ▪ Don't give the methods at first, askstudents to find out them.
  ▪ Check whether the number of operations or relations can be increased.
  ▪ Check whether you can increase the level during implementation.

Content of task
• Check shapes used
  ○ Check the number of shapes used
  ○ How will my students perceive the given shapes?
• Check the questions
  ○ Is this question understandable by my students?
  ○ Can this question be asked in such a way that my students need to explain their reasons while answering it?
  ○ Does this question give an opportunity for examining and discussion?
• Check the language
  ○ Can the text be read clearly?
  ○ Is the font size appropriate?
  ○ Is there anything which may lead misunderstanding?

Difficulty Level of a Task

The first issue for Ms. Defne was consideration of how the tasks should be given in an activity based on what her students can do and can not do. This was mostly related to the difficulty level of the tasks.

In the following example, Ms. Defne checks the difficulty level of tasks in an activity. In this activity, in the first task the students are expected to find the area of four squares in different sizes. The squares are on grid paper and their lengths vary such that counting the number of unit squares is the easiest for the first square. In the second task in the activity, the students are expected to write the relationship between the area and side length of a square in their own sentences. The tasks in consideration can be seen in Figure 4.2.

> "In this activity it's very important for them to explore the relationship. Side length, the number of squares and area. They are all proceeding from easy to difficult, just in the order that makes the students to explore, and think in each step." (Turkish version: *Bu etkinlikte ilişkiyi keşfetmeleri çok önemli. Kenar uzunluğu, kare sayısı ve alan. Hepsi basitten zora doğru gidiyor, öğrencinin yavaş yavaş keşfetmelerini sağlayacak sırada gidiyor. Her aşamada düşünmesini sağlayacak şekilde.*)

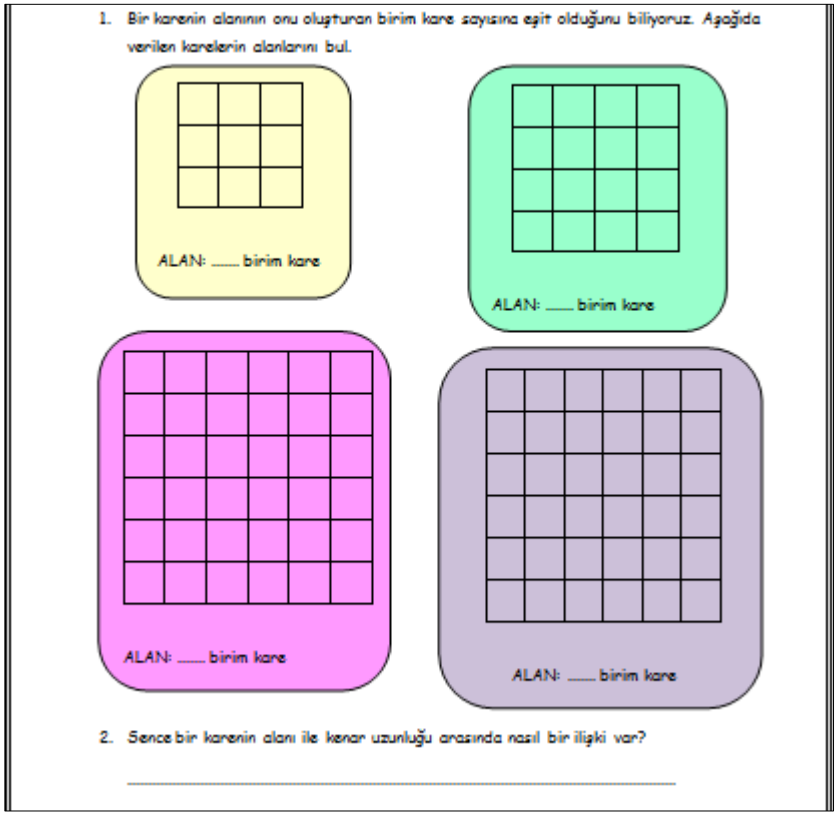


Figure 4.2. The Tasks for Deriving the Formula for Calculating the Area of a Square

It is seen that Ms. Defne considers proceeding from easy to difficult for her students to be able to think at each step of the activity. While she checks the difficulty levels of the tasks; she considers what will be easy and what will be difficult for the student.

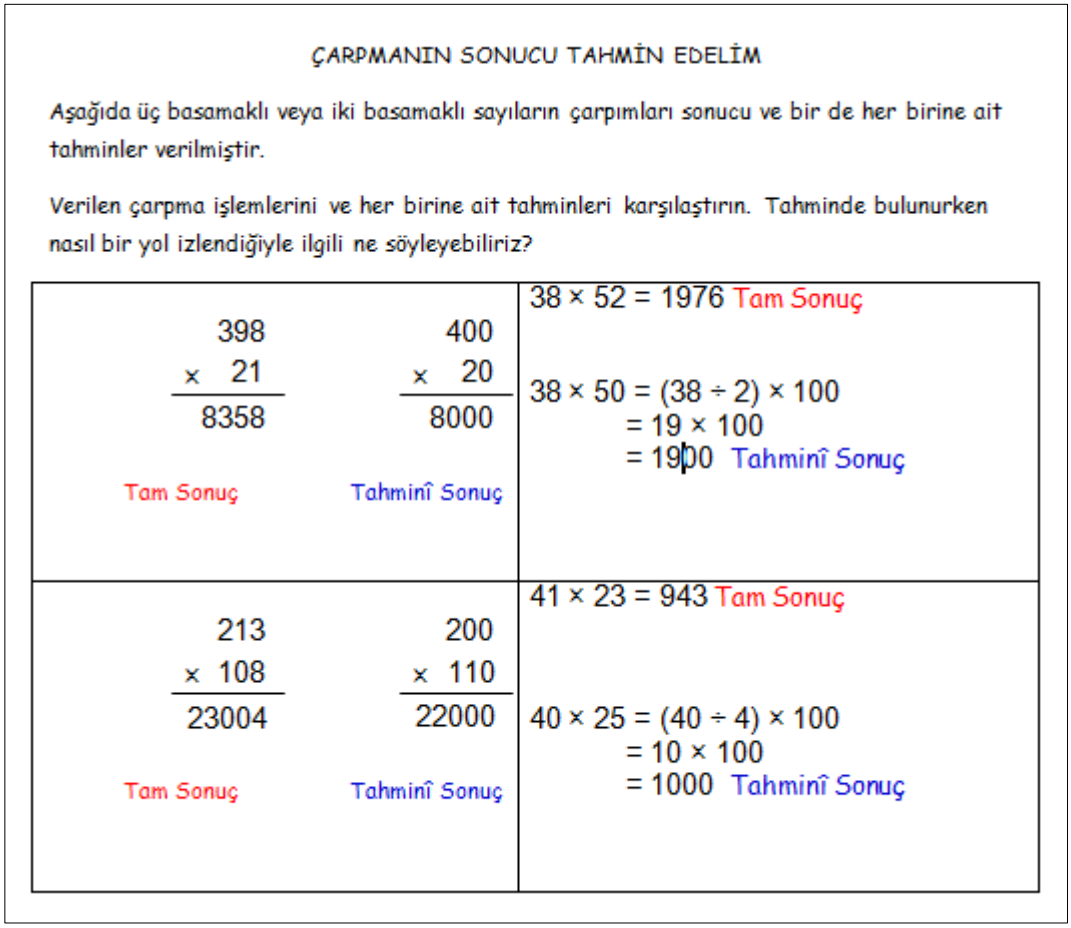
In the following conversation, working on a previously known task is defined as a property which makes it easy for the students. The activity in consideration is the area of a square activity which has been mentioned also above.

"I think this activity may be quite easy for their level.Instead of 4 shapes, 2 may be given for them to recall. Last semester, they dealt with counting the unit squares while calculating the area." (Turkish version: *Bence bu etkinlik seviye olarak biraz kolay gelebilir. Hatırlatmak için 4 yerine 2 şekil konabilir. Geçen dönem birim kareleri sayarak alan hesaplama üstünde uğraştılar.*)

Ms. Defne decided to keep the task with a less number of shapes. It is seen that she may use some tasks to recall the related content although the tasks are easy.

Ms. Defne also noted that what is easy for one student may be difficult for another student. In the following example, she considered the difficulty level of the task for low achievers too. Ms. Defne stated that the estimations in the task might not be given for high achievers, but it might be given for low achievers. The task in consideration is given in Figure 4.3.

"It does not matter if they see the answers, they will still be wanting to perform it by themselves. For low achievers, it would be a pleasing thing to have a method." (Turkish version: *Cevapları görseler de kendileri üretmek isteyeceklerdir. Düşük seviyede ise ellerinde yöntem olması hoşlarına gidecektir*.)



ÇARPMANIN SONUCU TAHMİN EDELİM

Aşağıda üç basamaklı veya iki basamaklı sayıların çarpımları sonucu ve bir de her birine ait tahminler verilmiştir.

Verilen çarpma işlemlerini ve her birine ait tahminleri karşılaştırın. Tahminde bulunurken nasıl bir yol izlendiğiyle ilgili ne söyleyebiliriz?

398 × 21 = 8358 Tam Sonuç	400 × 20 = 8000 Tahminî Sonuç	38 × 52 = 1976 Tam Sonuç 38 × 50 = (38 ÷ 2) × 100 = 19 × 100 = 1900 Tahminî Sonuç
213 × 108 = 23004 Tam Sonuç	200 × 110 = 22000 Tahminî Sonuç	41 × 23 = 943 Tam Sonuç 40 × 25 = (40 ÷ 4) × 100 = 10 × 100 = 1000 Tahminî Sonuç

Figure 4.3. The Task for Estimating the Multiplicaiton of Two Numbers

According to Ms. Defne, low achievers like having an example in hand for a task in the activity. She thinks that this is a kind of guidance and if it is not given some students may get lost.

In another activity, students were expected to calculate the area of two given composite shapes. One of them is a house made of a rectangle, a square, a triangle and a parallelogram. The second one is a robot made of three squares in different sizes and

two couples of rectangles in different sizes. The shapes are given on the grid paper. The task in consideration is given in Figure 4.4.

> "I look at another activity. There is a house and a robot. At this point, if this is going to be used for reinforcement, I think the unit sqaures are not necessary anymore. When the lenght is given, the students can calculate. This should be asked by preventing them to count the unit squares." (Turkish version: *Başka bir taneye bakıyorum. Ev, robot var. Bu artık pekiştirme olarak kullanılacaksa birim karelere gerek yok diye düşünüyorum. Uzunluk verilince öğrenci hesaplayabilir. Birim kareleri tek tek sayarak yapmasını da engelleyecek şekilde sorulmalı.*)

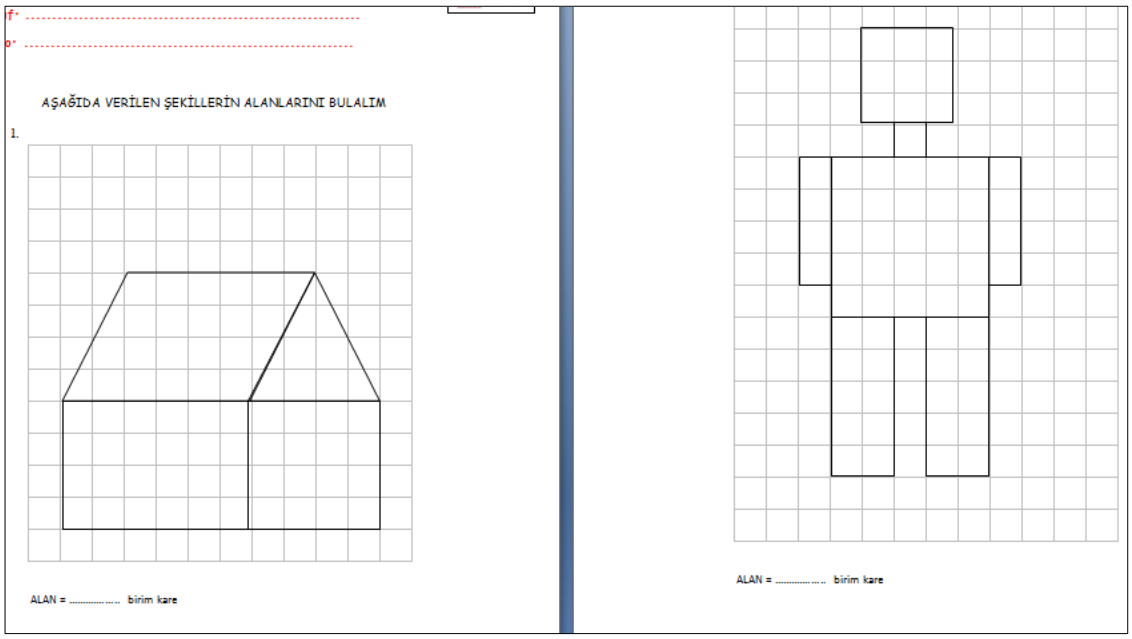


Figure 4.4. Task for Calculating the Area of Two Composite Shapes

The data revealed that the type of activity is also a concern for deciding on the difficulty level of tasks within an activity. Ms. Defne decided to exlude unit squares since calcuting the area when the lengths are given was a previously known task for her students. Her decision was based on the fact that the activity was going to be used as reinforcement activity.

In the composite shapes activity, Ms. Defne suggested making an addition to the activity. This addition asks for the students to form a composite shape for instance a house which has the given area:

> "After these, what can be next. They calculated the area of the house and found let's say 50. Extra space may be given on the sheet and, they may be asked to draw some shapes and make the area 30. Windows will not be counted. Or, they may draw a chimney to increase the area. At this point, they need to think of the side lenght, drawing is not enough. So, we incease the difficulty level." (Turkish version: *Bunlardan sonra şöyle bir şey olabilir. Evin alanını hesapladı örneğin 50 buldu. Yanına boşluk verip şekiller çizerek alanı 30 yapmasını istemek. Penceler sayılmasın. Veya baca çizerek alan artırılabilir. Bunun üzerinden giderek ekstra bir şey yapılabilir. Duvar alanı sorulabilir. Burada kenar uzunluklarını kendi düşünmek zorunda kalacak, şekil uydurmak yeterli olmayacak. Seviyeyi artırmış oluyoruz.*)

Ms. Defne used the word "challenge" for this kind of tasks. She told that she tried to increase the difficulty level of the tasks by including challenge where possible. According to her, students' need of thinking about the lengths themselves in the activity

will be a challenge for them. She also commented on the same task as follows: "*I thought it would be a good thing to give them a template and chance to free their creativity. Yes, this is a house but they can design the rest of it as they wish."* (Turkish version: Onlara bir taslak verip yaratıcılılıklarını konuşturmalarına bir fırsat vermek iyi olur gibi geldi. Bu bir ev ama devamını nasıl isterse öyle tasarlayabilir.)

The findings indicated that regarding increasing the difficulty level of a task, Ms. Defne also checks the numbes in the related task. According to her, the size of the numbers effect the difficulty level of a task since making operations with greater numbers or decimals is more difficult for student. For instance, in the estimation activity she suggested to change the difficulty level of the activity by decreasing or inscreasing the numbers. Regarding the estimation activity, she also noted that the appropriate size of the numbers could be deduced from the national curriculum:

> T: I look at the appropriateness of the numbers for the grade. In the program it says that the multiplication should be 5 digits at most, there's nothing overruling it. In order to increase the difficulty of the task, greater numbers may be used. (Turkish version: *Sayıların sınıf seviyesine uygunluğuna bakıyorum. Programda da çarpımları en fazla 5 basamaklı diyor, bunu geçen bir durum yok. Seviyesini artırmak için sayılar büyütebilir.*)
>
> R: What else can be done? (Turkish version: *Başka ne yapılabilir?*)
>
> T: Without giving the method at first, I may ask the students to guess the method. There are of course alternative answers then, it can be asked how they come to that conclusion. By this way, they really do think. (Turkish version: *Bir*

de başlangıçta nasıl yapıldığı gösterilmeden, nasıl yapılmış olabileceği sorulabilir. Alternatif cevaplar var, nasıl ulaşılabileceği sorulabilir. Derinlemesine düşünebilirler.)

Another way of increasing the difficulty level of a task suggested Ms. Defne was not giving the methods at first and asking students to find out them. According to her, this increases the level since it leads students to think more deeply.

Regarding increasing the level of the tasks in the problem solving activity, Ms. Defne explained that she chose problems at different difficulty levels: "*In the first problem, they will just find the least common multiple of numbers. Just with one operation. In the next problem, there will be more operations included. With the number of the operations, the number of relations will be increased, so does the difficulty level*." (Turkish version: İlk problemde sadece ekok hesaplayacaklar. Bir işlem yapacaklar. Bir sonraki problemde, kendi içinde başka işlemler veya ilişkilendirmeler olacak. İşlem sayısı da ilişkilendirme de artacak. Seviye artmış olacak.) It is seen that increasing the number of operations and the number of relations is also a way of increasing the difficulty level of task for Mr. Altın.

