A CASE STUDY ON THE ASPECTS OF CLASSROOM DISCOURSE IN A FIFTH GRADE MATHEMATICS CLASS IN A REGIONAL ELEMENTARY BOARDING SCHOOL

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF SOCIAL SCIENCES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY

ŞULE ŞAHİN

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF MASTER OF SCIENCE
IN
THE DEPARTMENT OF ELEMENTARY SCIENCE AND MATHEMATICS EDUCATION

DECEMBER, 2009

Approval of the Graduate School of Social Sciences

_____

Prof. Dr. Sencer AYATA

Director

I certify that this thesis satisfies all the requirements as a thesis for the degree of Master of Science.

_____

Prof. Dr. Hamide ERTEPINAR

Head of Department

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

_____

Assist. Prof. Dr. Mine IŞIKSAL

Supervisor

Examining Committee Members

Assist. Prof. Dr. Mine IŞIKSAL	(METU, ELE)	_____
Assist. Prof. Dr. Çiğdem HASER	(METU, ELE)	_____
Dr. Cengiz S. AŞKUN	(METU, CEIT)	_____

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name, Last name : Şule ŞAHİN

Signature :

ABSTRACT

A CASE STUDY ON THE ASPECTS OF CLASSROOM DISCOURSE IN A FIFTH GRADE MATHEMATICS CLASS IN A REGIONAL ELEMENTARY BOARDING SCHOOL

Şahin, Şule
M.S., Department of Elementary Science and Mathematics Education
Supervisor: Assist. Prof. Dr. Mine Işıksal

2009, 130 pages

The purpose of this study was to analyze and interpret specific aspects and characteristics of classroom discourse of an elementary mathematics classroom. To examine the classroom discourse, a fifth grade mathematics classroom was observed during sixteen weeks, and twenty lessons in total. The analysis was based on two main categories: (1) Student Learning and (2) Teacher Moves. Student Learning further divided into two sub-categories as *content* and *learning*. Additionally, Teacher Moves also divided into *content knowledge and pedagogy* and *creating learning environment* sub-categories.

Results of this study showed that despite the many efforts in mathematics education in Turkey and the accepted importance of student-centered classrooms; still in some elementary classrooms teacher-centered instruction continue to be dominating. Moreover, the teacher questions generally seemed to have short answer and low-level characteristics that require students to recall mathematical

rules and procedures rather than high-level questions that require students to recall mathematics rules and procedures rather than high-level questions that require students think deeper and draw inferences on mathematical content. Although, the results did not meet the assumptions of discursive classroom at all; based on the results, it could be said that in classroom practices, mathematics teachers try to make connections between mathematical content and other disciplines where they tried to give examples from real-world situations and also encourage students in that way; as pointed out in new mathematics curriculum.

Keywords: Mathematical classroom discourse, Elementary mathematics classes

ÖZ

BİR YATILI İLKÖĞRETİM BÖLGE OKULU BEŞİNCİ SINIF MATEMATİK DERSİ SINIF İÇİ SÖYLEMİNİN İNCELENMESİ ÜZERİNE BİR DURUM ÇALIŞMASI

Şahin, Şule
Yüksek Lisans, İlköğretim Fen ve Matematik Alanları Eğitimi Bölümü
Tez Danışmanı: Yrd. Doç. Dr. Mine IŞIKSAL

2009, 130 sayfa

Bu çalışmanın amacı, bir matematik sınıfında, sınıf içi söylemi belirli yönlerden analiz edip yorumlamaktır. Bu aktiviteleri incelemek üzere, bir beşinci sınıf 16 hafta, 20 ders saati boyunca gözlemlenmiştir. Analizler (1) Öğrenci Öğrenmeleri (2) Öğretmen Çalışmaları olmak üzere iki ana kategoride toplanmıştır. Öğrenci Öğrenmeleri kendi içinde *İçerik* ve *Öğrenme* olmak üzere iki alt kategoriye ayrılmıştır. Ek olarak, Öğretmen Çalışmaları da *İçerik Bilgisi ve Pedagoji* ile *Öğrenme Ortamı Oluşturma* olmak üzere iki kategoriye ayrılmıştır.

Çalışma sonuçları, matematik eğitiminin geliştirilmesi yönündeki çabalara ve sınıfların öğrenci merkezli olarak tasarlanmasının öneminin kabul edilmesine rağmen, bazı ilköğretim matematik sınıflarında öğretmen merkezli içeriğin baskın olmaya devam ettiğini göstermiştir. Ayrıca, öğretmenlerin sorduğu soruların, öğrencileri konu hakkında daha derin düşünüp çıkarımlarda bulunmaya teşvik etmekten ziyade; onları daha alt düzeyde düşünmeye yönlendiren, kural ve formül kullanımını öneren özelliklerde olduğu gözlemlenmiştir. Çalışmadan elde edilen sonuçlar, gözlemlenen sınıfın söyleme dayalı sınıf özelliklerine sahip olmamakla

birlikte, matematik öğretmenlerinin sınıf içi matematiksel içerik ile diğer disiplinler arasında bağlantı kurarken gerçek yaşam durumlarından örnekler vermeye çalıştıklarını ve matematik müfredatında vurgulandığı gibi öğrencileri bu yönde desteklemeye de gayret gösterdiklerini ortaya koymuştur.

Anahtar Kelimeler: Matematikte sınıf içi iletişim, İlköğretim matematik sınıfları

To My Family

ACKNOWLEDGEMENTS

There are many people behind who helped me with completing my study.

First, my greatest thanks to my supervisor Assist. Prof. Dr. Mine IŞIKSAL for her helps and advices. She always believed in me and fostered in complementing my study. I will not forget her support in this exhaustive process.

Another important person in this study is my former supervisor, Dr. Yusuf KOÇ, who helped me with his suggestions, especially while organizing the data collection instruments and procedure.

Dear father, Hüseyin ŞAHİN, I will not forget your efforts in this process, furthermore your efforts during my all education process. I know you got tired with carrying article and book copies to me, and scanning my collected data. You are the most important person in my life. I am also thankful to my mother, Sevgi ŞAHİN, for her encouragement in this stressful process. My friend, my brother, Hasan ŞAHİN. Thank you for reading my notes to me, while I was writing them on computer.

I am also very thankful to Ayfer TAŞCI, Çiğdem TURGUT, and Yeşim ÜNAL, for sparing their time to work on my data analysis process. Their help and suggestions were crucial for me; I will be always grateful for them.

One of the most important processes of the study was its grammar check. My friends spent grate effort for helping me. Thank you, Esra GÜVEN and Nihat GÜVEN for checking grammar of my thesis, and for answering my questions about the mean meaning of words. I cannot state my thankfulness to you. Dear Gülçin GÖKCE, I will not also forget your looking up dictionaries, and helping in grammar check process.