Finally, Ms. Defne noted that without changing a task, increasing its difficulty level while applying is also possible. For instance, in the problem solving activity she stated that letting students solve the problem themselves alone increased the difficulty level:

"In solving the first problem, actually I play a big part. Yet, in the following second or third problems, I let them do all the job. In some lessons, I also let

them to solve the problem at the beginning as well. This also increases the difficulty level." (Turkish version: *İlk çalışma çözümlü bir problem gibi aslında. Çözümde ben ağırlıklı durumdayım. 2. ve 3.problemde çözümü tamamen onlara bırakabilirim. Bazı sınıflarda çözümü ilk başta tamamen onlara bırakabilirim. Bu seviyeyi artırır.*)

She suggested a similar way to increase to level while applying for the prime number activity. "*Without stating the points directly, it may be difficult for the students to identify the patterns and find the results. In some classes we state the points. In short, the way you apply also increases the difficulty level. The material is the same but the application is different*". (Turkish version: Hemen açık açık budur demeden, öğrencilerin örüntüleri, sonuçları çıkarması zorlaştırabilir. Bazı sınıfta biz kendimiz verebiliriz. Yani uygulama ile seviye artırılabilir. Materyal aynı ama uygulama farklı olur.) It is seen that while examining the tasks of an activity, Ms. Defne makes some decisions regarding increasing the difficulty level of a task while applying. The data reveals that this decision depends on the classroom level.

Content of a Task

While talking about the activities, Ms. Defne made some decisions regarding the content of a task. Those were mostly related to the number and nature of shapes used, the nature of the questions asked, and language used.

Regarding the content of a task, shapes included were examined by Ms. Defne. She stated that shapes were very important to her: "*For me the shapes are also*

important, if the perimeter was asked, the thing inside the shape wouldn't be important, but it is important in the area." (Turkish version: Şekilleri de önemsiyorum ben. çevre sorulsaydı içerdekilerin önemi olmayacaktı ama alanda var.) She considers how students will perceive the shapes. Ms. Defne made the following comment for the activity which is about comparing the area of given rectangles by calculating their areas. The task in consideration is given in Figure 4.5.

> "The student may perceive these as different shapes; one is horizantal the other vertical. Therefore, this is good. The areas are the same." (Turkish version: *Öğrencilerimiz bunları farklı şekil gibi algılayabilir, biri dik biri yatayda. Onun için bu iyi olacaktır. Alanları aynı.*)

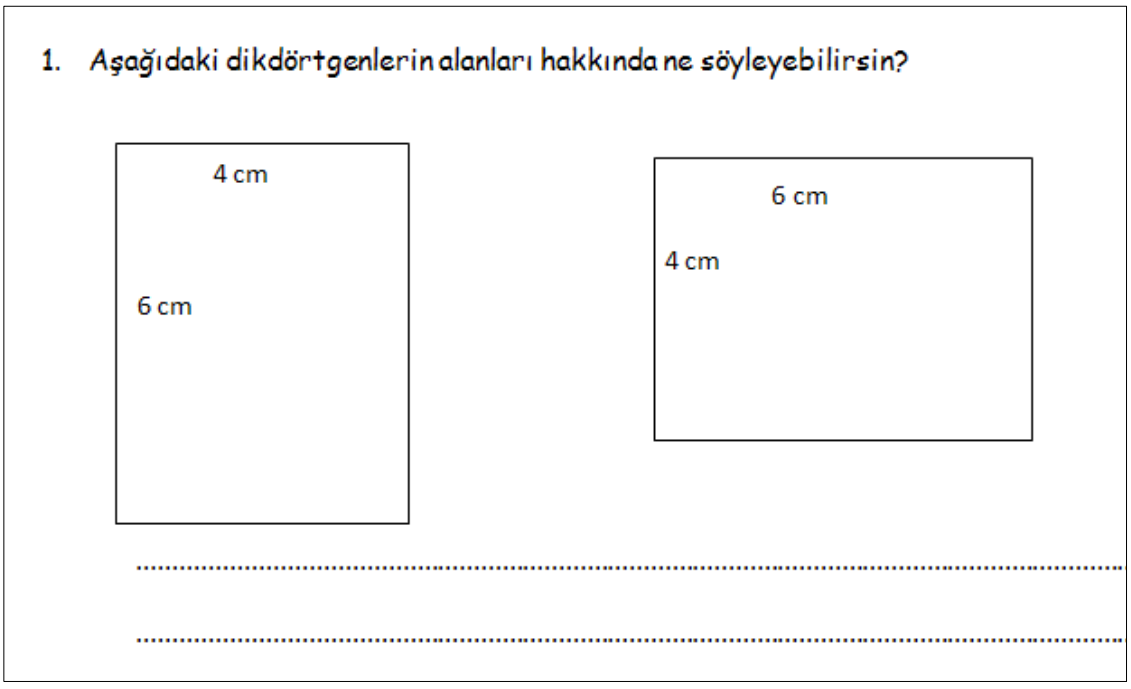


Figure 4.5. One of the Tasks in Comparing the Area of Rectangles Activity

According to Ms. Defne, questions within a task should also be determined carefully. She examined whether the questions in the activities would be understood or not. She tries to ask such questions that the students can write reasons.

T: We ask questions that they need to explain the reasons. (Turkish version: *Nedenleriyle açıklamalarını gerektiren sorular soruyoruz.*)

R: Do you always ask the questions? (Turkish version: *Soruları hep siz mi soruyorsunuz?*)

T: Not necessarily. They may bring an activity or example. (Turkish version: *Onların kendilerinin bir etkinlik, örnek bulması olabilir. İlla benim verdiğim sorular olmayabilir.*)

It is seen that reasoning is an important criteria in Ms. Defne's considerations. Moroever, whether the questions will give an opportunity for examining and discussion is also important. The following is her comment on such an activity: "*Before answering the question, we may examine the shapes. I may let them discuss so I can see their reasoning.*" (Turkish version: Soruyu cevaplamadan önce bu şekilleri inceleyebilliriz. Tartışmalarını sağlayabilirim, düşünme becerilerini yoklayabilirim.)

In this activity, students were expected to solve a real-life problem which involves calculating the area of rectangles. Ms. Defne stated that she liked it since before calculations; they can make a discussion by looking at the shapes only. At the end, they need to make a decision. This activity is given in Figure 4.6.

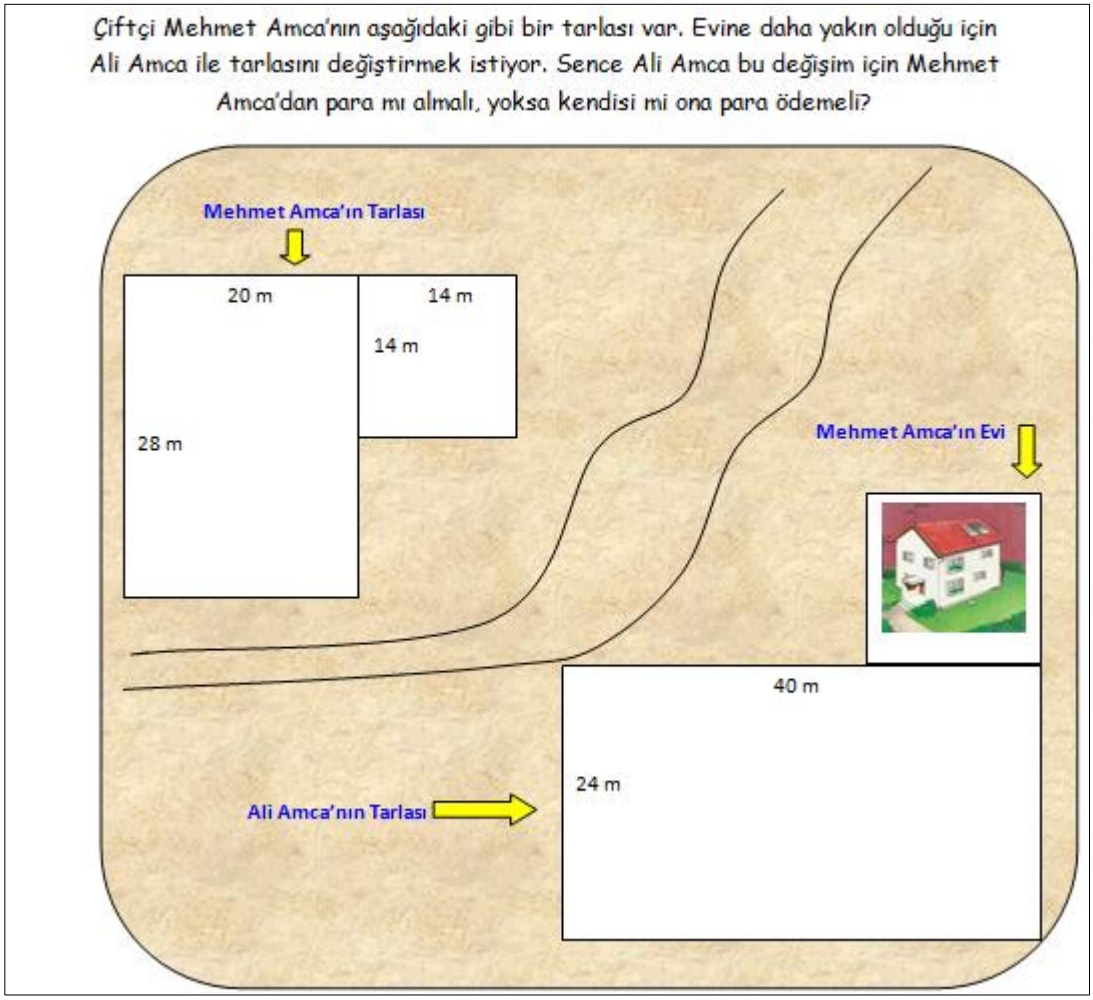


Figure 4.6. The Activity about Solving a Real-life Problem which Involves Calculating the Area of Rectangles

The last consideration was about the language used. Ms. Defne carefully examined the language. According to her, language may affect students' understanding of what the task is asking for them.

T: I don't feel comfortable about something within the language of the question, in the second and third sentences. I guess, be paid or pay is a bit confusing. (Turkish version: *Soru kökünde bir şeye takıldım. İkinci cümlede ve üçüncü*

cümlede.... Para mı almalı ifadesine takıldım sanırım. Bu değişim için para mı vermelidir yoksa üstüne para mı almalıdır? Öğrenciler bunu üstünde para taşımak olarak anlayabilirler. Dil de önemli çünkü. Burada para mı almalıdır yoksa para mı vermelidir şeklinde bir değişiklik yapılabilir.)

T: I always check the texts. How will it be when it is printed, if there may be a problem with the colors. Is it clearly read. The font size may be critical sometimes. Actually the first thing I look at is how does it look visually. Is there anything which may lead misunderstanding. (Turkish version: *Metinleri mutlaka incelerim. Basınca nasıl çıkar, renk sorun yaratır mı diye bakarım. Okunabirliğine bakarım. Font büyüklüğü bile bazen kritik olabiliyor. Aslında ilk baktığım şey görsellik ve yanlış anlaşılabilecek bir şey var mı oldu.*)

It is seen that Ms. Defne makes some corrections in the language for her students understand the tasks clearly. In addition to language, whether the text can be read clearly, the font sizes are also examined by Ms. Defne.

To sum up, Ms. Defne examined the difficulty level and content of the tasks within an activity while selecting activities or designing activities for her lessons.

4.2.1.2 Considering How the Activities will affect Students' Understanding of Concepts

Ms. Defne has previously stated one of her aproaches in teaching mathematics as focusing on concepts and the logic behind them: "*I try to emphasize concepts and the*

logic behind them." (Turkish version: Kavramlara, onların mantığının ne olduğuna ağırlık vermeye çalışıyorum.) The findings also indicated that Ms. Defne had some considerations regarding her students' understanding of the concepts. A summary of her considerations is given in the Table 4.5.

Table 4.5. Ms. Defne's Considerations Related to Students' Understanding of Concepts

Consideration
Considering relationships between concepts • Have the relationships between concepts have been adressed correctly?
Foreseeing what may cause misconception • Is there any issue which may cause misconception?
Representing concepts visually • Can the concepts be also represented visually?
Relating concepts with real life • Is relating concepts with real life possible for this concept?

Considering Relations between Concepts, Foreseeing what may Cause Misconceptions

According to Ms. Defne, the relation between the concept in consideration and the other concepts is as important as the concept in consideration. The data revealed that Ms. Defne checked the relation between the concepts in the activities she examined. For instance, for deriving the formula for the area of a rectangle Ms. Defne questioned the difference between a recatangle and a square. She noted that in the textbook, square is not given as a rectangle:

> "They learn it as two different shapes. They don't call a square, a recrangle but neither does the book. We discussed this a lot. I try to make them sense the relation but also fear that it would be above their level. Yet, when you teach them seperately, it's too difficult for them to get the relation." (Turkish version: *Ayrı şekiller olarak öğreniyorlar. Kareye dikdörtgen demiyorlar ama kitapta da böyle veriliyor. Çok tartıştık kendi aramızda da. İlişkiyi sezdirmeye çalışıyorum ancak üst seviye olur diye de korkum var. Ayrık ayrık verince ilişkiyi görmeleri iyice zor olabilir.*)

It is seen that she doesn't want her students to learn rectangle and square as two distinct shapes. To prevent this, she suggested to include squares in the practice part of the activity for calculating and comparing the areas of several rectangles. The suggested form of the task is given in the Figure 4.7.

> "I don't want my students to be able to say this is the area of the squares and this the rectangle's, I just want them to be able to understand the general view. May

be a rectangle with equeal side lenghts may be included and the point that a square is actually a rectangle may be made." (Turkish version: *Kareninki bu dikdörtgeninki bu istemiyorum öğrencilerde, daha genel durumu bilsinler istiyorum. Belki bunun içine kenar uzunlukları eşit bir şey koyarak karenin dikdörtgen olduğu vurgulanabilir.*)

2. Tabloda kenar uzunlukları verilen dikdörtgenlerin alanlarını karşılaştır.

I. Dikdörtdenin Kenar Uzunlukları	II. Dikdörtgenin Kenar uzunlukları	Alanları Arasındaki İlişki
3 cm, 5 cm	2 cm, 6 cm	
7 cm, 10 cm	8 cm, 9 cm	
8 cm, 8 cm	10 cm, 6 cm	
12 cm, 14 cm	11 cm, 13 cm	
4 cm, 11 cm	5 cm, 7 cm	
19 cm, 12 cm	13 cm, 13 cm	
22 cm, 16 cm	18 cm, 15 cm	

Figure 4.7. The Task of Comparing the Areas of Rectangles Whose Lengths are Given

Ms. Defne noted that not regarding square as a rectangle is a common misconception for students at this level. It is seen that she tries to foresee what may cause misconception. Ms. Defne questioned a similar point in the activity for deriving the formula for the area of a triangle. First the area of a square is calculated, and then

half of it gives the area of each congruent triangle obtained. The obtained triangles are isosceles. The task is given in the Figure 4.8.