My cousin Handan Duran, thank you for giving time by reading my notes to me, while I was writing them on computer. I considered this help as a first aid. Thanks forever.

The participated teacher and students acted the main role in this study. If they did not participate, this study would not have accomplished. Thank you for accepting me as a guest in your classroom.

Thank you all.

TABLE OF CONTENTS

PLAGIARISM iii
ABSTRACT iv
ÖZ vi
DEDICATION viii
ACKNOWLEDGEMENTS ix
TABLE OF CONTENTS x
LIST OF TABLES xiv
LIST OF FIGURES xv
CHAPTER I 1
INTRODUCTION 1
1.1. The Definition and Importance of the Classroom Discourse 3
1.2. What the New Elementary Mathematics Curriculum Says about the Classroom Discourse 5
1.3. Research Problem 9
1.4. Significance of the Study 10
1.5. My Motivations for the Study 12
1.6. Definitions of Important Terms 13
LITERATURE REVIEW 16
2.1. The Nature and Components of Classroom Discourse 16
2.2. Theoretical Perspective 24
2.3. Studies on Mathematical Classroom Discourse 26
2.4. What Happens in Turkey? 29
2.5. Summary 38
METHODOLOGICAL FRAMEWORK 39
3.1. Introduction 39

3.2. A Qualitative Research Approach-Case Study 39
3.3. Participants and Setting of the Study 41
3.4. Data Collection Procedure 44
3.4.1. Classroom Observations 44
3.4.1.1. Focus on Student Learning 45
3.4.1.1.1. Content 45
3.4.1.1.2. Learning 47
3.4.1.2. Focus on Teacher Moves 48
3.4.1.2.1. Content Knowledge and Pedagogy 48
3.4.1.2.2. Creating a Learning Environment 49
3.5. Observation Duration and Observed Units During the Study 51
3.6. Analysis of Recorded Data 53
3.7. Limitations of the Study 54
3.8. Trustworthiness 55
RESULTS 58
4.1. Organization of Chapter Results 58
4.2. Analysis of Student Learning 59
4.2.1. Results of Content Case 59
4.2.2. Results of Learning Case 69
4.3. Analysis of Teacher Moves 73
4.3.1. Results of Content Knowledge and Pedagogy 73
4.3.2. Results of Creating Learning Environment 79
DISCUSSION 82
5.1. About the Discussion Part 82
5.2. Discussion on Students Learning 82
5.2.1. Discussion on Content Case 83

5.2.2. Discussion on Learning Case 85
5.3. Discussion on Teacher Moves 87
5.3.1. Discussion on Content Knowledge and Pedagogy 88
5.3.2. Discussion on Creating Learning Environment 90
5.4. Summary of Discussion Part 93
5.5. Implications 96
5.6. Recommendation for Future Research Studies 98
REFERENCES 82
APPENDICES 113
APPENDIX A 113
Original Mathematics Classroom Observation Form of CMSI 113
APPENDIX B 115
B.1. Observational Data Analysis Form (Student Learning) 115
B.2. Observational Data Analysis Form (Teacher Moves) 116
APPENDIX C 117
A Sample from Filled Observation Sheet of One Lesson 117
APPENDIX D 122
Samples of Filled Data Analysis Form 122
D.1. A Sample of Filled Observational Data Analysis Form (Student Learning) 122
D.2. A Sample from Filled Observational Data Analysis From (Teacher Moves) 123
APPENDIX E 124
Samples from Our Interpretations of Each Observed Lesson 124
E.1 A Sample from Coder A's Interpretation 124
E.2 A Sample from Coder B's Interpretations 125
E.3 A Sample from Coder C's Interpretations 126
E.4 A Sample from Coder D's Interpretations 127
APPENDIX F 128

APPENDIX G 129
APPENDIX H 130

LIST OF TABLES

TABLES

Table 1. 1 Characteristics of Official Activity Setting in Classrooms 6
Table 2. 1 Comparison of Prior and New Mathematics Programs..... 30
Table 2. 2 Opinions of Mathematics Teachers on Frequency of Their Usage of Discursive Practices in Classes 33
Table 2. 3 Students' Opinions on Frequency of Usage of Discursive Practices in Classes 35
Table 3. 1 Observed Lessons and Observation Dates 52
Table 4. 1 Obtained categories for content subcategory of student learning case 60
Table 4. 2 Obtained categories for learning subcategory of student learning case69
Table 4. 3 Obtained categories for content knowledge and pedagogy subcategory of teacher moves cases..... 74
Table 4. 4 Obtained categories for creating learning environment subcategory of teacher moves case..... 79

LIST OF FIGURES

FIGURES

Figure 2. 1 Flow of Interaction in Classroom 18
Figure 2. 2 Areas of Focus of Discourse 1 19
Figure 2. 3 Areas on Focus of Discourse 2 20
Figure 3. 1 The seating plan of participated classroom..... 43

CHAPTER I

INTRODUCTION

Research studies on mathematics education have gained importance because of the troubles that students have with learning mathematics. Since this seems to be a general problem in the world, educators have developed a great deal of approaches and many educational reform movements in mathematics education (Hiebert & Wearne, 1993). From the many aspects of these educational reforms process of learning mathematics is generally perceived as a social enterprise, taking place during the interactions in a classroom community, which provide opportunities and chances for students to learn by thinking, talking, agreeing, and disagreeing about mathematics (Cobb, Yackel, & Wood, 1992; Lampert, 1990).

Since the language and communication, aspects are not new in mathematics classes, a question would arise "Why have these become more discussed recently?", or more specifically, it would be asked, "Why has classroom discourse become more essential and focused issue rather than as it is before?"

Sierpinska (1998) highlights this subject by saying:

> "Language in mathematics education has always been an issue, but now the attention has shifted from the study of texts to the study of language in action-its use in different contexts and as a part of social practices; in brief the focus has moved from language to discourse." (p.30)

Additionally, NCTM (2000) has a supportive effect on increasing popularity of usage of communication and writing (Green & Johnson, 2007). Related reform movements have also highlighted that communication is a necessary tool for teaching and learning of mathematics (NCTM, 2000). However, only communication cannot offer an effective learning. Research has showed that to provide a conceptual understanding, quality and type of discourse is important (Kazemi & Stipek, 2001). This kind of descriptions has made

mathematics classrooms to be seen as learning societies instead of being a collection of children (Hodge, 2008). Among reform movements and related studies, many of them are interested in examining of whole class discussions. Zolkower and Shreyar (2007) believed that for a meaningful classroom discourse, students should involve in a "*thinking aloud*" (p.178) discussion and they should have chance to share their own mathematical ideas and solutions with classmates under the leadership of teacher. This is an important approach to classroom discourse, because when some mathematics problems have a complex understanding, planning and solving process; it would be helpful for students to share their ideas with others; to write a solution plan for understanding them meaningfully. As students are allowed to explore classroom activities with each other, this environment is providing opportunities to improve their communication skills. By learning to work with each other, they would have chance to discover different solution strategies for mathematical problems. Hence, the classroom, which is shaped by interaction, occurs among students and teacher has impact on shaping the quality of classroom discourse (Cazden, 2001).