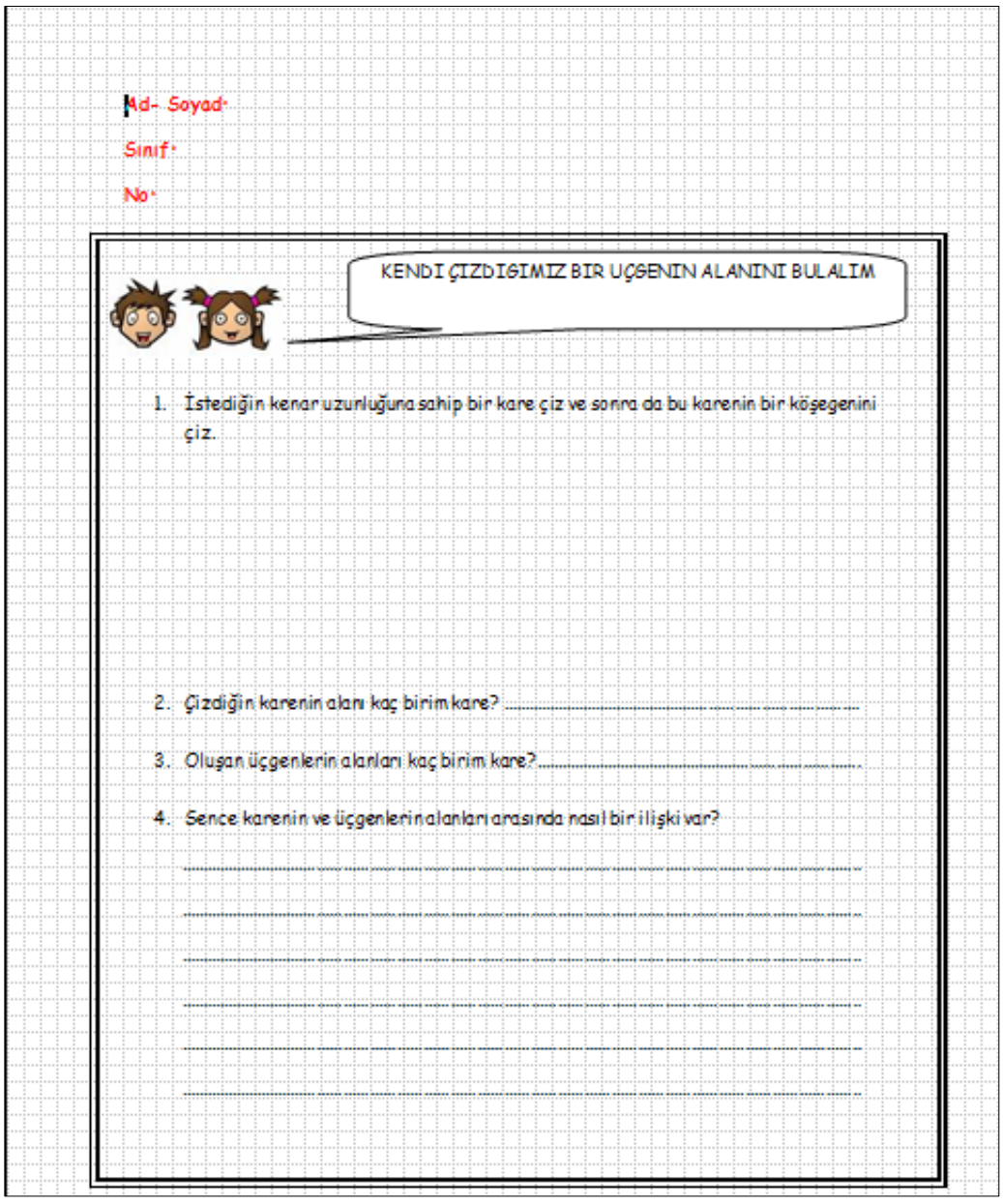


Figure 4.8. The First Version of Tasks before Ms. Defne's Comments

Ms. Defne suggested adding a second step. In the second step, the student calculates the area of a triangle which is not isosceles. Ms. Defne's comment is as follows:

> T: It starts with a square and then goes to a triange. We have one example. By using the sqaure, we get two isoscles triangles. In the next task, let's use a triangle which is not isoscles. So, may be instead of a square, a rentangle should be used. (Turkish version: *Kareden üçgene gidiyor. Tek örneğimiz var, kareden giderek ikiz kenar dik üçgen elde ediyoruz. Bir sonraki uygulamada ikiz kenar olmayan bir üçgen ile işlem yapıyor. Acaba kare yerine dikdörtgenden mi gidilmeli diye düşündüm.*)
>
> R: Shall we use first a square then a rectangle? (Turkish version: *Önce kare sonra dikdörtgen mi yapalım?*)
>
> T: No, we may start with a rectangle, starting with the more general may be useful. We are not only learning the area of isoscles triangles. A square may even be excluded. We may ask the fourth and the fifth questions for both a square and a rectangle to make a generalization. What is the relationship between a square and a triangle and a rectangle and a triangle. (Turkish version: *Yo doğrudan dikdörtgenden başlanabilir, daha genelden gitmek iyi olabilir. Sadece ikiz kenar dik üçgen alanı öğreniyoruz gibi bir anlaşılma olmasın. Kare hiç kullanılmayabilir bile. 4 ve 5.soruları hem kare hem de dikdörtgen için sorabiliriz. Genel bir çıkarım olması için. Kareyle üçgenin arasında nasıl bir ilişki var, kareyle dikdörtgenin arasında nasıl bir ilişki var.*)

The updated version of the task is given in the Figure 4.9. The fourth and fifth questions mentioned are about asking the relation between the area of the square and the triangles, and asking the relation between the area of the rectangle and the area of the triangles. The suggestion made can lead students to think about the lengths of the sides, which can make their understanding stronger.

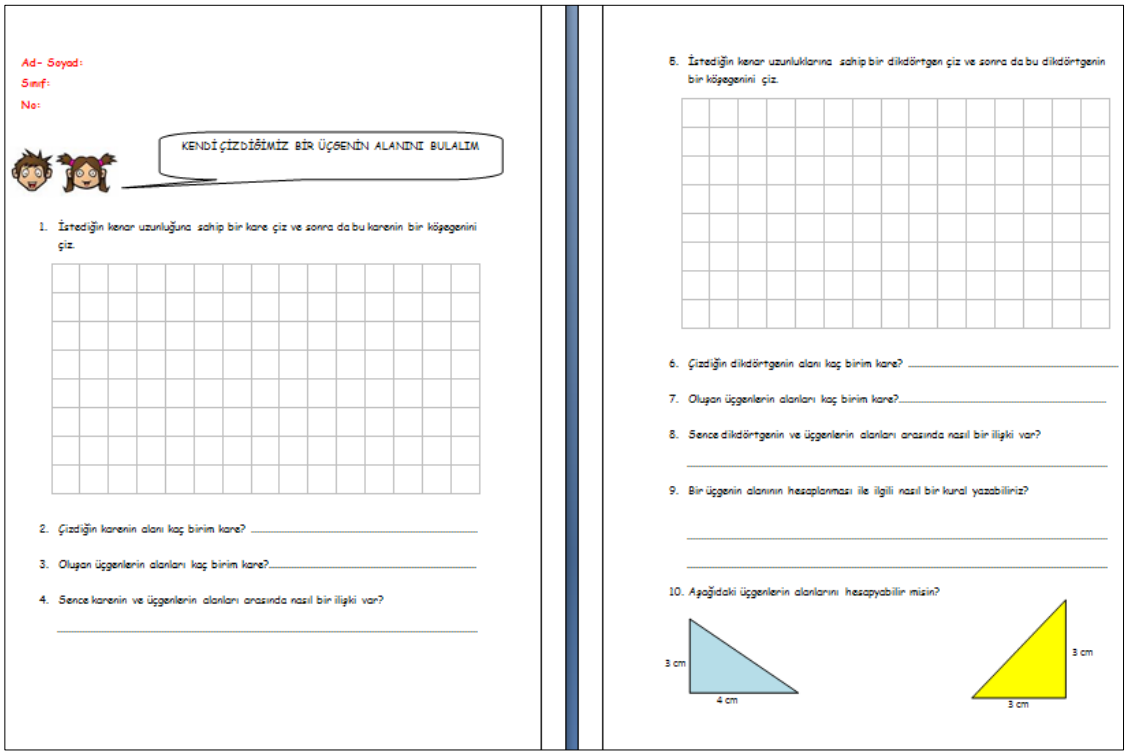


Figure 4.9. The Updated Version of Tasks after Ms. Defne's Comments

In another activity Ms. Defne stated that some students would have confusion between area and perimeter. The activity she examined was about solving a real-life problem which involves calculating the area of rectangles.

T: At this point, some of them will be confused about the perimeter and area. (Turkish version: *Burada çevre ve alanı karıştıranlar olacak.*)

R: What can be done to prevent this? (Turkish version: *Onu engellemek için ne yapılabilir?*)

T: Well, I think the unit squares help. When they see and count the unit squares, it's easier for them to see and compare perimeter and area. After the comparison, an activity to prevent this confusion may be included. (*Ben şey düşünmüştüm. Birim kareler işe yarıyor, somut olarak alanı ve çevreyi karşılaştırınca görüyorlar. Karşılaştırma bittikten sonra çevre ve alan karmaşasını engellemek amacıyla bir etkinlik olabilir diye düşünüyorum.*)

Ms. Defne suggested adding another activity for preventing area and perimeter confusion. In this activity, students will compare the area and perimeter of the given shapes on a grid area. According to Ms. Defne, making concepts concrete for students is important.

Relating the Concepts with Real Life

Ms. Defne has previously noted that her students often ask whether the concepts they study are used in real-life and she tries to consider this question while planning her lessons. Her comment was as follows: "*When I'm planning for instruction, I consider many things. Like I think of how can I answer if the students ask how they should suppose to use that subject in their lives.*" (Turkish version: Planlarken göz önünde bulundurduğum şeyler var. Öğrencilerden gelebilecek bu konu ne işime yarar sorusuna cevap arıyorum.)

In the real-life problem activity mentioned above, Ms. Defne stated that she liked its connection with real-life. She thought that it would create awareness: "*It's a nice activity. Our students are unaware of these real life connections. It's a good one to create this awareness.*" (Turkish version: Hoş bir etkinlik. Öğrencilerimiz bu tür günlük hayat kullanımlarından haberdar değil, farkındalık yaratması açısından güzel.)

In another activity which was brought by Ms. Defne, she emphasized the daily life raletion again. Her reason for this emphasis was that she wanted her students to think that such a case in the problem could really exist. This was a problem solving activity and the teacher was asked what she considered while choosing the problem:

> "First I checked if the problems demand finding the greatest common factor and least common multiple of numbers. I make sure the problem has a real life connection to make the students realize that this is something that they may face in real life. I try to make the real life connection in the first problem and as the subject was very appropriate for that, I didn't have any difficulty." (Turkish version: *Problem seçimini yaparken, problemlerin öncelikle ebob ve ekok kullanılmasını gerektirmesine baktım. Günlük hayattan bir problem olmasına dikkat ettim, çocukların gerçekte de böyle bir durumun olabileceğini algılayabilmesi için. İlk problemde günlük hayatla ilişkilendirmeye çalıştım. Zaten konu da buna uygundu, zorlanmadım.*)

In the problem, there is a nurse Merve and a doctor Ata. They are on duty on the same day. One of them is on duty every 6 days and the other is on duty every 8 days. It is asked to find how many days after they will be on duty together again.

In a similar way while examining the estimation activity, Ms. Defne suggested to give the estimation as relating with real life so that students need to do it. This was related to giving the task in consideration as a story instead of just giving the estimation problem.

> "Let's say we have a CD and we'll estimate the empty space. We are going to make a music CD, the lenght of the songs are equal. It must be something that really gives the sense estimation is necessary." (Turkish version: *Bir cd olsa, boş yer konusunda bir tahmin yapması gerekse. Şarkı cd'si oluşturacaktır. Şarkıların büyüklükleri aynı olur. Tahmini gerçekten hissettirecek bir şey olmalı.*)

The data from lesson observation notes also confirmed that relating the concepts with real life is a concern for Ms. Defne. For instance, in the activities about calculating the area of rectangles they had a discussion about where and how they used area units. "While buying a house, one can say that the house is 150 m^2", "The areas of countries and cities are expressed in km^2", and "The area of a tile is expressed as 22 cm x 17 cm" are the examples given by the students and Ms. Defne.

Representing Concepts Visually

The findings indicated that another important point for Ms. Defne was representing concepts visually. She thinks that more visuals mean more student attention: "*The more visuals are used, the more attention the students pay*." (Turkish version: Görsellik arttıkça öğrenciler için ilgili çekiciliği artıyor bence.) She wants the concepts to be visualized as far as possible. In the activity for deriving the formula for calculating the area of a parallelogram, Ms. Defne suggested to display an animation in which a parallelogram turns into a rectangle. She thought that this would make the activity visually more efficient. Considering her comment, the researcher asked for adding arrows to make moving the triangle more understandable. Then Ms. Defne stated that a transition step was necessary. Her comments can be seen in detail in the following conversation:

> "I think I can use worksheets for this activity and pass them to the students. The drawings are not necessarily be on the orijinal, there are dots. The students may construct the dotted parts at first and then keep going step by step by themselves." (Turkish version: *Bu ilk etkinliği kağıtları dağıtarak, kağıt üzerinde yapabilirim diye düşünüyorum. Bu çizilenler orjinalinde olmak zorunda değil, nokta noktalar. Önce elinde yapar öğrenci, paralelkenar üzerinde noktalı kısımları oluşturabilir. Öğrenci aşama aşama kendi yapabilir diye düşünüyorum.*)
>
> "May be a powerpoint presentation for the same activity will also be useful. Visually it would be better. Or may be, an extra step may be included, arrows

may be added. Definately an extra step is needed for a slight transition." (Turkish version: *Belki burada aynısını power point animasyon şeklinde de olsa iyi olabilir. Görsel olarak iyi hale gelebilir. Ya da ara bir step konulabilir, oklarla gösterilen. Kesinlikle ara bir geçiş gerekli anlaşılması için.*)

In another activity, Ms. Defne emphasized using visuals again. In this activity, students have a chance to explore the prime numbers. They are given a table and asked to find the multiples of integers in the table and put a cross on them. At the end, what they have are the prime numbers. This table is known as "Riddle of Erosthenes". The teacher was asked how she made the decision to use an activity for this lesson. Her answer is as follows:

R: So, how did you decide that you should use an activity for this lesson? What was your motive? How would it be if you didn't use it? (Turkish version: *Peki etkinlik kullanmalıyım kararını nasıl verdiniz? Bu noktada belirleyici ne oldu? Bu dersinizde etkinlik kullanmasaydınız da olur muydu?*)

T: Actually, I may also say that these are the prime numbers and these are not. This is also possible for sure. Yet, this table will visually stay in the students minds. (Turkish version: *Aslında şunlar şunlar asal sayılardır, bunlar da değildir gibi de işlenebilirdi bu ders. Ancak şu tablo öğrencilerde görsel olarak da akıllarında kalacak.*)

It is seen that more than one method can be used to make an activity stronger. This is related to the fact Ms. Defne has more than one consideration and she tries to make the activities stronger in all aspects.

4.2.1.3 Considering the How the Activities will affect Students' Motivation

The data revealed that, related to student learning one of Ms. Defne's considerations was about increasing motivation. Ms. Defne has previously stated that students should be allowed to perform something to be able to learn better. The findings indicated that this was her general approach about motivation. More specifically, a motivating start activity, making students feel the necessity for doing a task, making students feel satisfied after doing a task and trying to include interesting things were her consideations related to student motivation. A summary of these considerations is given in the Table 4.6.

Table 4.6. Ms. Defne's Considerations Related to Increasing Motivation

Consideration
Start/Entry Activities • How can I motivate my students at the beginning? • Can this start activity motivate them?
Consider necessity • Will my students feel necessity to perform the given task or will it be just compulsory work for them? • Can I start with an example which emphasizes need?
Consider satisfaction • Will my students be satisfied when they comple this task?
Include interesting things • Will this activity call for my students' attention? • Can I include insteresting things; can I include more visuals to increase attractiveness?

Ms. Defne has already previously defined the aim of start/entry activities as calling attention and increasing motivation. "*Starting activities motivates and attracts the students.*" (Turkish version: Giriş etkinliğinde motivasyon artırma, ilgi çekme var.) In the activity brought by Ms. Defne for the lesson on prime numbers, the start is made with a story. She stated that she wanted to use it as a start which calls for attention. In the story, numbers are introduced as brothers. Ms. Defne's comment is as follows: "*There is a story at the begining, so I'd liked to use it when I start to take their attention.*" (Turkish version: Başlangıçta bir hikaye var. Ben onu giriş için kullanmak istedim, dikkat çekmek için.)

While Ms. Defne was examining another activity, she commented on starting with an example which emphasizes need. She also noted that it should be impressive. This activity is about estimation and Ms. Defne thinks that when students don't feel necessity for estimation then the given task is just compulsory work for them. Her comment is as follows:

> "Let's say we have a CD and we'll estimate the empty space. We are going to make a music CD, the lenght of the songs are equal. It must be something that really gives the sense of estimation is necessary. Othervise, it's just too heavy a burden for them. They need a striking example they will really operate." (Turkish version: *Bir cd olsa, boş yer konusunda bir tahmin yapması gerekse. Şarkı cd'si oluşturacaktır. Şarkıların büyüklükleri aynı olur. Tahmini gerçekten hissettirecek bir şey olmalı.Yoksa angarya gibi geliyor onlara. Gerçekten işlem yapacakları çarpıcı bir örneğe ihtiyaç var girişte.*)

Ms. Defne notes that she previously made estimation necessary by keeping the time limited for addition. Then students used estimation to make the addition operations quickly. But this kind of estimation necessity is defined as "just operational" by her and she emphasizes the importance of necessity for estimation. In the following conversation, her comments can be seen in detail.

> "We did with the addition, by limiting the time and making them to estimate. Yet this is still operational. Must find something that really makes it necessary to estimate." (Turkish version: *Toplama işleminde yapmıştık. Zamanı kısıtlı tutarak, tahmin yapmak durumunda bırakarak yapmıştık. Ama bu işlemsel oldu. Gereklilik hissettirecek bir şey olmalı.*)

Another point related to motivation for Ms. Defne is trying to include interesting things in the activities and she thinks that visuals increases being interesting. According to her, students find visual topics more interesting as in the case of geometry. She states the importance of visualization as follows: "*Their use of visuals is different. The more visuals are used, the more they are attracted in the subject. Therefore, subjects like geometry is more intresting for them.*" (Turkish version: Görsellikleri arasında farklılık var. Görsellik arttıkça öğrenciler için ilgili çekiciliği artıyor bence. Geometri gibi görsel konular daha cazip geliyor.) She stated that in the problem solving activity she used a nurse image but her students asked what the image and the problem had to do.

Regarding including interesting things in the activities, Ms. Defne also critisized the problem in the problem solving activity not being a part of students' lifes: "*If a nurse and a doctor were not used, it would be more interesting, for they are not a part of their*

lives. May be, the dialogues in the problem can be dramatized to attract them." (Turkish version: Hemşire ve doktor olmasaydı daha ilgi çekici olabilirdi, onların hayatlarından bir parça değil çünkü. Problem metnindeki konuşmaları dramatize etmek belki daha ilgili çekici kılabilir.) It is seen that the things to make an activity interesting for students need not be directly related to the aim of the activity.