Related to many studies specifically have focused on mathematical classroom discourse (Hufferd-Ackles, Fuson, & Sherin, 2004; Inagaki, Morita & Hatano, 1999; McCrone, 2005; Nathan & Knuth, 2003; Sherin, 2002; Zolkower & Shreyar, 2007;), kinds of classroom discourse models have been offered by researchers. For instance, Nathan and Knuth's (2003) model was a graph showing the directions of discourse among participants of a whole class activity. Hufferd-Ackles, Fuson and Sherin (2004) offered a model explaining the levels of developments in mathematical language for teacher and students. In their study, Truxaw and De Franco (2005) investigated interactions by categorizing talking styles. By this way, they tried to develop a discourse model in elementary mathematics classes. Related to results of this study they have pointed out that providing a model for classroom discourse can be helpful for mathematics educators, especially for mathematics teachers and researchers to understand mathematical instruction meaningfully and to improve their content and

pedagogical knowledge. Usage of that model can provide opportunities to examine some patterns and identify themes (Truxaw & De Franco, 2005).

Looking at the reform movements in mathematics all around the world and the lack of the quality in mathematics education, there have been also some efforts about the issue in Turkey in recent years. One of these novelties that come with reform movements was the development of new Elementary Mathematics Curricula. In the new program, changes has placed to increase the quality of mathematics education and related to this, importance of quality of classroom discourse is stressed (MoNE, 2005). In following sections of this part, it will be also discussed about how the classroom discourse was integrated in the curricula and in which ways it was defined.

1.1. The Definition and Importance of the Classroom Discourse

In general, mathematical discourse has been defined as a "purposeful talk on a mathematics subject" (Pirie & Schwerzenberger, 1988, p.460). In addition, Gee (1996) defines discourse as:

> "…ways of talking ,listening, acting, interacting, believing, valuing, and using tools and objects in particular settings…" (p.128)

However, it would not be right to see discourse just as a talking way (Hiebert & Wearne, 1993). It gets the meaning with involvement of some aspects. According to this statement, mathematical classroom discourse can be described as whole-class discussions in which students talk about mathematics to get deep understanding of concepts. Students learn to engage in mathematical ways of thinking and self-perceiving which would be described as a deeper understanding of concepts (McCrone, 1997). In addition, classroom discourse is expected to involve asking questions about solution ways of a problem or reason for a chosen method. Questions would come from both students and teachers. By this way, students would learn to evaluate their own and others' ideas, find efficient mathematical solutions (Hiebert & Wearne, 1993, McCrone, 1997). In the same context, NCTM (1991) defines discourse as:

"…the ways of representing, thinking, talking, agreeing, and disagreeing that teachers and students use to engage... *"* (NCTM, 1991, p.20.)

After the definition the nature and requirements of classroom discourse is also mentioned below:

> *"*Its nature is reflected in what makes an answer right and what counts as legitimate mathematical activity, argument, and thinking. Teachers, through the ways they orchestrate discourse, convey messages about whose knowledge and ways of thinking and knowing are valued, who is considered able to contribute, and who has status in the group*"*(NCTM, 1991, p.20)

Hicks (1995-1996) define discourse as "discourse implies dialectic of both linguistic form and social communicative practices. Use of the term discourse implies a decision about how classroom communication is to be theoretically positioned in research on teaching and learning." (p.51) Moreover, she points out that discourse is a social construct that leads and constitutes teaching and learning process that occurs in classroom environment. According to Yackel and Cobb (1996) to get place in this discourse community, it is a necessity for students learn the usage of mathematical language in their daily language. To create a classroom in which a mathematical discussion occurs, students are responsible with explaining, justifying, or proofing their activities in a mathematically acceptable way (Yackel, 2000). Additionally, in a classroom as a community, usage of some aspects of language makes the discourse occur. The main aspects are reading, writing, speaking and listening which provide to communicate concepts, ideas, etc. (Beatty, 2001). In the same study vocabulary have been accepted a key to all these aspects, since its usage is a source in providing mathematical symbols for mathematics concepts. Meaning of these concepts should settle in discussions with reading, writing, speaking, and listening since discourse is shaped by these (Beatty, 2001). From a different view, Sherin (2002) saw classroom discourse in two dimensions. First definition was about the "process":

> "...the process of mathematical discourse refers to the way that the teacher and students participate in class discussions. This involves how questions and comments are elicited and offered, and through what means the class comes to consensus. (p.206)

Second one was related to "content":

"…the content of mathematical discourse refers to the mathematical substance of the comments, questions, and responses that arise." (p.206)

As an example to these definitions; when the question "Are students have opportunities to state and share their ideas with their peers?" concerns with the process; the question about the appropriateness of these ideas to mathematical curriculum goals, concerns with the content of classroom discourse.

In this study, characteristics of classroom discourse are analyzed with respect to both process and content of discourse. For instance, while kind of students' thinking and their way of making connections in and outside to mathematics is investigated under the title of content; their engagement in activities, discussions and usage of variety of demonstration models are placed in process part. Since the essence of classroom discourse is legitimate and its affect on students learning is a doubtless issue, studies which try to explore classroom discourse in its own setting seems to be a necessity (Leonard, 1997).

1.2. What the New Elementary Mathematics Curriculum Says about the Classroom Discourse

Before exploring the new program, it would be significant to have a look at some other programs developed parallels to reform movements and their visions.

Forman (1996) mentions about "What reform movements call for in mathematics lessons?" According to her statement, there is an emphasis on enhancing students' communication abilities and working collaboratively with classmates in new programs. In addition, she points out the importance of active involvement in problem solving process which is stressed in those programs. In the same article Forman (1996) uses following table to compare traditional versus reform classrooms:

Table 1. 1 Characteristics of Official Activity Setting in Classrooms (Forman, 1996, p.122)

Activity settings And Personnel	Values	Task Demands	Scripts	Purposes
		Traditional Mathematics Classrooms		
Teacher-led recitations	Teacher or text are sources of learning Automaticity and accuracy	Internalize mathematics facts and algorithms	Recitation script	Introduce basic skills
Individual Seatwork	Teacher or text are sources of learning Automaticity and accuracy	Practice mathematics facts and algorithms	Work independently	Individual mastery of basic skills
		Reform Mathematics Classrooms		
Student-led Presentations	Multiple sources of learning Multiple solutions Effective strategies and explanations	Pedagogical and communication skills	Instructional conversation	Establish community of learners
Small group work	Multiple sources of learning Multiple solutions Effective strategies and explanations	Cooperation and communication skills	Instructional conversation	Establish community of learners Foster collaborative problem solving

While looking at the table above it is possible to see that a quality classroom discourse means a reform classroom at the same time. This would be a good source for question "Why classroom discourse has become more essential parallels to reform movements in mathematics education." Moreover, this table would be helpful to understand "What kind of classrooms we need and it is expected to create after development of new program in Turkey?" It will be

clearer after examining the program that similar conceptions are underlying the vision of it.

Green and Johnson (2007) advocates related to NCTM that a school program must be developed in a way to provide students to coordinate their understanding of mathematics by interaction, promote usage of mathematical language both when justifying and explaining their own thinking and evaluating classmates' strategies. Similarly, Meyer, Midgley, Patrick and Turner (2003) mention a math curriculum called "Connected Mathematics" and its emphasis on mathematics lessons. According to their commentary, mathematics classes should have real world applications, including manipulatives. Teachers are expected to encourage students working in-groups or in pairs. Another significant example is Romberg's (2001) broader information, about the project called MiC (Mathematics in Context) which was occurred to provide the teaching style designed in NCTM Professional Standards for Teaching Mathematics as mentioned above. According to Romberg's (2001) statement, in this curriculum project, units have tasks, questions, and activities aimed to involve students in mathematical classroom discourse. With this program, students are expected to develop different strategies for problems, learn to work together, listen, and understand others' ideas and explain their opinions and strategies in a mathematical logic. Moreover, teachers are expected to encourage their students in usage of mathematical terms, rules, symbols etc. to provide a deeper understanding. Romberg's emphasis is on making connections between different mathematical tasks, and between mathematics and real world situations.

Above some information was given about currently developed programs, which has placed the students' participation at the central part of classroom practices. Related to these efforts to enhance the quality of mathematics education all around the world, our new curricula have been developed as one of the reform movements in Turkey. In our new curriculum, there is also a strong emphasis on active learning and a quality classroom discourse in math lessons. Its principle is based on the idea that "all students can learn to do mathematics" (MoNE, 2005).

This idea is the same as the one that mentioned in NCTM's "-Curriculum and Evaluation Standards for School Mathematics-" (NCTM, 1989). Further, in the new curricula, the statement about the importance of classroom discourse is as following:

> "To improve their mathematical communication skills, students need to share their ideas with their peers. Another way to improve these skills is writing about and on mathematics. Students can be required to write about the way of their solving a problem or want them to explain what a rule means. To talk and write about/on mathematics will help them to construct the mathematical concepts easier. Teacher should provide appropriate classroom discourse in which students have opportunities to explain their ideas, discuss, and explain by writing. Teacher also should provide this environment by appropriate questioning*".* (MoNE, 2005, p.13)

Significantly, Bulut (2007) explains the idea underlying the reforms in Turkey as: shifting the program from subject-centered form to student centered one. In the same article, some aspects of new curriculum are mentioned. The important ones fit with requirements of classroom discourse would be summarized as: its requirement from students' actively participation in learning practices and process, giving them chance to express and share their own opinions and abilities by assigning projects and homeworks, aiming to provide classrooms for students to enable them discuss and discover different solutions and strategies (Bulut, 2007).

The given information on 2005 curriculum tells us about the kind of mathematical concepts which are aimed to developed. In addition to others, mainly problem solving and communication skills are integrated and stressed in the program (MoNE, 2005).

Related to the given information about the importance of the classroom discourse in mathematics education, this study aimed to provide deeper understanding about the ongoing process of the issue in Turkey.

1.3. Research Problem

Research Problem: In what ways mathematical classroom discourse is practiced in a fifth grade mathematics class in a regional boarding elementary school?

This study specifically focused on the issues given below;

1. What are the general characteristics of student learning in classroom discourse in a fifth grade mathematics class in a regional boarding elementary school?

1.1. What are the features of students' behaviors related to content of the lesson with respect to classroom discourse?

1.2. What are the features of students' behaviors related to learning case of the classroom discourse?

2. What are the general characteristics of teacher moves case in classroom discourse in a fifth grade mathematics class in a regional boarding elementary school?

2.1. How does the teacher's content knowledge and pedagogy fit the requirements of classroom discourse?

2.2. How does the learning environment created by the teacher fit the requirements of classroom discourse?

1.4. Significance of the Study

Since the importance of this kind of studies comes from classroom observation process, first it would be significant to mention about essence of this issue.

Parallel to recent reform movements in mathematics education and its aspects, it has become one of the most interested subject that what happens in classrooms, and related to this an increasing attention has given to the classroom observation. O'Sullivan (2006) has an important view on issue by stressing that the quality of primary education is clearly related to studies with classroom observation. According to this statement, for most of the developing countries, studies on quality of primary education are placed at center of process since the quality is critical for children's future life. There is a call for attention to poor quality of programs and projects which have been attempted to develop since 1990s. O'Sullivan's (2006) opinion is in a way of engaging with the reasons to overcome with all disadvantages in process. He indicates -by pointing out the literacy- that since the beginning of the illness in education is placed in classroom where teaching and learning occurs, classroom observation studies should have a primary place in the education agenda, they would try to evaluate "what happens" there.

The given information above fits with the condition of Turkey's education system. Since Turkey is already a developing country, our education system also has deficiencies and needs to be made critical changes in it. Currently, efforts have spent compared to the previous years to increase the quality, yet still it is early to say that last innovations are complete and perfect. Since the changes have been made under influences of other countries' programs or researches, some practices do not fit perfectly well with our classrooms or education system. There are many factors create these incompatibility, like economical differences, lack of materials in classes, being teachers' unready to these kind of changes. These listed factors create disadvantages to reach a high quality in education system (Bulut, 2007). To cope with the obstacles more studies should be conducted that based on

classroom observation to investigate what goes on in classrooms, around what aspects lessons are oriented (McCrone, 2005).

More specifically present study is expected to be helpful for highlighting elementary mathematics classroom discourse quality related to new program. In Turkey, still there are not sufficient studies with a basis of observation focusing on mathematical classroom discourse. Study may constitute a source to see current practices with their deficiencies and requirements and may contribute to arguments about "What kind of coordination would be made in order to use classrooms more effective places in learning sessions?" To state differently, this study aims to improve our understanding about what classroom discourse means, what are its aspects, where its importance come from, what are the teacher's and student's role in a discourse-based classroom. In addition, the study may provide a vision for teachers about interpretations of a discursive classroom with different dimensions of practices and routines of this learning environment.