In addition to being interesting, whether completing a task will make students feel satisfied was also a consideration for Ms. Defne. For the estimation activity, she questioned whether the given estimation methods will be satisfactory for her students or not. She noted that this activity would give different results in different classrooms. When she was asked what she meant by different results, she explained it as using different estimation methods. Her detailed comment can be seen in the following conversation.

> R: We said that the results may differ in different classes. What exactly that means? (Turkish version: *Biraz önce sonuçlar sınıflarda farklı olabilir dedik, tam olarak sonuçların farklı olması ne demek acaba?*)
>
> T: One is, to focus on different estimations. Will this estimation lead us to a method or will this one satisfy the students. (Turkish version: *Farklı tahminlerin üzerinde durup durmama bir tanesi. Buradakinden farklı bir yöntem çıkacak mı yoksa buradakiyle tatmin olacaklar mı?*)

To sum up, it is seen that learner motivation is an important consideration for Ms. Defne. An interesting start, making students feel necessity for the given tasks, their

feeling of satisfaction completing a task, trying to include interesting things for example with more visuals are the main focus of her considerations.

4.2.2 Considerations based on Organization of Teaching

Regarding Ms. Defne's pedagogical reasoning while selecting or designing activities, the interview transcripts were coded to identify her decisions which take "the teacher" into consideration. Each decision which takes the teacher into consideration was coded and the findings indicated that the decision and considerations were mostly related to organization of teaching. In this category, the teacher's decisions and considerations related with activities are examined in terms of how she organized her teaching. More specifically, the data revealed that those decisions and considerations were related to objectives of the lesson, lesson flow, purposes of the activities, time use for an activity, and materials to be used are examined.

4.2.2.1 Considerations based on the Objectives of the Lesson, Lesson Flow and Purposes of the Activities

Alignment of an Activity with the Learning Objective

Before arranging the interviews with Ms. Defne, she was asked about the topics she will cover in the following weeks. The researcher was planning to bring activities which were about the topics the teacher would ask for. Instead of topics, Ms Altın gave the learning objectives of the lessons and asked for the activities to cover those learning

objectives. The learning objectives are stated in the national curriculum published by the Ministry of Education. The list of activities Ms. Defne brought is given in Table 4.7.

Table 4.7. Learning Objectives of the Lessons for Which Ms. Defne Examined Activities

Lesson Duration	Learning Objective
2 hours	Determines the area of rectangular and square regions in square and square meter.
1 hour	Determines the area of a parallelogram.
1 hour	Determines the area of a triangle.
2 hours	Estimates the multiplication of two numbers which have 3 digits at most, and compares his estimation with the actual result of the multiplicaiton.

The data analysis revealed that Ms. Defne's first consideration about a learning activity is its alignment with the learning objective of the related lesson. Recall that in the previous section "Ms. Defne's General Views about Teaching Mathematics and Activity Use in Lesson", Ms. Defne emphasized that an activity have a purpose and this purpose should align with the learning objective or objectives of the lesson. This was derived from her understanding of a learning activity: "*An activity should have a purpose at the first place. When the teacher looks at it, s/he should sense what the target to be reached is. It should fulfill the learning objective*." (Turkish version: Bir kere bir etkinliğin bir amacı olması gerekli. Neye ulaştırmak istediğini öğretmenin görünce sezmesi gerekli. Kazanımla örtüşmesi gerekli.) Alignment with the learning objective of the lesson is one of Ms. Defne's considerations.

The data also revealed that not only the learning objective of the current lesson but also the learning objectives of the previous and the following lessons affect the content of the activities. Ms. Defne stated that:

> "The learning objective affects the activity or the activities by itself but the previous and the following objectives are also effective. Therefore, considering the following lesson, I try to design a closure that is also related to the next lesson's objective. But for the main activity, being stick to the objective is important." (Turkish version: *Kazanım etkinliği veya etkinlikleri tek başına etkilediği gibi önceki ve sonraki kazanımlar da etkili. Önceden öğrenilmiş ve kullanılacakları giriş etkinliğine almaya çalışıyorum. Bir sonraki derste ne işlenecekse kapanış etkinliğinde onu da kapsayan şeyler tasarlamaya çalışıyorum. Ana etkinlikte ise kazanımla örtüştürmek önemli.*)

It is seen that while explaining the effect of learning objective on the activities, Ms. Defne used a term "main activity". She emphasized the alignment of the learning objective especially with the "main activity". She also used the terms "start activity" and "closure activity". Previously learned concepts which are prerequisite for the current lesson are included in the "start activity" and the content of the next lesson are considered for the current lesson activities too. It is seen that Ms. Defne classifies activities according to their use in the flow of the lesson like "start activity", "closure activity" and the "main activity".

According to Ms. Defne, the flow of a lesson has some stages and she tries to progress without any disconnection: "*Actually, there are stages in a lesson.I try to tie up*

everything without letting any gaps. Start activity may be a song, a connection with previous subjects, entertaining questions, a joke or a quotation. The circle song for example, in and out of the circle and you can be on it. Then there is the main activity and the reinforcement." (Turkish version: Aslında aşamalar var işlenişte. Kopuk olmadan bağlamaya çalışıyorum. Giriş şarkı olabiliyor, eski konularla bağlantı olabiliyor, eğlenceli sorular, fıkra, alıntı. Çemberin içi dışı şarkısı, bir de üstünde olabilirsin. Ana etkinlik var, sonra pekiştirme.)

Ms. Defne's Description of a Typical Mathematics Lesson

For a better understanding the stages in the flow of a lesson and her classification of activities, the interview data and the lesson notes were examined to identify Ms. Defne's a typical lesson. A summary of her description is given in Figure 4.10. She describes a typical lesson as follows:

> "In a typical math class I teach… First, I try making an interesting entrance. A connection with the previous subject may be, a thing that will make them curious about the new subject. After spending some with that, I move on to the real subject. Depending on the nature of the subject, I try to include as many activities as I can. Then we have the reinforcement, after the conception activity." (Turkish version: *Tipik bir matematik dersimi tarif edecek olursam, öncelikle ben ilgi çekici bir şekilde başlamaya çalışırım. Önceki konuyla bir ilişkilendirme olabiliyor, yeni bir konuyu merak ettirecek bir şey olabiliyor. Onunla biraz vakit geçirdikten sonra asıl konuya geçiyoruz. Konunun yapısına*

göre mümkün olduğunca etkinliklerle yapmaya çalışıyorum. Bundan sonra pekiştirme yapıyoruz, kavrama olduktan sonra.)

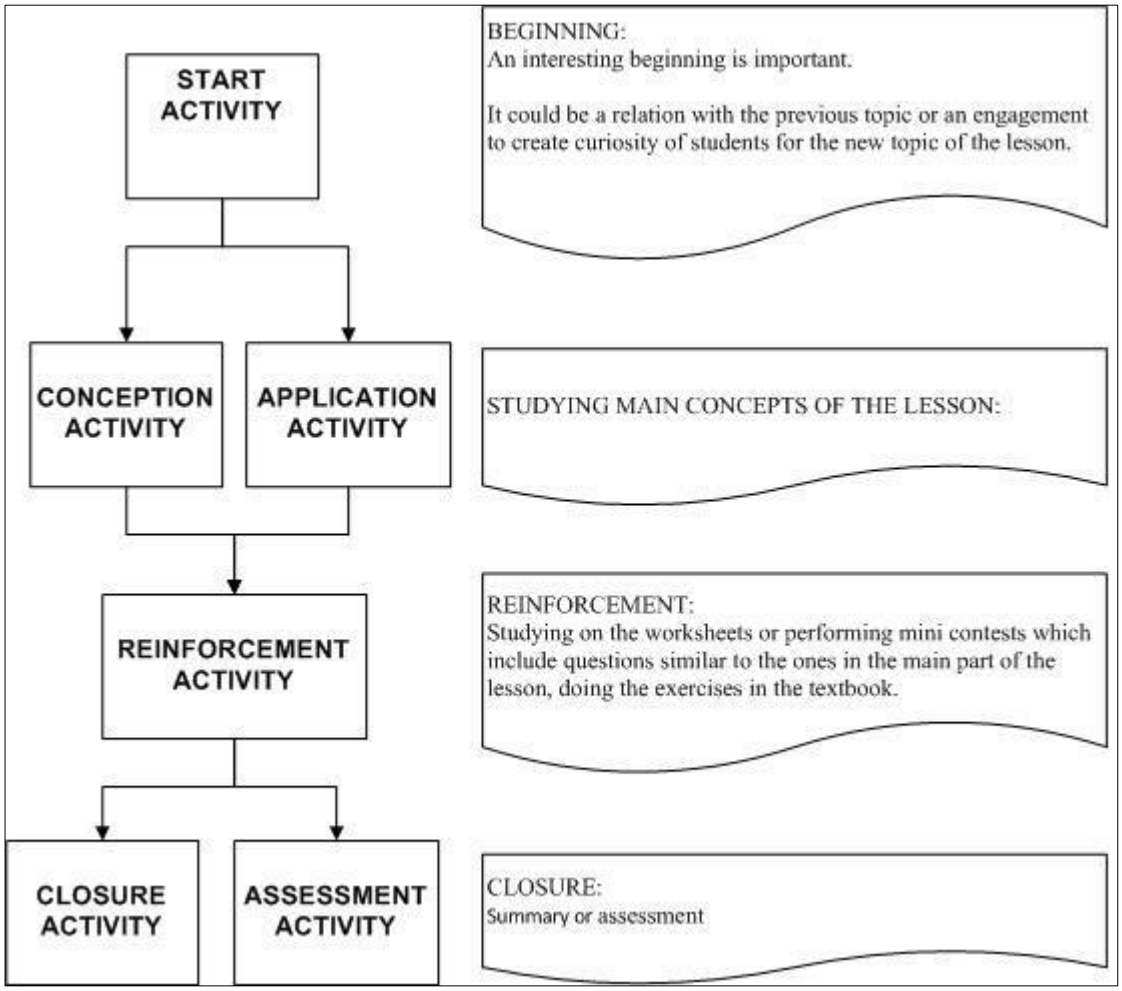


Figure 4.10. Ms. Defne's Organization of a Lesson into Stages

The data obtained from lesson observation notes also confirmed Ms. Defne's typical lesson description. The flow of one of her observed lessons the lesson is given in Table 4.8.

Table 4.8. The Flow of One of Ms. Defne's Lessons Examined

Activity Type	Description
Start Activity	Discussion on a story which is about the fellowship of numbers. If a number has divisors except the number 1 then, those numbers are the brothers of that number.
Conception Activity	(Erotosthenes Kalburu) Identifying and then marking the multiples of given numbers in 1-99 table. Making students notice the numbers which have no divisor except the number 1.
Reinforcement Activity	Playing a game – Dev/Cüce.
Closure Activity	Each student summarizes what he's learned in one sentence.

According to the data obtained from the interview transcripts, an interesting beginning was important for Ms. Defne. This could be a relation with the previous topic or an engagement to create curiosity of students for the new topic of the lesson. In the following example given by her, the concept of perimeter and finding the perimeter of previously known shapes are recalled for the lesson on the circumference of a circle:

> "This week for example, in one of my classes we dealt with perimeter of the circle. First we talked about the concept of perimeter. It doesn't matter what shape the object is, perimeter means the same thing and we remembered the perimeters of the square, rectangle and triangle." (Turkish version: *Bu haftaki derslerimden bir örnek verecek olursam, bir dersimizde çemberin çevresiyle ilgilendik. Önce çevre kavramı hakkında konuştuk. Nasıl bir şekil olursa olsun*

çevrenin aynı şey demek olduğunu konuştuk. Bildikleri şekiller olan, dikdörtgen ve üçgenin çevresini hatırladık.)

She told that after spending some time at the beginning, they focused on the topic of the lesson. This stage of the lesson is focused on the main concepts of the lesson. Ms. Defne underlined the importance of making students understand the concepts. This stage of the lesson for which the start has been explained below is as follows:

> "The main activity of the lesson was an outdoor activity in which we explore Pi. My aim was to let them experience by themselves that it is true in different cases. We calculated the toilet paper's perimeter, Duxtil box's. We found that the ratios are pretty close, something like 3. If we don't know the perimeter, then we may use diameter we said and move on to the formula." (Turkish version: *Pi ile bahçede yaptığımız bir keşfetme etkinliği idi, dersin ana kısmı idi. Farklı şekillerde bunun doğru olduğunu keşfetmelerini amaçladım. Tuvalet kağıdının çevresini hesapladık. Duxtil kutusunun çevresini hesapladık. Baktık oranlar birbirine çok yakın değerler. 3 gibi bir sayı. Çevresini bilmiyorsak çapından bulabiliriz deyip formüle geçtik.*)

According to the flow given in figure 4.10, after studying on the main concepts of the lesson, the reinforcement section of the lesson starts. Studying on the worksheets or performing mini contests which include questions similar to the ones in the main part of the lesson, doing the exercises in the textbook are the examples of what is going on in the class given by Ms. Defne for reinforcement section of her lessons.

The last section of her lesson is the closure. Ms. Defne stated that this could be a summary or an assessment. After doing these, she tries to give some clues about the next lesson to relate the lessons with each other. The following conversation is about how Ms. Defne describes the reinforcement and closure sections of a lesson and examples of what is done in each section.

> "For the reinforcement, there are plenty of things to be done. Worksheets, textbook, mini contests, questions make the subject to be seen in different perspectives. Sometimes, the reinforcement activity can be done in another lesson. If I will include something new to the reinforcement, first I shortly go over the subject. After the reinforcement, I have the closure. This may be a summary, an evaluation. After all these, I try to give them some tips about the following subject. I try to make connections." (Turkish version: *Pekiştirme kapsamında farklı şeyler yapılabiliyor: çalışma kağıtları, kitap, mini yarışmalar yapabiliyoruz, konuyu farklı boyutlarıyla ele alabilecek sorular içeren, bazen pekiştirme etkinliklerini başka bir derste yapabiliyoruz. Pekiştirmede yeni bir şey de ekleyeceksem öncekilerin tekrarını yapıyorum önce. Pekiştirmeden sonra kapanış yapıyorum. Bu bir özet olabilir. Tek bir değerlendirme olabilir. Bunları yaptıktan sonra bir sonraki konu hakkında da ipucu vermeye çalışıyorum. İlişkilendirme yapmaya çalışıyorum.*)

It is seen that Ms. Defne puts the main activity in the center of her lesson flow. According to her, main activity leads the lesson to the purpose of the lesson, namely the learning objectives: "*Main activity is the one that makes the lesson reach its aim. This is*

the part that is related with the objective." (Turkish version: Dersin ana amacına ulaşmayı sağlayan kısım ana etkinlik. Kazanımla ilgili kısım.)

Ms. Defne's "main activity" use can also be seen in her examining set of activities brought by the researcher. For instance, Ms. Defne identified that activity, which is about finding the formula for the area of a rectangle, as the "main activity" of the related lesson: "*It may be used as the main activity that is related with the objective.*" (Turkish version: Kazanımla ilgili ana etkinlik olarak kullanılabilir.) In this activity, firstly students are expected to find the area of two squares by counting the unit squares within them. Then they are expected to find the area of two rectangles by using the same logic without unit squares.

While examining two activities about estimating the result of multiplication of two numbers, Ms. Defne made decisions for which one to use first, which one should be the "conception activity" and which one should be the "assessment activity". Ms. Defne commented on their type as follows: "*The one with the music band may be used as an assessment activty after the others. As the other one gives the method, it can be used as the conception activity. If we don't satisfy with the other activity, then we can use this one.*" (Turkish version: Müzik grubuyla ilgili olan diğerinden sonra değerlendirme etkinliği olabilir. Diğeri metodu verdiği için kavrama etkinliği olabilir. Bir önceki etkinlikten tatmin olmazsak bu da kavrama olabilir.) Ms. Defne classified the second activity as "conception activity". Her consideration for this was that estimation methods were given in this activity. This activity was about identifying the estimation methods for the given multiplications and their estimations. Since the methods are not explained,

the students are expected to explore the methods. The other activity, the one about answering a real-life question which asks for how to estimate the result of collected money from a concert, was classified as "assessment activity" by Ms. Defne. In this activity, three answers are given and the student is asked which one is the closest. To answer the questions, students need to know the estimation methods.

The data revealed that the learning objective of the lesson is a consideration for Ms. Defne. The findings also indicated that she classified activities depending on their purposes and their order in the flow of the lesson and she makes decisions regarding the purpose and order of an activity in the flow of the lesson. According to her, the activity which is the most aligned with the learning objective is the "main activity" of the lesson. "Conception" and "application" activities are the main activities of a lesson in which main concepts are given and related applications are made. Other than conception and application activities, an activity can be a start activity, an assessment activity, a reinforcement activity or closure activity depending on its use in the lesson flow and its purpose.