Other expectation about the results of the study is, it would be helpful for both pre-service and in-service teachers' getting insights about "What's going on in classrooms?", and "In what ways current teachers lead the classroom discourse?" This approach would affect them in different aspects. In-service teachers would try to see their deficiencies in orchestrating classroom practices and in usage of discourse in these. To create learning environments that is more efficient, they would feel themselves responsible with changing their teaching activities in an expected way. They would make deeper analysis in the new elementary mathematics program to get a better understanding of requirements from teachers. Additionally, evaluating the results would make pre-service teachers to constitute a strong base before starting teaching career to provide more effective classrooms in which discourse is placed at the center of it.

Moreover, an important effect of classroom practices -in this study specifically observed classroom discourse practices- would be on teacher education programs of universities (Doğan, 2006). All teachers are confronted with the reality of the teacher education programs' differing from their working

conditions. As Çakıroğlu and Çakıroğlu (2003) stated (as cited in Doğan, 2006) that current teacher educator programs are far away from real classroom practices. Furthermore being both an in-service teacher and a researcher make the one realize this difference more clearly. Results of this study may constitute an example for teacher education programs that reminds not to underestimate real classroom environment. They would add this kind of study examples to their programs to make pre-service teachers be aware of what kind of situations they would confront with. They would organize their programs over again in a way adapting their courses to real classroom discourses.

1.5. My Motivations for the Study

The observer's experiences and opinions about the issue of mathematics discourse may produce some effects on overall process of the study. Identification of these issues would be provide a better understanding for readers in getting insights related to intentions of study. In addition, it would be helpful for them in drawing inferences from the results of study by relating to written statements below.

As a three-year-worked mathematics teacher, I also have gained some ideas about mathematics teaching and learning; furthermore I have learned to look from different perspectives to the issue when compared to my experiences in school life.

Being a public school graduated person, I was programmed to learn and do what our teachers say. I also involved in traditional mathematics practices during my both elementary and secondary education process. After beginning of teaching profession and to masters program at the same time, I have realized the changes in mathematics education all over the world and efforts in Turkey parallel to these movements. All these issues have made me to find myself in a contradiction between new attempts and experienced situations in the way deciding how to act in teaching processes; and have driven me to study on this kind of issue. By conducting this study, also I have aimed to complete deficiencies in my own teaching practices.

Especially beginning masters program have made me to think deeper about the issue of mathematics education, specifically about classroom discourse activities. Currently, I support that the teacher's role should be acting as a guide or an orchestrator of discourse in class. Contrary to traditional practices, teacher's should limit their talking duration with teaching essential concepts and leading role; and should provide students more chance to express their ideas and involve in learning process actively by having speech and discussion with classmates and teacher. In my opinion, students' own identification are crucial in getting real understanding of mathematics. They should be aware of the reasons of practices with mathematical meaning underlying them. Students under the guidance of their teacher should practice all aspects of discursive classroom that are mentioned Sierpinska (1998). Exploration, discussion, learning to listen and respect others ideas and getting knowledge from them, sharing own opinions and inferences with classmates, using mathematical language as possible in their arguments and explanations, getting the ability to make connections to prior work in mathematics or to other disciplines should be placed in essential part of students' discourse practices. They should definitely be away from being a collection of passive listeners in a restricted area (Sierpinska, 1998).

Additionally, in spring 2007, (the second term of my master's education), two of the articles we studied attracted my attention. When those articles were our homework, I wrote my best reflection paper in spite of my bad English. "Reflective Discourse and Collective Reflection" by Cobb, Boufi, McClain, and Whitenack, (1997) and "Instructional Tasks, Classroom Discourse, and Students' in Second Grade Arithmetic" by Hiebert and Wearne (1993) made me think about the issue of classroom discourse. In the same year after my start of working in a public school as a mathematics teacher, I decided to focus on this subject in my master's thesis. Although the study does not show my teaching performance, my idea is to complete my deficiencies and try to perform better in lesson practices.

1.6. Definitions of Important Terms

In this part, definitions of important terms are presented.

Classroom Discourse; refers to the "ways of representing, thinking, talking, agreeing, and disagreeing that teachers and students use to engage" (NCTM, 1991, p. 20).

In this study, the term refers to practices occur in classroom during the lesson sessions including students and teacher interacting with each other. Specifically this interaction should have mathematical feature to make students to get significant understanding. Teachers are expected to foster students' usage of mathematical language acting as a model for this. Asking questions, facilitating connection to other disciplines, real world situations and to prior work in mathematics, assessing prior knowledge and student understanding, encourage students' alternative solution strategies, proof and justification are other aspects of mathematical classroom discourse. Moreover, some other aspects can be listed for student roles as; using variety of representation models (graphs, drawings, writing etc.), being able to work in pairs or in groups, offering different solution strategies and demonstrating that their strategies work (NCTM, 1991, 2000).

Discursive Classroom: refers to a classroom model in which the ways of representing, thinking, talking, agreeing, and disagreeing activities are practiced by teachers and students (NCTM, 1991).

In the current study, this term is used to define aspects of discourse practicing by community members.

Student Learning: refers to **"**student learning and the evidence of that learning within the mathematics classroom" (CMSI, 2007, p.3).

In this study students learning case specifically focused on content and learning cases of students related to the guide of CMSI (2007).

Content case interested in kinds of thinking that students engaged in as: procedural, conceptual thinking or problem solving and justification process etc.

Learning case investigated the level of students' participation to the classroom activities.

Teacher Moves: refers to "questions that focus on the instructional decisions that teachers make during the course of a lesson to promote learning" (CMSI, 2007, p.3).

Teacher's Content Knowledge and Pedagogy: refers to the teacher's abilities about leading activities and practices of classroom discourse, his or her choice and usage of appropriate teaching methods and techniques (CMSI, 2007).

Procedural Thinking, refers to "solving problems that involve procedures or standard algorithms" (CMSI, 2007, p.7).

Conceptual Thinking, refers to "developing conceptual understanding of the mathematical ideas" (CMSI, 2007, p.7).

CHAPTER II

LITERATURE REVIEW

"Classrooms are filled with complex dynamics, and many factors could be responsible for increased student learning" (Grouws & Hiebert, 2007, p.373)

In this chapter, a review of literature about the classroom discourse is presented. In the first part, related to research study, detail information is given about "What is mathematical classroom discourse?" and "What components does it have?" Secondly, the information about the theories underlying classroom discourse is briefly presented. In the third part, conducted researches on discourse are evaluated. Finally, studies about discourse and new mathematics program and other changes in development of mathematics education in Turkey are mentioned.

2.1. The Nature and Components of Classroom Discourse

Since the reform movements have emphasized the quality of mathematical experiments occurred in classroom environment many researchers (Hiebert & Wearne, 1993; McCrone, 1997; McCrone, 2005; Yackel & Cobb, 1996) focused on this issue. Cobb, Boufi, McClain, and Whitenack (1997) have suggested that:

"The current reform movement in mathematics education places considerable emphasis on the role that classroom discourse can play in supporting students' conceptual development." (p.258)

In her study, McCrone (2005) defined the term "discourse" as exchange of students' ideas and knowledge during the classroom practices. Sfard (2000) pointed that discourse is "more comprehensive than knowledge" (p.161). In this view, Sherin (2002) stated that discourse "refers to the mathematical substance of the ideas raised, to the depth and the complexity of these ideas in terms of mathematical concepts under consideration. Furthermore, the content of the discourse concerns how closely the ideas that are raised in discussion are aligned with the teacher's curricular goals and with mathematics as it is understood by the mathematical community that exists beyond the boundaries of the classroom." (p.209)

According to Ball (1991), classroom discourse has nature that plays an important role in promoting the valued thinking and learning. She says that it has a critical role in improving the quality of thinking and learning. She also mentioned that classroom discourse should be used in mathematics education to make students to have the idea of doing and learning mathematics (Ball, 1993). Additionally, Lampert (1989) stated that in mathematics classes new knowledge should be "a joint venture in the class rather than as a communication from teacher to student" (p. 257). Similarly, Sfard (2001) stresses the importance of discourse by saying "…there is more to discourse than meets the ears, and that putting communication in heart of mathematics education is likely to change not only the way we teach but also the way we think about learning and about what is being learned." (p.13). Moreover, in NCTM (2000) importance of communication as a part of classroom discourse is mentioned as "an essential part of mathematics and mathematics education" (p. 60).

Analyzing the suggestions of NCTM standards (1991) mathematics lessons are expected to be away from traditional paper and pencil based concept and must get a discourse-based form. This kind of changes in area calls for teachers and students work together for stating, sharing and discussing mathematical ideas. On the other hand, in a discursive classroom environment, it is not enough for students to state and share their ideas, also they need to prove if

they are mathematically meaningful or not. Students are required to learn to judge other's ideas whether they give sufficient explanation about the issue or make a good justification about the solution (NCTM, 1991). In the same document, it is emphasized that in a discourse-based classroom students' participation should be placed in central.

When it is compared to traditional classrooms, in discourse based classrooms, teachers seem to act in roles that have different dimensions. For instance, in teacher-dominant traditional classes, teachers are seen mostly responsible for presenting the procedures, rules of mathematics (Forman, 1996). However, looking at discourse-based classrooms, in addition to tell the facts and procedures, there are many ways to communicate with students. Teachers should try to look for alternative strategies to build an effective interaction in class. Here it is crucial their providing appropriate settings for student (Ball, 1991; Ball, 1993; Bruce, 2007: NCTM, 1991). Related to these comments, it can be deduced that instead of flowing the knowledge with only one-way interaction (from teacher to student), communication should follow the way given below:

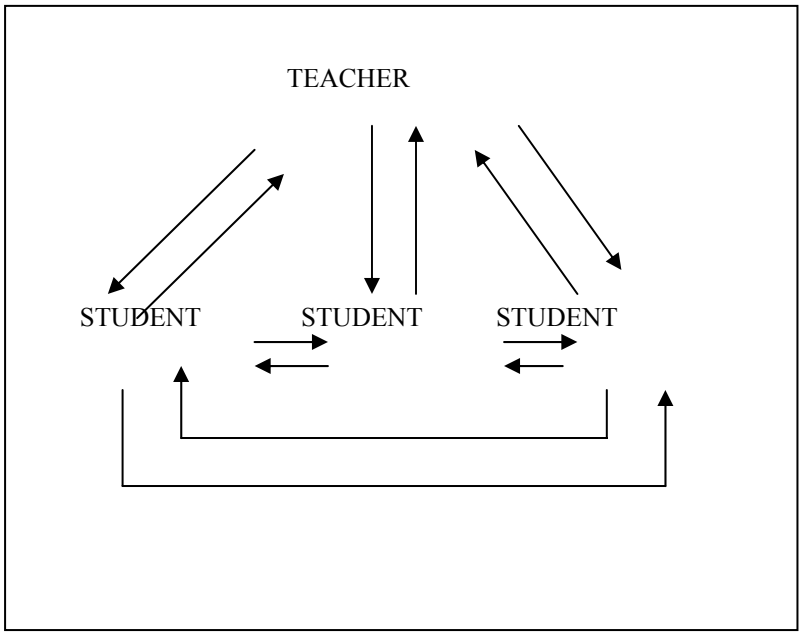


Figure 2. 1 Flow of Interaction in Classroom (Peng, 2009)

Also in her study, McCrone (1997) uses the following figure to explain the components of classroom discourse:

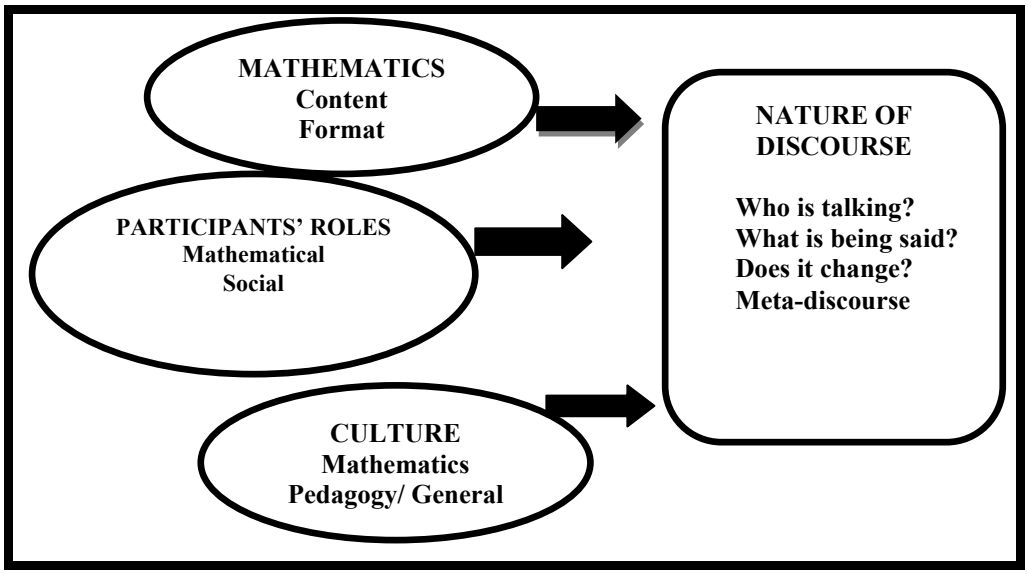


Figure 2. 2 Areas of Focus of Discourse 1 (McCrone, 1997, p.129)

She explains that the figure above "indicates that the mathematics, the participants' roles, and the classroom culture all influence the nature of classroom discourse" (p.14). More specifically, she presents the following figure to provide a narrower view to the issue:

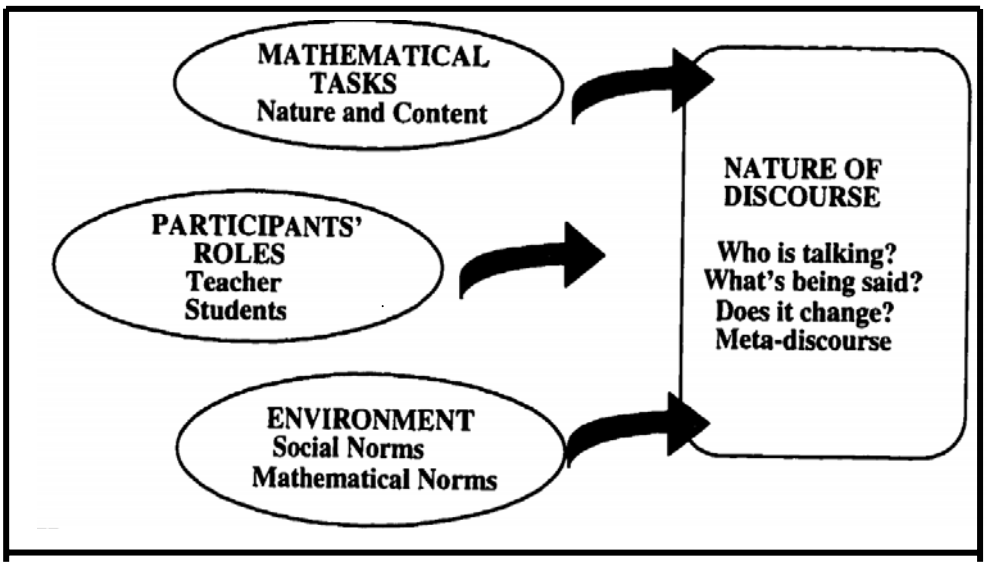


Figure 2. 3 Areas on Focus of Discourse 2 (McCrone, 1997, p.129)

In the classroom, teacher and students create discourse as they participate in mathematical discussions occur in lessons (McCrone, 1997). Each of them has a critical role in the process of forming the discourse in mathematics classes. Parallel to this view, NCTM (1991) addresses both the teachers' and students' role in discourse and the learning environment of mathematics classrooms. In NCTM (1991) it is said "teachers should promote classroom discourse in which students listen to, respond to, and question the teacher and one another; initiate problems and questions; make conjectures and present solutions; try to convince themselves and one another of the validity of particular representations, solutions, conjectures, and answers" (p. 45). It is stressed teachers should act as a guide of this nature, by listening to students, and encouraging them to get their own places. They are viewed as guide, leader, or an orchestrator. A teacher should provide opportunities to students to explore mathematical ideas themselves; make them to learn to think about their peers' ideas to see their own mistakes. It is important for a teacher leading the classroom discourse, guiding the discussion and activities carefully; to provide this kind of environment teacher must act as a real mathematical authority (NCTM, 1991). While acting this role they are expected to

give opportunities to students to make sense of mathematics (NCTM, 1991). Additionally, Ball (1991) says, "teachers play a crucial role in shaping the discourse of their classroom through the signals they send about knowledge..." (p. 44). Students (especially from one to eight graders) mostly view their teachers as a mathematics authority there. He or she constitutes a model that makes students to decide whether given information is appropriate for mathematics or not (McCrone, 1997).

Recent reforms in mathematics education have suggested that teachers' role in building up meaningful learning environments is to help students to promote their mental development (Fennema & Franke, 1992). To provide these opportunities more effort should be spent for allowing them to discover mathematical ideas, improve their understanding of concepts and learning to make connections to other mathematics subjects, to other disciplines and to the real world situations (Brown & Borko, 1992; NCTM, 1991).

Parallel to this view Harbaugh (2005) has stated in her doctoral dissertation that teachers act as a bridge between students' conceptual understanding of mathematics and their communication in classroom. A good explanation on the issue has been made in McClain, McGatha and Hodge (2000). They have mentioned that in discourse based classroom settings, the teachers are expected to lead and orchestrate the classroom norms to make students to involve in meaningful mathematical discussions with students. These discussions are expected to have asking questions and giving answers, problem solving activities, drawing inferences and evaluating mathematical interactions. They have pointed out that an increasing emphasis on discourse and communication in mathematics classes enables students to talk about mathematical ideas and strategies.

Furthermore, Pierson (2008) focused on the same issue (teacher's role in classroom discourse). Analyzing this research, it was concluded that certain discourse based moves such as asking high level questions, fostering discussion, re-voicing, focusing on students' thinking provide opportunities for a significant understanding of concepts. Moreover, in some cases it directly affects achievement in a positive way (Pierson, 2008).

Students' role in classroom also has importance in mathematics lessons. Creating classroom discourse is directly related to their understanding of problems, engaging in problem solving process by interacting with each other, participating in classroom discussions in a significant way. Here teachers act in encouraging students' participation. Children's justifying their answers, offer appropriate alternative solution strategies, sharing ideas and answers with class, proving to others that their strategies work, are also critical elements of discourse. As students are active participants of discourse, they are expected to settle believes, opinions, values and perspectives to the mathematical discourse in a way being consistent with classroom community (Beatty, 2001). In brief, things mentioned above can constitute an answer to question, "What kind of roles teacher and students play in discourse?"

According to the statements, it can be stated that students also effect and form classroom discourse by the way they use mathematical language (e.g. using mathematical terms to explain and justify their answers to each other, offering alternative solution strategies to the problems with their reasons and proofs, writing to show their understanding of mathematics). From this point of view, Cooke and Buchholz (2005) state that the communication standard of NCTM, highlights the importance of students communicating and sharing their ideas with their classmates and with teacher. They believe that some teacher movements can create a discourse-based classroom environment. For instance, teachers can enhance using math language. They say:

> "They can act as models as they use math language. Moreover, strategies such as providing materials for young children to explore and asking them math- related questions should be utilized to generate verbal participation. Additionally, use of appropriate questions can stimulate children's reasoning abilities as they respond to your inquiries while exploring objects in their world. Children should be encouraged to use math language in their responses" (p. 369)

Similarly, Lampert and Cobb (2003) stress the importance of the issue by saying:

"Like other aspects of mathematics, communication and language need to be taught and learned in school classrooms" (p.237)

In their view, communication is one element of practices of mathematics class or community. Related to the statement, it is not possible to separate learning to communicate from communication, which is the way for students' development of mathematical understanding. Usage of mathematical language and symbol is needed for learning to take place. For instance, building mathematically meaningful argumentations, students should use a common language to express their reasoning (Truxaw, 2004).