4.2.2.2 Considering Time Use for an Activity

Ms. Defne checked the length of each activity brought by the researcher. The data revealed that the length of an activity and how much time to use for an activity were the considerations she made. While making decisions about the activities, she considered those two points. For instance, in the activity about deriving the rule for a triangle, the length of the activity was a consideration for her. Ms. Defne questioned whether both the task for calculating the area of the rectangle and the task for calculating the area of the square would be included or not. Her detailed comment can be seen in the following conversation:

> R. Shall we do the square first and the rectangle next? (Turkish version: *Önce kare sonra dikdörtgen mi yapalım?*)
>
> T: No, we can start with the rectangle; it may be helpful to start with the more general. We may even skip the square, because the length of the activity is also important. It shouldn't be too long. (Turkish version: *Yo doğrudan dikdörtgenden başlanabilir, daha genelden gitmek iyi olabilir. Kare hiç kullanılmayabilir bile, uzunluk da önemli. Bir etkinliğin çok da uzun olmaması gerekiyor çünkü.*)

It is seen that an activity should not be too long. In the activity above, its length was related to the number of tasks within it. Ms. Defne also noted that she might spend more time while applying an activity depending on its topic. Then the activity may be longer. This was derived from the following comment:

"The time may be limited. There are 2 course hours for prime numbers. The thing that affects the time in here is divisibility rule for example; it may take some time, if there are misconceptions. Duration may be flexible. I'd like to spend time if there is any confusion here, in divisibility rules studying prime numbers." (Turkish version: *Süre olarak, daha kısa süre de verilebilir. 2 ders saati var toplamda asal sayılar için. Burada süreyi etkileyen bölünebilmeyle ilgili kısım, o değiştirebiliyor. Kavram yanılgıları falan da varsa. Süre esnek tutulabilir. Asal sayılar konusunda bölünebilme önemli, burada sıkıntılar varsa onları çözebilmek adına zaman ayırmak isteyebilirim.*)

This activity was about exploring prime numbers. Ms. Defne stated that she thought that it might take long since it involved a set of questions and she needed to discuss on those questions with her students. Each question is about one divisibility rule. Students first determine the multiples of 2, and then they determine the multiples of 3. When they need to determine the multiples of 4 they have a discussion about whether 4 and 2 have common multiples.

The data from the lesson observation notes also confirmed the time Ms.Altın used for the prime number activity. She planned to allocate 2 class hours for the prime number lesson. The discussion on finding the multiples of given numbers took one class hour. Especially for finding the multiples of 7 and 11, they spent more time compared to the other numbers. Ms. Defne explained that finding multiples of 7 and 77 were not given in this grade but she used in the activity since she thought that students could find the multiples by counting.

It can be concluded that not using long activities is a consideration but how much time should be spent on an issue is the major consideration for Ms. Defne's reasoning process. The findings indicated that the same consideration was observed while examining the problem solving activity. Ms. Defne stated that "*They are a bit slow in problem solving so I think the duration will be long. Yet, after the first problem they will gain speed. This isn't a thing related with the activity; it's just the students' problem solving skills.*" (Turkish version: Problem çözmede bir yavaşlık söz konusu. Süre uzun olacak diye tahmin ediyorum. Ancak birinci problemden sonra hızlanacaklardır. Etkinlikle ilgili bir durum değil tamemen problem çözme becerileriyle ilgili.) It is seen that the reasoning related to time to be used for this activity was also about Ms. Defne's knowing her students problem solving skills.

The data from lesson observation notes and the transcripts of the interview after the activity was applied revealed that time use for the activity was as Ms. Defne expected: "*The activity took quite a long time as I expected. I don't think of it as a waste of time. The first examples of the subject are always the most important ones for me.*" (Turkish version: Etkinlik beklediğim gibi yavaş geçti. Zaman kaybı olarak değerlendirmiyorum, konunun ilk örnekleri benim için hep çok önemli olmuştur.) It is seen that for the first examples of a topic Ms. Defne can allocate more time.

4.2.2.3 Considering Sources and Materials to be used

One of the sources for Ms. Defne's lessons is the textbook. Ms. Defne stated that they used the textbook suggested by the government in her lessons since she liked the

variety of questions within it: "*We use the textbook of the Ministry of Education, every student has one. It's good considering the variety of the questions.*" (Turkish version: MEB kitabını kullanıyoruz, her öğrencide var. Soru çeşitliliği bakımından hitap ediyor.)

The data revealed that in addition to deciding the questions to be included in an activity, Ms. Defne takes into consideration the textbook also for finding any different approach or example: "*I check the textbooks to see if there is any new or diffent approach.*" (Turkish version: Kitaplarda farklı bir şey var mı, ele alınmış mı diye bakıyorum.) For the prime number activity, Ms. Defne was asked how the concept was given in the textbook.

> R: The activity that you're going to use today, is it in the textbook? (Turkish version: *Bugün sınıfta kullanacağınız etkinlik ders kitabında yer alıyor mu?*)
>
> T: Not the exact one, a similar one may be we can say. But the riddle of Eratosthenes is not a changing thing. It's not a original activity in fact. I used these worksheets in 2005-2006 as well. I used this one as a table of 99, and this is something that I use to start. In short, I used the same general resources when I was preparing for the lesson. (Turkish version: *Ders kitabında aynen yoktu. Benzeri diyebiliriz. Ancak şöyle bir durum var, bu Erastotens kalburu pek değişen bir şey değil. Asal sayılar denince akla geliyor. Kullanımda basamaklar ve sıralama değişse de çok kullanılan bir etkinlik. Özgün bir etkinlik değil. Ben şu an elimdeki çalışma kağıdı formatında 2005-2006 yılında kullanmışım. Şunu 99'luk tablo olarak kullandım, şu da derse giriş amacıyla kullandığım bir şey. Yani daha önce de hazırlarken genel kaynaklardan yararlanmışım.*)

The data revealed that she also considered the materials in hand for selecting or designing an activity: "*I think of the past, looked if there is something that I can use from my previoues work.*" (Turkish version: Daha önceden neler yaptığımı düşündüm. Önceden hazırlamış olduklarımdan işime yarayacaklar var mı diye baktım.)

4.3 Summary of the Findings

In this section, the summary of the findings are given with related considerations which Ms. Defne made in her pedagogical reasoning process. The summary of the findings is given in Table 4.9.

Table 4.9. Summary of Ms. Defne's Considerations in her Pedagogical Reasoning Process in Selecting Activities

Considerations	
Based on Students' Learning	Based on Organization of teaching

• Characteristics of the tasks within the activities
  o Difficulty level of a task
  o Content of task
• Students' understanding of concepts: their conceptions and misconception
  o Considering relationships between concepts
  o Foreseeing what may cause misconception
  o Representing concepts visually
  o Relating concepts with real life
• Student motivation
  o Start/Entry Activities
  o Consider feeling of necessity
  o Consider studentsatisfaction
  o Include interesting aspects
	• Objectives of the lesson, lesson flow, purposes of the activities
	• Time use for an activity
	• Sources and materials to be used

CHAPTER V

CONSLUSION, DISCUSSION, AND IMPLICATION

The purpose of this study was to explore Ms. Defne's pedagogical reasoning on learning activities. This chapter addressed conclusion and discussion of the research findings and implications for the further researcher studies. In other words, the important points mentioned in the results part reviewed and discussed with references to previous studies in the literature. Recommendations for the mathematics teacher educators and implications for further studies were stated in addition to the limitations of the research study.

Conclusion of the research findings were discussed under two main sections. In the first section, Ms. Defne's pedagogical reasoning process on activities was discussed in terms of her considerations regarding how they will affect students' learning with references to the previous studies. In the second section, Ms. Defne's pedagogical reasoning process on activities was discussed in terms of her considerations regarding how to organize her teaching.

5.1 Considerations based on Students' Learning

Ms. Defne's thoughts about learning activities summarized in this section are discussed in three groups. The first was related to characteristics of the tasks within the activities, the second was considerations related to students' understanding of concepts,

such as their conceptions or misconceptions, and the last one was considerations related to students' motivation.

The results revealed that Ms. Defne considered various issues related to a task or tasks within an activity. Those were mainly related to the difficulty level of a task and content of a task. Ms. Defne questioned what would be easy or difficult for her students and she preferred to proceed from easy to difficult within an activity. While examining the tasks within an activity, she though that one of the tasks would be easy for her students since the task was familiar to the students. Even when she believed that a task was easy for her students, she wanted to use it for recall purposes. Then, such tasks shift from being the main idea of the activity to a supporting role. This consideration affects her decisions regarding the activity type. For instance, if the activity is an enhancement activity, then the students will be familiar with the task and this will affect its difficulty level.

Another point Ms. Defne emphasized was that difficulty level of the same task can be different students. For instance low achievers feel more comfortable with having an example in hand for a task in the related activity, whereas high achievers may find this very easy and prefer to find their own ways for performing the task. Therefore, checking the difficulty level of a task for students at different achievement levels is important.

The analysis also revealed that for the tasks which Ms. Defne identified as easy for her students, she tried to increase the difficulty level of the tasks by including challenge where possible. Regarding increasing the difficulty level of a task, Ms. Defne

checks the numbers involved in the related tasks too. According to her, the type and size of the numbers affect the difficulty level of a task since making operations with greater numbers or decimals is more difficult for student. Another way of increasing the difficulty level of a task suggested that Ms. Defne was not giving the methods at first and asking students to find out them. According to her, this increases the level since it leads students to think more deeply.

For problem solving activities, the results revealed that Ms. Defne chose problems at different difficulty levels. It was seen that increasing the number of operations and the number of relations were a way of increasing the difficulty level of task for Mr. Altın.

Finally, Ms. Defne noted that without changing a task, it is also possible to increase or decrease the difficulty level students experience during the implemention process, such as by letting students solve the problems by themselves instead of solving the first problem together and then letting students to solve the similar ones by themselves.

Regarding the tasks within an activity, the existing literature indicates that tasks within an activity is a major consideration in teachers' decision making. For instance, students' task related ability was reported as a feature that an activity should have in Clark and Yinger's (1982) study. In addition, in Zahorik's (1982) study where teachers were asked to describe successful and non-successful activities, task difficulty was reported to be given as a reason for non-successful activities by most of the teachers. However, based on the literature, we know little about the nature and the details of

teacher considerations regarding tasks within an activity. This study provides some details about teachers' reasoning about the characteristics of tasks within the activities.

Ms. Defne's pedagogical reasoning process also included some decisions regarding the content of a task. Those were mostly related to the type of numbers and nature of shapes used, the nature of the questions asked, and language used. She examined the shapes within the tasks in terms of how students will perceive them. For instance, while examining a task which asks for calculating the area of a rectangle given at two different orientations she though that her students would perceive them as different rectangles. Similarly, questions were examined carefully whether they would be understood or not. The data revealed that asking questions for which students can write reasons was an important consideration for Ms. Defne. Moroever, whether the questions will give an opportunity for discussion was also important for her. Last, Ms. Defne examined the language used. According to her, language may affect students' understanding of what the task is asking for them. In addition to language, legibility of the text and the text size were also examined by Ms. Defne. While explaining her decisions, she gave references to her previous experiences.

Another group of considerations made by Ms. Defne was related to how the activities will affect students' understanding of concepts. The analysis revealed that Ms. Defne considered the relationships between concepts, tried to foresee what may cause misconceptions, representing concepts visually, and related concepts with real life. This finding of the study was consistent with Shulman's (1987) model for pedagogical reasoning and action. Shulman (1987) states that a teacher considers what conceptions,

misconceptions, expectations, difficulties, or strategies might influence the ways students' understanding in the adaptation stage of the process, which is a sub process in the transformation stage. On the other hand, the analysis revealed that making students understand the concepts and the logic behind them was a major concern for Ms. Defne. She believes that mathematics is a tool for teaching concepts and skills. I can say that parallel to one of Ms. Defne's major concerns regarding teaching mathematics, her pedagogical reasoning process included considerations of how activities will affect students' understanding of concepts.

The last group of Ms. Defne's considerations in this section is related to increasing students' motivation. The analysis revealed that an interesting start, making students feel the necessity for the given tasks, their feeling of satisfaction when completing a task, trying to include interesting things for example with more visuals are the main focus of her considerations. This finding was expected since learner motivation is of high interest in education.

Similar findings in the literature support the importance of considering learner motivation in pedagogical reasoning. For instance, Shulman (1987) suggested to consider students' motivation in his model for pedagogical reasoning and action. It is given under the adapting and tailoring to students' characteristics stage, which is a sub process of transformation stage in the model. Similarly, Clark and Yinger (1982) reported that teachers regarded student interest and student enjoyment as the features which an activity should have. Zahorik (1982) emphasized that teachers are concerned with motivation because they see it as a prerequisite for learning and an indication that

learning will follow naturally. In his study, the primary reason given for successful activities was that they were motivational and majority of the teachers described non-successful activities as the ones which either failed to motivate, or insufficiently motivated students. Different from these studies, Sanchez and Llinares (2003) reported that student teachers participated in their study took into account the idea of "motivation" but this idea was always used in a general manner and without any more specification. Thus, it can be concluded that motivation is an important issue in learning, but the specifications regarding how it can be provided should be given.

5.2 Considerations based on Organization of Teaching

In this section, Ms. Defne's pedagogical reasoning process on learning activities was discussed in relation to how she organized her teaching. More specifically, Ms. Defne's decisions and considerations related with activities are discussed in terms of how she organized her teaching. The analysis revealed that those decisions and considerations were related to objectives of the lesson, lesson flow, purposes of the activities, time use for an activity, and materials to be used.

The analysis revealed that Ms. Defne's first consideration about a learning activity is its alignment with the learning objective of the related lesson. The data also revealed that not only the learning objective of the current lesson but also the learning objectives of the previous and the following lessons affect the content of the activities. Ms. Defne makes the connection between the learning objectives of the previous,

current, and following lessons by including the necessary information in the starting and closure activities.

According Ms. Defne, an activity should have a purpose and this purpose should align with the objectives of the lesson. This finding is parallel to the view which underlines the objective-achieving function of activities (Zahorik, 1982). In this view, it is believed that activities must be directly related to objectives and when the function of learning activities is to achieve objectives, the selection of objectives becomes the first decision and the major decision to be made and the selection of learning activities becomes a subordinate decision.

The data revealed that Ms. Defne usually follow a lesson flow which has some stages and she tried to progress without any disconnection. According to Ms. Defne, an interesting beginning was important. This could be a relation with the previous topic or an engagement to create curiosity of students for the new topic of the lesson. Prerequisites for the current lesson were usually addressed in this stage. After spending some time at the beginning, the focus was on the topic of the lesson. At this stage, the main concepts of the lesson were given and related applications of these concepts are made. Then, the reinforcement section of the lesson started. Studying on the worksheets or performing mini contests which include questions similar to the ones in the main part of the lesson, doing the exercises in the textbook are the examples of activities done in reinforcement stage. The last section of her lesson was the closure. Ms. Defne stated that this could be a summary or an assessment. Ms. Defne most of the time referred to the courses she took in her graduate studies while explaining her preferences of decisions.

Her academic background and experince with students may explain the reasoning behind her such preferences and decisions.

The data revealed that Ms. Defne's lesson flow approach affected her sequencing and structuring the activities for her lessons. That's to say Ms. Defne classified activities depending on their purposes and their order in the flow of the lesson and she made decisions regarding the purpose and order of an activity in the flow of the lesson. According to her, the activity which is the most aligned with the learning objective is the "main activity" of the lesson. Conception and application activities are the main activities of a lesson in which main concepts are given and related applications are made. Other than conception and application activities, an activity can be a starting activity, an assessment activity, a reinforcement activity or closure activity depending on its use in the lesson flow and its purpose.

In the literature, one important study which classified activities was done by Taba (1962). She noted that learning activities based on objectives can be classified into several types according to subfunctions they perform in the teaching-learning situation. She identified three common types of activities: introduction, development, and application. Introduction activities were described as being used to diagnose pupils' learnings and to motivate pupils; development activities were described as providing factual material; and application activities were described as serving to apply, evaluate, and conclude learnings. It can be deduced that Taba's classification suports the structue used by Ms. Defne. "start activity" structure is similar to what Taba called "introduction activities". However, their functions are the same. Similarly, "conception activity"

structure is like what Taba called “development activities” with similar functions. On the other hand, Taba used a general a classification for application activities where as Ms. Defne used two structures: assessment and closure activities. When their functions considered, they can be named as application activities as Taba did.

The results regarding Ms. Defne’s structuring activities and sequencing them are related to the *representation* stage of pedagogical reasoning model and action as suggested by Shulman (1987). He described *representation* as thinking about the key ideas in the text or lesson, identifying the alternative ways of representing them to students. In this process, the teacher examines what analogies, metaphors, examples, demonstrations; simulations can help to transform the content. Ms. Defne sequenced and structured the activities for her lessons based on her lesson flow approach and her previous experience. She used a variety of activities depending on the needs of students and the lesson flow.

Aytunga and Bayındır (2009) reported that 41% of the teachers stated that they used “exercise” type of activities most of the time. However, Taba (1962) emphasized that teachers should design every activity with a definite purpose in mind and different kinds of activities are needed to promote different objectives.

The literature supported the fact that teachers took purpose of an activity into consideration delicately like Ms. Defne. Teachers considered fit with purpose and description of an activity as an important feature (Clark & Yinger,1982). They also added that teachers took activity type and its design and flow into consideration. In addition, their findings included that an activity should fit the teacher’s goal, take into

consideration prerequisite instruction, and it should fit the past practice and current practice. The consideration of prerequisite information was also stated by Yıldırım (2003). He reported that teachers had the flexibility to align the content and the activities according to students' background.

The data revealed that the length of an activity and how much time to use for an activity were also among the considerations Ms. Defne made. While making decisions about the activities, she considered those two points. Not using long activities is a consideration but how much time should be spent on an issue is the major consideration for Ms. Defne's reasoning process. It was seen that for the first examples of a topic Ms. Defne can allocate more time. Moreover, the activities which include tasks that students may have difficulties need more time allocations by Ms. Defne. On the other hand, the reasoning behind the first point was different. Ms. Defne wanted to complete an activity within a class period, not to lose focus of the students; and also the schedule she needed to catch up with. Therefore, the length of an activity was important to her. Similarly in the literature, the existence of many activities to be applied and need of much time to apply them, inadequacy of class hours were stated as the problems regarding time use faced during instructional planning by teachers (Aytunga & Bayındır, 2009). Another researcher who mentioned durations of an activity was Yinger (1980). He reported that duration of an activity was one of the activity features that the teacher activity planning decisions were affected, and added that adequate time should be devoted for the implementation of an activity.

Finally, the data revealed that Ms. Defne used the textbook for deciding the questions to be included in an activity and for finding any different approach or example. She stated that she liked the variety of questions within the textbook. The data also revealed that she considered the materials in hand for selecting or designing an activity. Similarly, the literature supported that consideration of materials was an issue for teachers' activity planning (Zahorik, 1982; Yinger, 1980; Yinger, 1982). In Zahorik's study (1982), teachers were asked to describe successful and non-successful activities. Materials were also one of the elements in the topology to describe the successful and non-successful activities. Successful activity description included using one or more of a range of materials. In addition, Yinger (1982) reported that teachers judged whether or not there would be enough materials for a group or the whole class while making planning decisions. However, this concern was not observed in Ms. Defne's reasoning process in selection of activities. This may be due to the fact that the activity plans Ms. Defne examined needed printout materials and providing them was not an issue.

In addition to the discussion on the conclusion of the findings of the study, it is worth mentioning some factors which affected Ms. Defne's pedagogical reasoning in selecting activities for her lessons but not strong enough to be one of the findings of the study. One of these factors was her consideration of class time effect, whether being the first class hours of the day or being the last hours of the day may affect the implementation of an activity plan since students may be more tired at the end of the day.

Another factor which affected the pedagogical reasoning process was the implementation of the same activity plan in different classes of the same grade level. For instance, for the estimation activity Ms. Altın mentioned that in a class there may be some students who can find their own ways of estimation where as in another class there may be no such student. In such cases, she gives the methods herself. It can be argued that implementing the same activity plan in different classes of the same grade level gives the teacher a chance for making revisions based on the reflections of the implementation.

In conclusion, it can be argued that Shulman's model for pedagogical reasoning was confirmed for Ms. Defne's pedagogical reasoning process. She started with comprehension of the learning objectives in the curriculum, then made a preparation for her lesson by selecting appropriate methods and activities for her students in which she adapted any material to be used for her students, during instruction she made decisions depending on her observations of students' learning, after instruction an evaluation stage followed, and at the end some reflections on the whole process were made.

5.3 Implications

In this study, an elementary mathematics teacher's pedagogical reasoning process on selection of activities for her lessons has been investigated. The analysis of the research data has revealed the importance and variety of decisions and judgments a teacher makes while selecting activities. Those decisions are based on student learning and organization of teaching. Therefore, understanding the decisions and judgments

made from the point of a teacher may have implications for teachers, teacher educators, and content developers.

Reasoning process is special to each teacher. Therefore, understanding reasoning behind the activity selection of a mathematics teacher, how she adapts the activity plans for her students and for her classroom may give some idea about the teacher's point of view. The teacher in this study is an experienced teacher in use of activities and she may serve as a model who implements activities in her lessons for other teachers. Other teachers may utilize Ms. Defne's pedagogical reasoning experience by considering her major points such as the types of activities she used, how she organized her teaching, her experience on selection of tasks within the activity plans, adjusting the difficulty level of the tasks, and her ways of motivating students.

Teacher educators can make use of Ms. Defne's point of view and share some her experiences with their students on selection and adaptation of activity plans. Examining different activity plans and commenting on their implementation may be a part of their lessons. In teaching practice courses, different students may implement the same activity plans and after implementation they can share and reflect on their experience. This may be a good practice of decision making.

Content developers are generally people who are outside the classroom environment and they don't pass through the decision making processes which teachers do. Understanding a teacher's reasoning, knowing about the teachers' needs and students' needs may contribute to development of better activity plans for teaching or mathematics. When I think over what I have learned as a result of this study as a content

developer, I see that developing an activity plan taking into consideration both the low achievers and the high achievers is one of the most critical issues. In this way, the person to implement the activity plan will have chance for adjusting the difficulty level. Another critical issue for me was how different questions that students may ask about a task even though you may think that everything is clear. For instance, regarding the task for calculating the area of given triangles; the task asked for "*Can you calculate the area of the given triangles?*" One of the students said "*Yes, I could!*" At this point, Ms. Defne wanted him to calculate the related areas. Then I thought that language was very critical.

5.4 Recommendations for Further Research Studies

This research study focused on an elementary mathematics teacher's pedagogical reasoning process on selection of activities for her lessons. As stated above, findings believed to suggest valuable implications for mathematics teachers and content developers. Based on the analysis of the data, several suggestions for related research studies were identified.

One of the findings of the study was that the teacher's pedagogical reasoning process included considerations about the characteristics of the tasks within the activities. Further research can investigate the variety of mathematical tasks in activities and in what circumstances teachers prefer to use a specific task and the reasons behind those preferences.

Another finding was related to the activity types such as starting activity, conception activity, and closure activity which Ms. Defne identified. She identified

activities based on their purposes in the flow her lessons. Further research can investigate what kind of activities teachers use and the characteristics of these activities.

This study focused on exploring the pedagogical reasoning of the teacher and one of the main considerations made by the teacher was based on student learning. How those considerations affect students' learning can also be explored. Further research can investigate how a teacher's pedagogical reasoning can affect her students' learning.

In addition, the focus of this study was on the selection process of activities. However, decisions made during instruction are also part of a teacher's pedagogical process. Further research can be carried out to explore how teachers integrate activities into their instruction and decisions made during instruction.

5.5 Limitations of the Study

The study is limited by many factors such as the activity plans examined, the grade levels of the activity plans, characteristics of the students in Ms. Defne's classroom, her knowing students for two years, her teaching experience, and her working at a private school.

The main limitation of the study was the activity plans examined. Different activity plans might have provided different decisions and considerations.

The other limitation of the study is the grade level. The findings of the study are limited to the grade levels chosen for the study, which were the fifth and sixth grades. The findings might have been different for different grade levels.

The study is also limited to the characteristics of the students in Ms. Defne's class and the characteristics of the school. Since reasoning may change depending on the contextual factors, Ms. Defne's reasoning might have changed when the students or the school were different. Working at a private school might have affect may things from the number of students in a class to the materials avaliable in the class.

Another limitation was Ms. Defne's knowing her students for two years. Whether not knowing them previoulsy or knowing for a longer time might have affected Ms. Defne's reasoning since students' background information is an important factor for her decisions.

Last, if Ms. Defne was a more experienced teacher, this might also has affected her reasoning process. Regarding the role of reflections in the pedagogical reasoning model, more experince might add more reasoning into the process.

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APPENDIX A

INTERVIEW QUESTIONS

A.1 Interview Questions (General)

1. Kaç yaşındasınız?
2. Öğretmenlikteki kaçıncı yılınız?
3. Bu okulda kaçıncı yılınız?
4. En son mezun olduğunuz okul hangisi?
5. Kaç sınıfın matematik derslerine giriyorsunuz?
6. Sınıflarınızdaki öğrenci sayısı nedir?
7. Haftalık ders saatiniz nedir?
8. Tipik bir matematik dersinizi tarif edebilir misiniz? Nasıl geçer, neler yaparsınız?
9. Derslerinize hazırlanırken ve plan yaparken hangi kaynakları kullanırsınız? Nasıl?
10. Ders kitabı kullanıyor musunuz? Hangisini? Ders kitapları size ne kadar faydalı oluyor, nasıl yararlanıyorsunuz?
11. Müfredat hakkında ne düşünüyorsunuz? Pratikte müfredat dokümanları size ne kadar faydalı oluyor? Nasıl?
12. Ne tür ölçe-değerlendirme etkinlikleri yapıyorsunuz? Ne sıklıkta?

13. Öğrencilerinizin en iyi ne şekilde öğrendiğini düşünüyorsunuz? Öğrencilerinizin öğrenmekte güçlük çektiği konular oluyor mu? Nasıl başa çıkıyorsunuz?
14. Sizin matematik öğretiminizin temelini ne oluşturuyor? (kavramlar, etkinlikler, adım adım işlemler, problem çözme, günlük hayattaki yeri, vb...)
15. Matematik öğretiminde etkinlik kullanımıyla ilgili ne düşünüyorsunuz/genel düşüncenizi kısaca tanımlar mısınız?
16. Sizce tipik bir etkinlik neye benzer? Örnek verebilir misiniz?
17. Etkinlik kullanımıyla ilgili aldığınız bir ders veya gittiğiniz bir kurs var mı? Nerede? Neler öğrendiniz?
18. Son zamanlarda kullandığınız etkinlikler var mı? Neler? Nereden buldunuz? Nasıl sonuçlandı?
19. Genelde ne tür etkinlikler kullanırsınız? En sık kullandıklarınız hangileridir?
20. Hangi etkinlikleri kullanacağınıza nasıl karar verirsiniz?
21. Bir etkinliğin işe yarayıp yaramadığına/etkin olduğuna nasıl karar verirsiniz?
22. Etkinlik sonunda bir değerlendirme yapar mısınız?
23. Artıları ve eksileri ile bir derste etkinlik kullanmayı nasıl değerlendiriyorsunuz?

A.2 Interview Questions (Examining Activity Plans Brought by the Researcher)

1. Önümüzdeki haftalarda işleyeceğiniz konular açısından değerlendirdiğinizde bu etkinlikler hakkında ne söylersiniz?
2. Bu etkinlikler içinde sınıfınızda kullanmak isteyecekleriniz var mı? Var ise nedeni nedir?
3. Olduğu gibi mi kullanırdınız yoksa değişiklik yapmak ister miydiniz? Neden ve nasıl?
4. Bu etkinliği/etkinlikleri dersinizde hangi amaçla kullanırdınız? Seçtiğiniz etkinliği/etkinlikleri dersinizin hangi aşamasında kullanırdınız?
5. Etkinliğin kullanımıyla ilgili öngördüğünüz herhangi bir nokta var mı?
6. Sizce bu etkinlik sınıfınızda nasıl bir sonuç verecek?
7. Farklı şubeler arasında uygulama açısından farklılıklar olabilir mi? Neden?
8. Öğrencilerinizi düşünerek bu etkinliklerin seviyeleri hakkında ne söyleyebilirsiniz? Farklı seviye için kriterleriniz nelerdir?
9. Sizce bu etkinlikler arasında diğerlerine göre farklı olanlar var mı? Var ise hangi açıdan farklı olduğunu düşünüyorsunuz?
10. Ele almadığımız ancak sizin eklemek istediğiniz bir nokta var mı?

A.3 Interview Questions (Examining Activity Plans Brought by the Teacher)

1. Bu dersinize hazırlanmadan önce neler yaptınız?
2. Yararlandığınız, kullandığınız kaynaklar nelerdir?
3. Etkinlik kullanmalıyım kararını nasıl verdiniz? Bu noktada neler belirleyici oldu?
4. Etkinlik seçimini nasıl yaptınız? Yaptığınız seçimlerin matematik öğretimi açısından sizce en önemli noktaları neler?
5. Bu etkinliği seçerken nelere dikkat ettiniz?
6. Değiştirdiğiniz veya eklediğiniz kısımlar oldu mu? Nasıl, neden?
7. Sizce bu nasıl bir etkinlik?
8. Bu etkinlikte öğrencilerinizden tam olarak ne bekliyorsunuz?
9. Dersinizin hangi aşaması için kullanacaksınız? Hangi amaçla kullanacaksınız?
10. Sizce nasıl sonuç verecek? Sınıfta kullanımıyla ilgili öngörüleriniz nelerdir?
11. Sorularınızı belirlerken nelere dikkat ettiniz?
12. Cevapların belirli bir formatta verilmesi sizin için önemli mi?

A.4 Interview Questions (Evaluation)

1. Sizce etkinlik nasıl geçti, amacına ulaştı mı? Buna nasıl karar verdiniz?
2. Sizce bu etkinliği uygularken güçlü veya zayıf yönleri ne oldu?
3. Sizce öğrencileriniz etkinlik sonunda ne kazanmış oldu?
4. Tekrar kullansanız değiştireceğiniz bir yönü olur mu? Uygulamada nelere dikkat edersiniz?
5. Öngörmediğiniz bir durum oldu mu?
6. Süre yeterli oldu mu?

APPENDIX B

ACTIVITY PLANS EXAMINED BY THE TEACHER

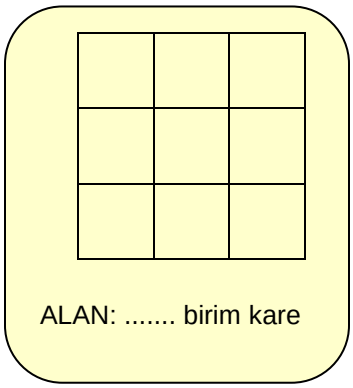
In this section, the activity plans examined by the teacher are given. A total of 10 activity plans were examined. The list of the activity plans is as follows:

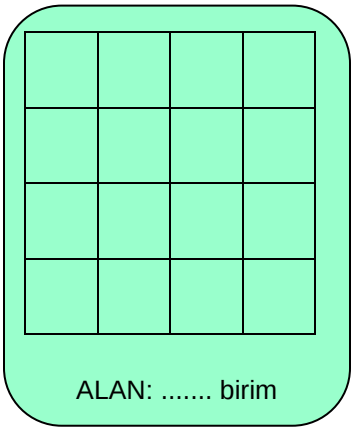
1. Deriving the relationship between the length of a square and its area
2. Deriving the relationship between the lengths of a rectangle and its area
3. Comparing the Area of Given Rectangles by Calculating Their Areas
4. A Real-Life Question Which Involves Calculating the Area of Rectangles
5. Deriving the Rule for Calculating the Area of a Parallelogram
6. Deriving the Rule for Calculating the Area of a Right Triangle
7. Deriving the Rule for Calculating the Area of a Triangle
8. Calculating the Area of Given Composite Shapes
9. A Real-Life Question Which Asked for How to Estimate the Result of Collected Money from a Concert
10. Identifying the Estimation Methods in Given Calculations

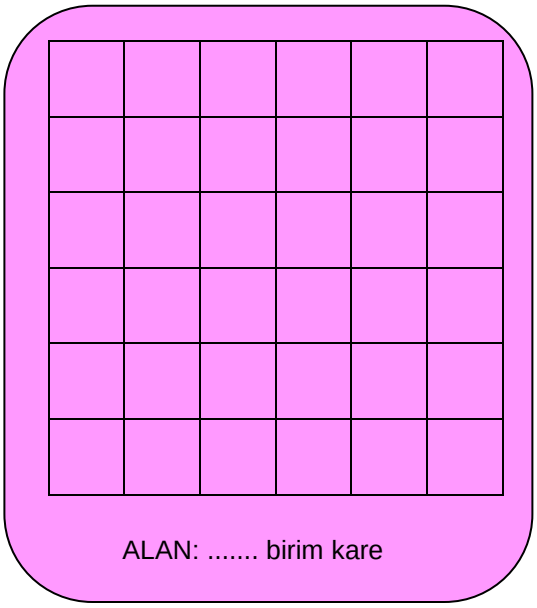
B1.Activity Plan-01: Deriving the relationship between the length of a square and its area

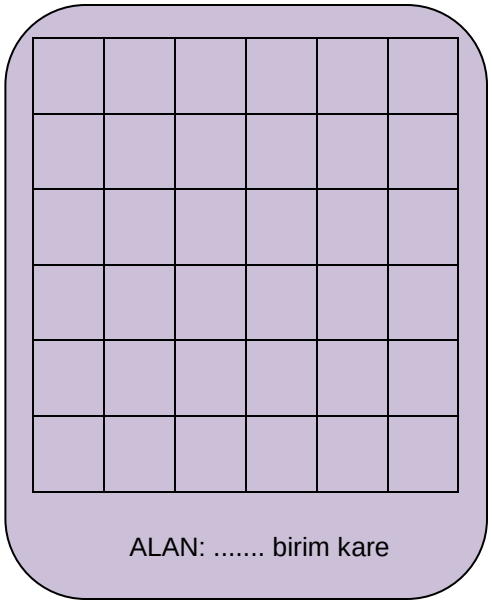
Ad- Soyad: .....
Sınıf: .....
No: .....

1. Bir karenin alanının onu oluşturan birim kare sayısına eşit olduğunu biliyoruz. Aşağıda verilen karelerin alanlarını bul.





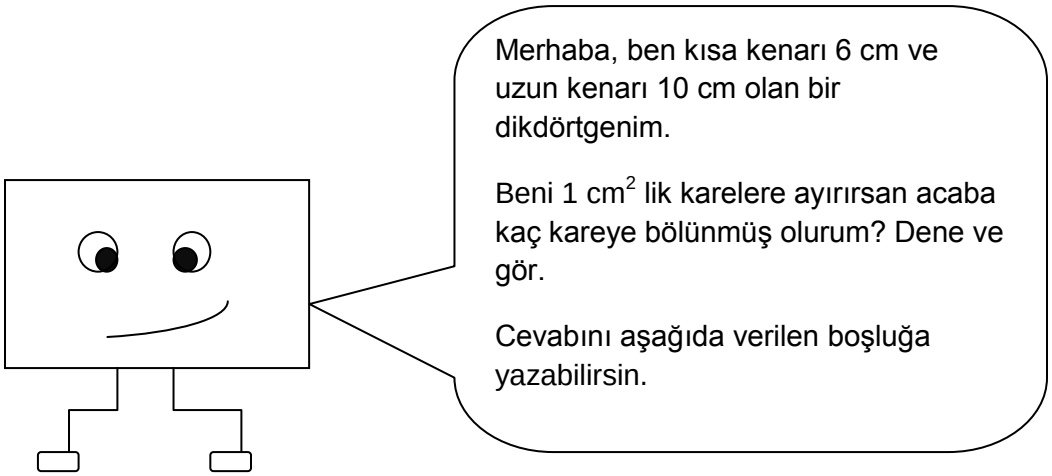




2. Sence bir karenin alanı ile kenar uzunluğu arasında nasıl bir ilişki var?
.....

B2.Activity Plan-02: Deriving the relationship between the lengths of a rectangle and its area

Ad- Soyad: .....
Sınıf: .....
No: .....

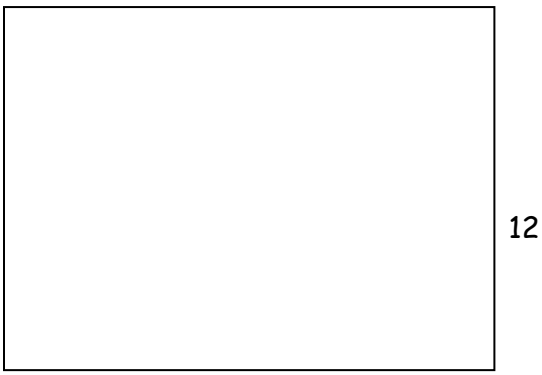


Cevap: .....

Sence kare sayısı ile kenar uzunluklarım arasında nasıl bir ilişki var?

Cevap:
.....

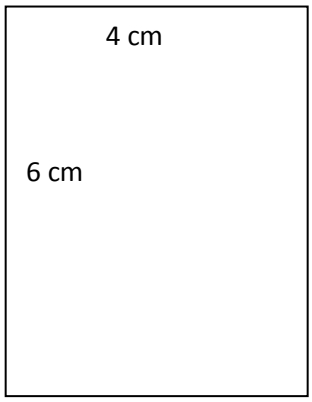
Aşağıdaki dikdörtgeni karelere böldüğünü varsayalım, kaç kareye bölünmüş olur? Bu sayıyı bölmeden hesaplayabilir misin?

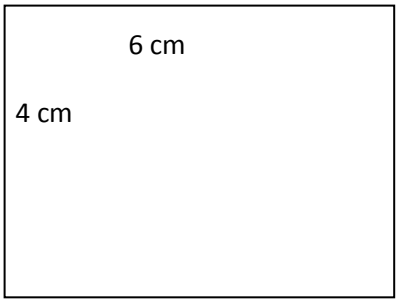


B3.Activity Plan-03: Comparing the Area of Given Rectangles by Calculating Their Areas

Ad- Soyad: .....
Sınıf: .....
No: .....

1. Aşağıdaki dikdörtgenlerin alanları hakkında ne söyleyebilirsin?





.....

.....

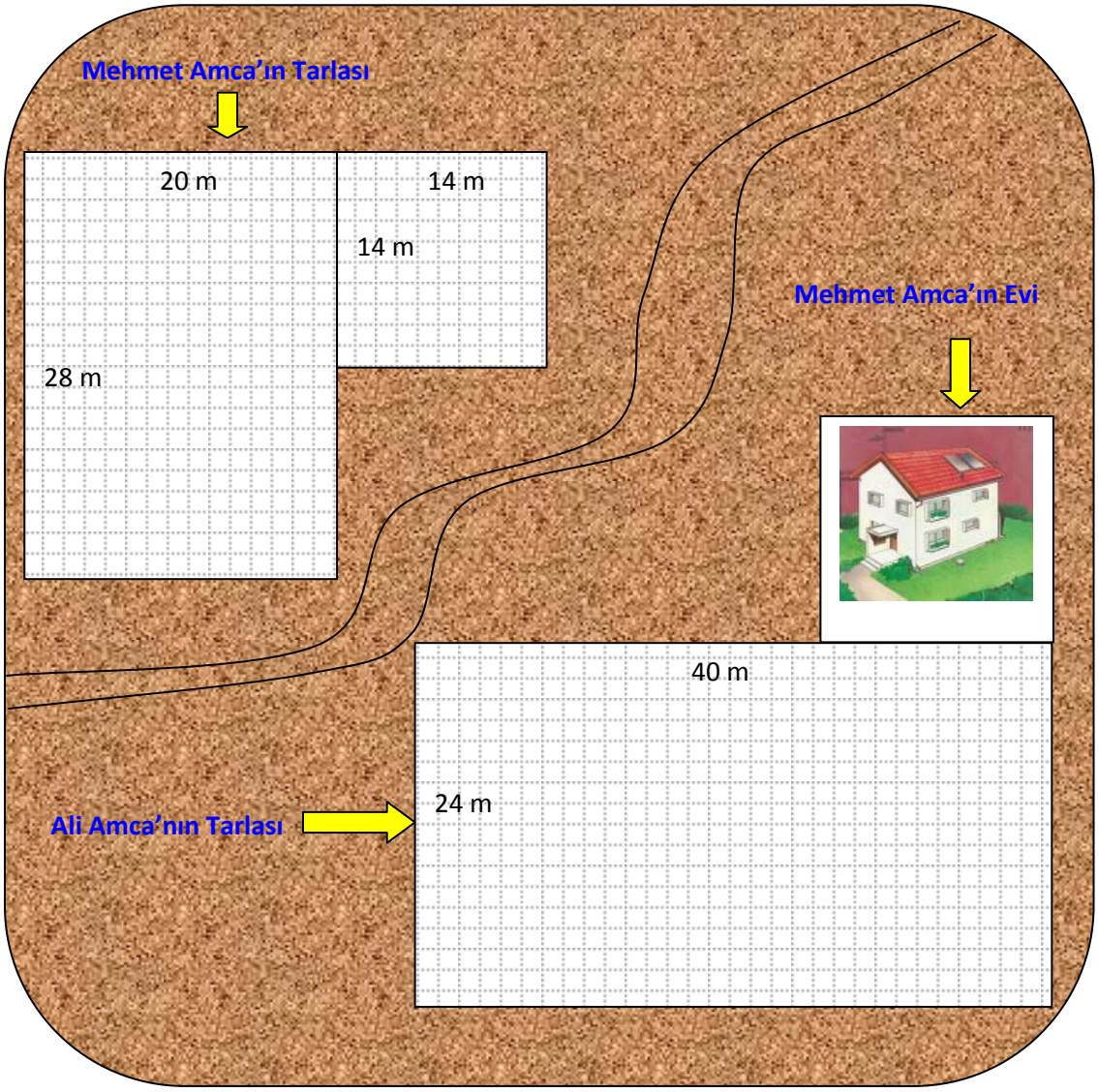
2. Tabloda kenar uzunlukları verilen dikdörtgenlerin alanlarını karşılaştır.

I. Dikdörtdenin Kenar Uzunlukları	II. Dikdörtgenin Kenar uzunlukları	Alanları Arasındaki İlişki
3 cm, 5 cm	2 cm, 6 cm	
7 cm, 10 cm	8 cm, 9 cm	
4 cm, 11 cm	5 cm, 7 cm	
12 cm, 14 cm	11 cm, 13 cm	
22 cm, 16 cm	18 cm, 15 cm	

B.4 Activity Plan-04: A Real-Life Question Which Involves Calculating the Area of Rectangles

Ad- Soyad: .....
Sınıf: .....
No: .....

Çiftçi Mehmet Amca'nın aşağıdaki gibi bir tarlası var. Evine daha yakın olduğu için Ali Amca ile tarlasını değiştirmek istiyor. Sence Ali Amca bu değişim için üstüne para mı almalı yoksa para mı ödemeli?



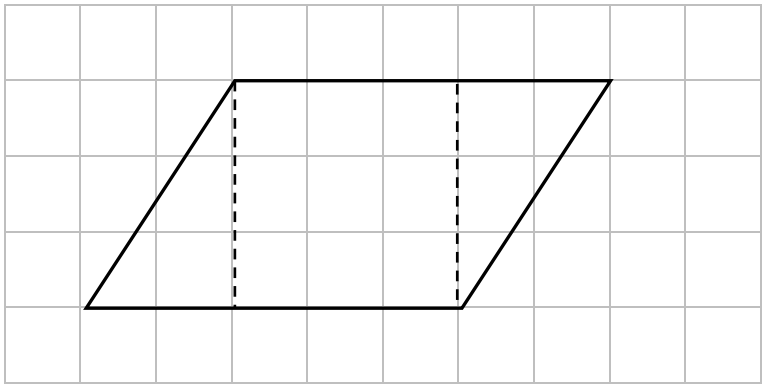
B.5 Activity Plan-05: Deriving the Rule for Calculating the Area of a Parallelogram

Ad- Soyad: .....
Sınıf: .....
No: .....

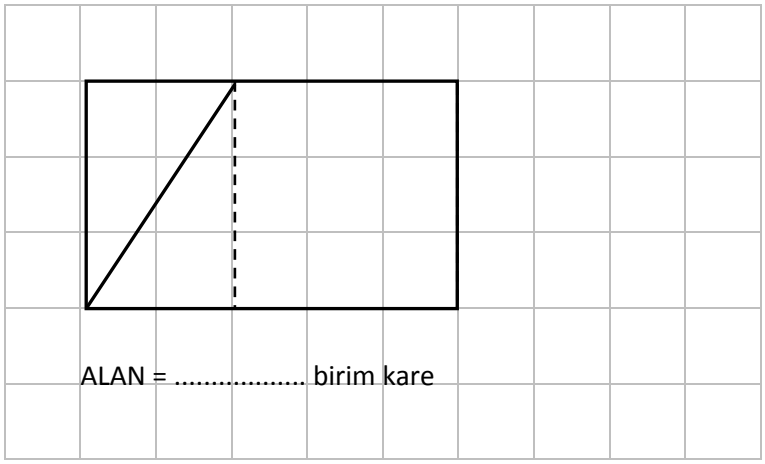
PARALELKENARIN ALANINI BULALIM

Sence aşağıdaki paralelkenarın alanını nasıl bulabiliriz?

1. Paralelkenarı aşağıdaki gibi 3 parçaya ayıralım.



2. Şimdi de üçgenlerden birini diğer üçgenin üzerine taşıyalım.



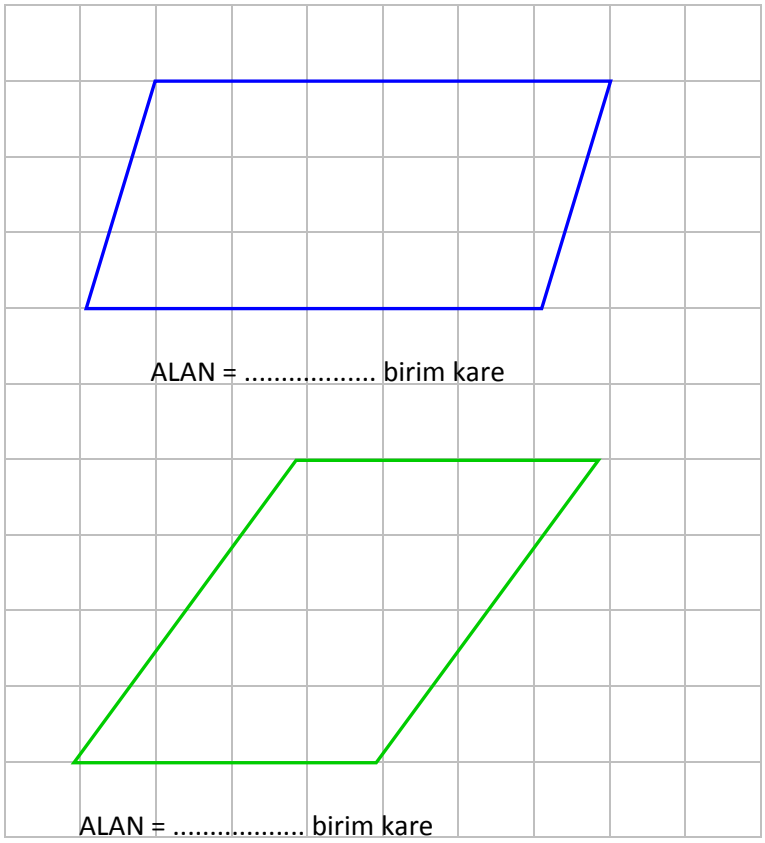
Oluşan şekil bir dikdörtgen olduğundan alanını kolayca hesaplayabiliriz.

3. Peki sence bu dikdörtgen ile paralel kenarın alanları eşit olduğundan kenar uzunlukları arasında nasıl bir ilişki var?

……

……

4. Bu örnekten yola çıkarak aşağıdaki paralelkenarların alanlarını hesaplayabilir misin?



5. Bir paralelkenarın alanının nasıl hesaplanacağı ile ilgili öğrendiğin kuralı yazar mısın?

……

……

B.6 Activity Plan-06: Deriving the Rule for Calculating the Area of a Right Triangle

Ad- Soyad: .....
Sınıf: .....
No: .....

1. İstediğin kenar uzunluğuna sahip bir kare çiz ve sonra da bu karenin bir köşegenini çiz.

2. Çizdiğin karenin alanı kaç birim kare?
   ....

3. Oluşan üçgenlerin alanları kaç birimkare?
   ....

4. Sence karenin ve üçgenlerin alanları arasında nasıl bir ilişki var?

.....

.....

.....

.....

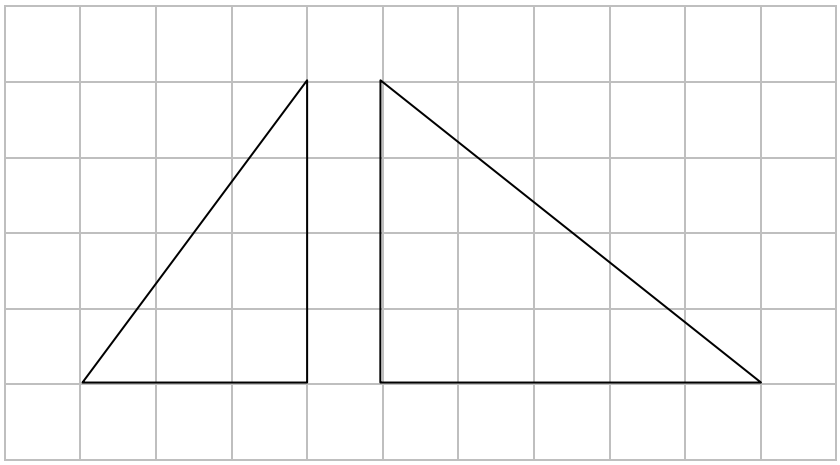
.....

.....

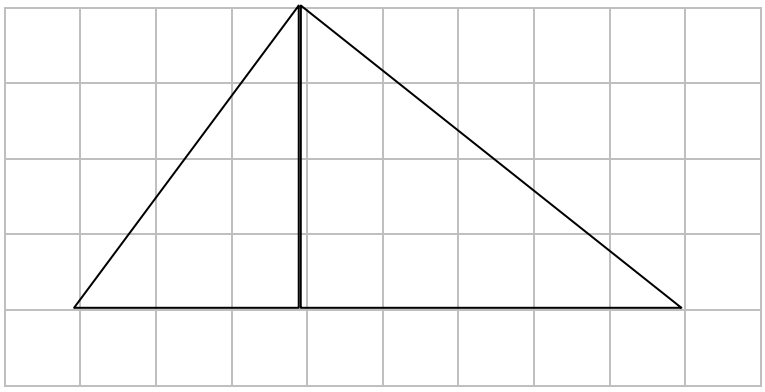
B.7 Activity Plan-07: Deriving the Rule for Calculating the Area of a Triangle

Ad- Soyad: .....
Sınıf: .....
No: .....

1. Aşağıdaki iki üçgenin alanını bulalım.



2. Şimdi de bu üçgenin alanını bulalım.



3. Sence dik olmayan bir üçgenin alanını hesaplamanın bir kuralı var mı?

.....

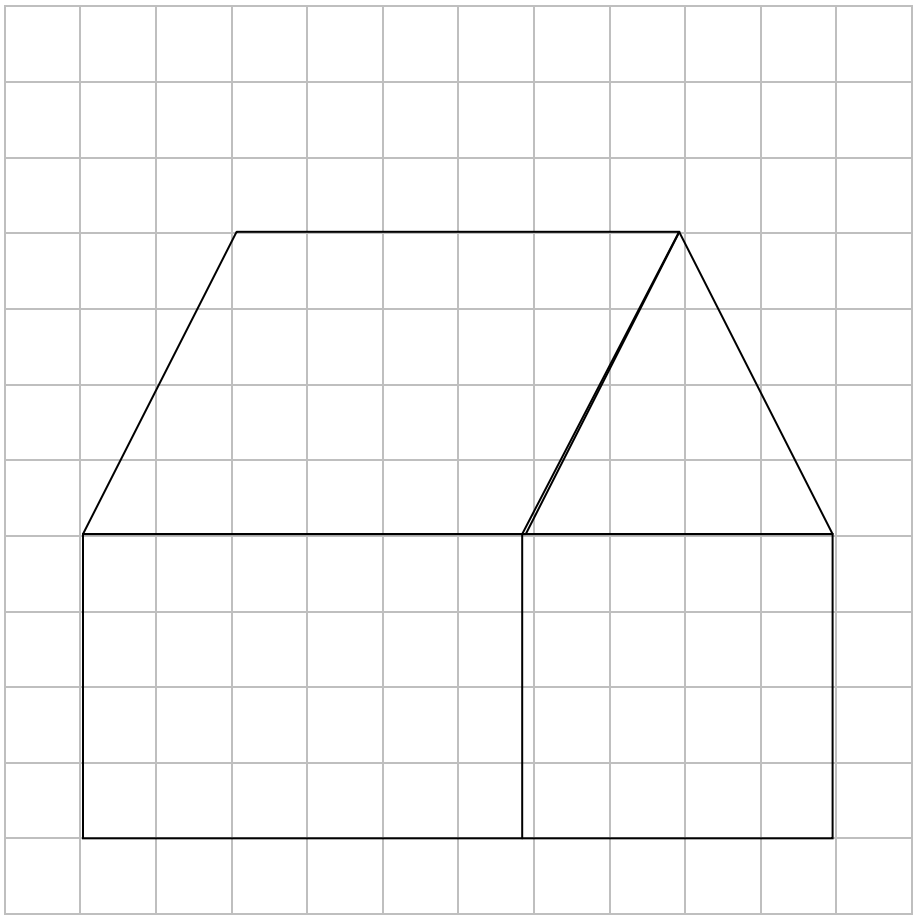
.....

B.8 Activity Plan-08: Calculating the Area of Given Composite Shapes

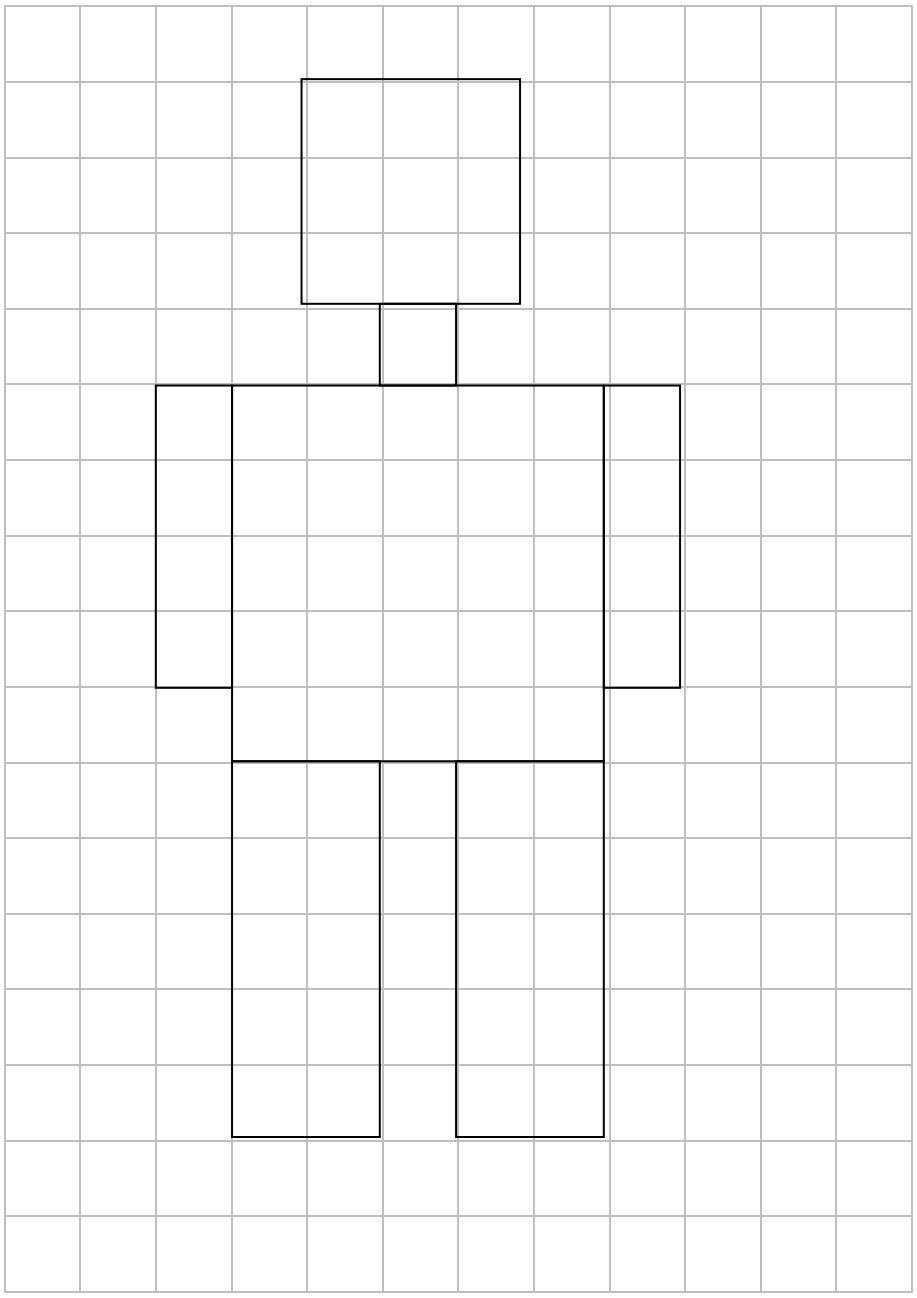
Ad- Soyad: .....
Sınıf: .....
No: .....

AŞAĞIDA VERİLEN ŞEKİLLERİN ALANLARINI BULALIM

1.



ALAN = ... birim kare



ALAN = ... birim kare

B.9 Activity Plan-09: A Real-Life Question Which Asked for How to Estimate the Result of Collected Money from a Concert

Ad- Soyad: .....
Sınıf: .....
No: .....

Biz müziği çok seven üç arkadaşız. Okulları gezip konser vermeye baylıyoruz. Son konserimizi **378** öğrencinin izlediği bilgisini aldık. Bir biletin fiyatı **12 TL** olduğuna göre acaba **yaklaşık ne kadar paramız oldu**?

I.GRUP ÜYESİ — Bence yaklaşık 3780 TL paramız oldu.

II.GRUP ÜYESİ — Bence yaklaşık 3800 TL paramız oldu.

III.GRUP ÜYESİ — Bence yaklaşık 4000 TL paramız oldu.

Sizce hangi grup üyesi en yakın tahminde bulundu?

.....

İşlemin sonucunu bulun ve tahminlerle karşılaştırın.

.....

Her bir grup üyesinin tahmin ederken nasıl bir yol izlediğini tartışın.

.....

B.10 Activity Plan-10: Identifying the Estimation Methods in Given Calculations

Ad- Soyad: .....
Sınıf: .....
No: .....

ÇARPMANIN SONUCU TAHMİN EDELİM

Aşağıda üç basamaklı veya iki basamaklı sayıların çarpımları sonucu ve bir de her birine ait tahminler verilmiştir.

1. Verilen çarpma işlemlerini ve her birine ait tahminleri karşılaştırın. Tahminde bulunurken nasıl bir yol izlendiğiyle ilgili ne söyleyebiliriz?

398 × 21 = 8358 Tam Sonuç 400 × 20 = 8000 Tahminî Sonuç	38 × 52 = 1976 Tam Sonuç 38 × 50 = (38 ÷ 2) × 100 = 19 × 100 = 1900 Tahminî Sonuç
213 × 108 = 23004 Tam Sonuç 200 × 110 = 22000 Tahminî Sonuç	41 × 23 = 943 Tam Sonuç 40 × 25 = (40 ÷ 4) × 100 = 10 × 100 = 1000 Tahminî Sonuç

2. Sayıların çarpımını tahmin ederken nasıl bir yol izlendiğini kendi cümlelerinizle özetleyin.

.....

.....

.....

3. Aşağıda verilen çarpma işlemlerin sonucunu tahmin edin ve sonra da işlemleri yaparak tahminlerinizle karşılaştırın.

Tahminî Sonuç	Tam Sonuç
529 × 210 = ?	
295 × 18= ?	
406 × 7= ?	
81 × 52= ?	
672 × 953 = ?	

4. Tahminlerinizi sınıf arkadaşlarınızla tartışın. Farklı sonuçlar bulan arkadaşlarınız var mı? Nedeni ne olabilir?

APPENDIX C

ACTIVITY PLANS BROUGHT BY THE TEACHER

In this section, the activity plans brought by the teacher are given. A total of 3 activity plans were examined. The list of the activity plans is as follows:

1. Introducing Prime Numbers
2. Riddle of Eratosthenes
3. Problem Solving Involving LCM or GCD

C.1 Activity Plan-01: Introducing Prime Numbers

Aşağıda verilen masalı sessizce okuyun. Okurken önceki derslerde öğrendiğimiz kavramları düşünmeye çalışın.

MASAL

Bir varmış bir yokmuş. Evvel zaman içinde kalbur zaman içinde sayılar ülkesi varmış. Bu ülkede bütün sayılar birbirine iyi davranırmış. Buradaki her sayının en az iki kardeşi varmış. İstisnai olarak 1 sayısının sadece bir kardeşi varmış. Bu ülkede bir sayının kardeşi olabilmek için o sayıyı bölebilmek gerekiyormuş. Mesela 10 sayısının kardeşleri 1, 2, 5 ve 10'dur. Burada dikkat ederseniz 10 sayısını da söyledik. Çünkü 10 sayısı 10 sayısının ikiz kardeşidir. Fakat bazı sayıların sadece iki kardeşi varmış. Mesela 5 sayısının kardeşleri 1ve 5'tir. Şimdi bu sayıların bazılarını size söyleyeyim. 2, 3, 5, 7,11, 13, 17…. Bu sayılar o kadar çokmuş ki kaç tane olduğunu kimse bilmiyormuş. Bu sayıların sadece iki kardeşinin olduğunu söylemiştik. O yüzden bu sayılar diğer sayıları kıskanırmış. Çünkü diğer sayıların ikiden fazla kardeşi varmış. O yüzden bu sayılar hep üzgün üzgün dolaşırlarmış. Diğer sayılar da bu sayıların üzgün duruşlarından dolayı onlara asal sayılar demeye başlamış. O gün bu gündür bu sayılara asal sayılar denilmiş. Burada bir noktaya dikkat etmenizi istiyorum. Gördüğünüz gibi 2 sayısı hem çift bir sayı hem de asal bir sayı. Fakat 2 sayısından başka hem çift hem de asal bir sayı yoktur. Daha önce sadece bir kardeşi olan 1 sayısını söylemiştik. Fakat 1 bu halinden memnunmuş. Çünkü o sayılar ülkesinde tekmiş. Kendisinin özel biri olduğunu düşünüyormuş.

1. İki basamaklı bir sayı seçin, bu seçtiğiniz sayının kardeşleri kimler olabilir?

   .....

2. 0 sayısının kardeşleri sizce kimler olabilir?

   .....

C.2 Activity Plan-02: Riddle of Eratosthenes

Ad- Soyad: .....
Sınıf: .....
No: .....

0	1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18	19
20	21	22	23	24	25	26	27	28	29
30	31	32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47	48	49
50	51	52	53	54	55	56	57	58	59
60	61	62	63	64	65	66	67	68	69
70	71	72	73	74	75	76	77	78	79
80	81	82	83	84	85	86	87	88	89
90	91	92	93	94	95	96	97	98	99

1. 10'un katlarını tabloda boyayın.
2. 2'nin katlarını tabloda boyayın, 2 hariç.
3. 5'in katlarını tabloda boyayın, 5 hariç.
4. 3'ün katlarını tabloda boyayın, 3 hariç.
5. 7'nin katlarını ritmik sayarak bulun ve sonra da tabloda boyayın.
6. 11'in katlarını tabloda boyayın, 11 hariç.
7. 0 ve 1'i sizce boyamamız gerekir mi? boyadığımız sayıların ortak özelliği sizce nedir?

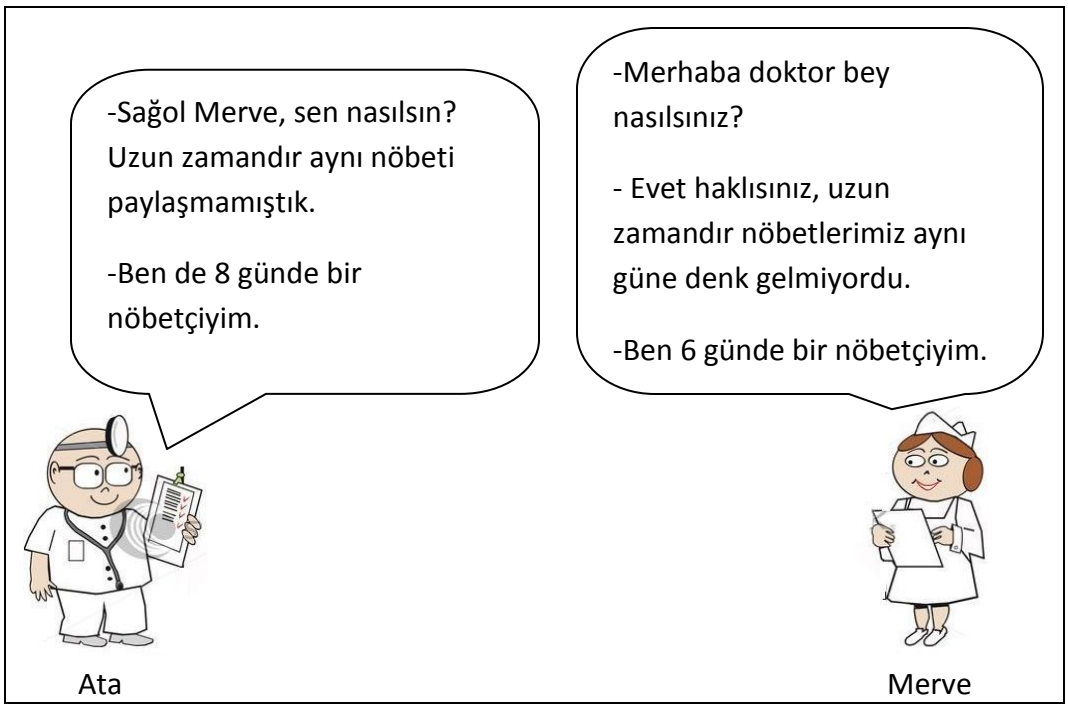
   .....
8. Tablomuzda boyamadığımız sayılarla ilgili ne söyleyebiliriz?

   .....

   (İşlenişte bu kısımda defterlere boyalı tablo yapıştırıldı, altına asal sayı tanımı yazıldı.)

C.3 Activity Plan-03: Problem Solving Involving LCM or GCD

Ad- Soyad: .....
Sınıf: .....
No: .....



Sizce buradaki doktor ve hemşire kaç gün sonra yine aynı günde nöbetçi olur?

NOTLAR:

- Projeksiyon ile problem yansıtıldı.
- Öğrenciler dinledikleri problemi kendi cümleleriyle yazdılar.
- Aşağıdaki şablona göre, öğretmenin yönlendirmeleriyle problem adım adım çözüldü.

PROBLEM:

……

……

……

……

PROBLEMİ ANLAYALIM:

PLAN YAPALIM:

PLANI UYGULAYALIM:

KONTROL EDELİM:

CURRICULUM VITAE

PERSONAL INFORMATION

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2000 Fall – 2002 Fall	Middle East Technical University Ankara, TURKEY M. S., Dept. of Science and Technology Policy Studies Thesis Title: "Investigation of the effects of school type, gender, and grade level on students' attitudes toward technology"
1996 Fall- 2000 Spring	Middle East Technical University Ankara, TURKEY B. S., Mathematics Education B. S., Mathematics

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2000 Fall- 2002 Spring	Software Specialist ÜLSA in Ankara

PUBLICATION

Çatak, M., Özdal, J., K Ünlü & Sarı, S.(2006). *A mathematics lesson designed using 5E learning cycle model*. 6.Uluslararası Eğitim Teknolojileri Konferansı**,** Doğu Akdeniz Üniversitesi, Magosa-K.K.T.C

Çatak, M. & Karaoğlan, C. (2005). *Tanılayıcı dallanmış ağaç yöntemiyle ölçme değerlendirme: 7. Sınıf Matematik Dersi İçin Bir Örnek Uygulama*. Poster sunumu XIV. Ulusal Eğitim Bilimleri Kongresi, Pamukkale Üniversitesi Eğitim Fakültesi, Denizli.