Interpreting the research conducted on providing effectiveness of classroom discourse, Hoffmann (2004) listed some outcomes; the quality of mathematical talk, such as whether the talk maintained cognitive demand or mathematical precision; whether students were highly involved; the reported motivation of students; students' achievement (p.52).

Similarly, Cooke and Buchholz (2005) identified some informal strategies that teacher should use to enhance students' use of math language. Strategies, which are important to create an effective classroom environment can be summarized as; serving as a facilitator, providing opportunities for self-expression, asking kinds of questions, fostering usage of appropriate terms in mathematics discussions, connecting classroom practices to mathematics, helping students to connect new knowledge to the prior one.

According to Brophy (1999), some teaching features have potential to create an effective discourse environment. For instance, a teacher is expected to ask questions to students whether they are able to find different solution strategies for problems. In addition, created discussions would be interested in the meaning of procedures underlying them rather than the procedure or rule itself.

In the same context, Kazemi and Stipek (2001) has pointed out that a meaningful discourse may enhance learning but it does not mean that students'

thinking and understanding will improve. It is crucial that teacher show the way of conceptual and procedural thinking of mathematics. To be an effective guidance of a classroom discourse, teachers should improve their ideas on content knowledge and pedagogy. This requires teacher facilitate connections to other disciplines, to real world situations and to prior work studied in class, use problem solving process to promote understanding, rather than practicing the rules and procedures repeatedly. Related to these features, also Grouws and Hiebert (2007) stressed the value of making connections among mathematical concepts and usage of different demonstration types in class practices by saying, "…..- to connections among mathematical ideas and representations- can facilitate student's conceptual understanding" (p.384).

Classroom discourse makes teachers identify problems and misconceptions that students have. Discourse is not only crucial in developing interaction between students and their mental skills, but also in enhancing the teacher's evaluation of analyzing their own effectiveness and deficiencies in the classroom. Furthermore, a classroom discourse allows students to experience the mathematical understanding process and increasing their mathematical empowerment by this way (Moore, 2002). In this part, general futures and components were discussed around the related literature. In the following part, theoretical perspective of classroom discourse will be discussed in the same way.

2.2. Theoretical Perspective

Most of the mathematics reform efforts point out the importance of student-centered communication in which students take an active role in classroom discourse, instead of teacher-dominant classroom (Forman & Ansell, 2001). When the literature has considered many conceptions about learning, especially social-cognitive and social-constructivist perspectives address the valuable place of student engagement in learning process (Cobb, Yackel, & Wood, 1992). Between two approaches, more important one underlying the classroom discourse seems to be constructivist views of learning in which

knowledge is built up by interaction within the classroom environment. In addition, it is possible to say that discourse fits with socio-cultural views on learning according to which students working together are able to reach new understandings that could not be gotten if they work alone (McCrone, 1997) .

Most known issue that beginning of the social constructivist view goes to the Vygotsky's time (Temple, 2008). In the document, it was summarized the aspects of social constructivism underlying classroom discourse. He stated that the social constructivism affects the relationship between language, literacy, and content. According to him, Vygotsky's idea was to conceptualize these aspects under the influence of the theory. He interpreted that Vygotsky's views about the social aspects of language and knowledge development; moreover, his relating thought and language have affected literacy in a way paying more attention to the role of language in learning. Since they faced both inside and outside of the school, meaning has become a social construction with participants' involvement of multiple discourses (Temple, 2008). More broadly, Au (1998) suggested from the beginning of those movements, discipline knowledge have not just existed in textbooks, it has started to seem to be constructed by teachers-students interactions with each other. Cobb (1988) mentioned social constructivists' view mathematical learning as an interactive activity, as it is a constructive activity. Classroom discourse plays a significant role in this interactive part. In the group interactions, which can be a source for the development of mental abilities and mental activities, students internalize most of the talk that occur in there. By this way, they begin to think deeply about issues, challenge themselves, ask for reasons, and in general, their own mental works do their daily language. According to Moore (2002) an aspect of the constructivist response to improve students' mathematics understanding is the increase of their opportunity and ability to participate in mathematical discourse. Additionally, it would be significant to state that the kind of group work and communication Cobb mentioned above, parallels with the vision for classroom discourse pointed out in the NCTM (1991).

2.3. Studies on Mathematical Classroom Discourse

Since reform movements in mathematics education have reached an incredible speed and issue of classroom discourse has become more discussed, research on this area have increased parallel to the circumstances. In this part, I try to focus on some of these studies. First, literature is considered and some researches on mathematical classroom discourse are mentioned, and then theses are examined in the same way. Here, the given information about studies is chosen from other countries, Turkey's condition is mentioned in the following part.

Given an emphasis on mathematical discourse recently, research focuses on the subject have increased parallel to that. There has been an improving demand for investigation of classrooms to explore what kinds of practices are occurred in them.

Studies on classroom discourse in mathematics lessons have generally conducted on different aspects of it. For instance while Stipek et al. (1998) interested in student engagement; Yackel and Cobb (1996) studied on classroom norms of discourse. They focused on determining the discursive practices that can be considered significant for mathematical context. Again, Yackel (2002) investigated the same issue. Hiebert and Wearne (1993) studied on the importance and effect of classroom discourse on students learning process of mathematical concepts. They compared the traditional and discourse-based approaches to obtain whether there was any linkage between classroom practices and learning mathematics. Results of their study showed that there was a relationship between instructional approaches used in classroom practices, which have critical role in shaping the nature of classroom discourse and students' learning. In addition, Lampert (1990) have examined the kind of reasoning abilities that occur during mathematical classroom discourse when students and teacher engage in. In that study, students and teachers worked on some problems that are generally related to real world situations. The working group students' solutions to these problems are categorized as right or wrong hypothesis. With these changes in classroom discourse, students' performances clearly improved on tests.

In another important research on classroom discourse, Teasley (1995) worked with fourth grader students who studied on a logo problem-solving task. They placed in four different experimental settings. These studies designed as; students worked alone with no talking, students worked alone with talking, students worked in pairs with no talking, and students worked in pairs with talking. Results of this study showed that working in pairs with having discussions and conversations is very effective on learning process.

In another study, Clement (1997) worked with a mathematics instructor who believed the importance of discussions and communication in math classes. According to her, as long as teacher gets students involved in classroom practices (e.g. conversations, problem solving process) they would have more opportunities to get a deeper understanding in mathematics tasks. Similarly, Clement's (1997) study focused on the quality of classroom discourse. The instructor videotaped her own teaching and viewed them after lessons. Results of this study showed that only engaging in conversations, questioning students, probing them for alternative solution strategies, making them to work in groups or in pairs, using manipulatives, does not mean that teacher provide an environment for students to get a deeper understanding. The important point would be stated as leading all these practices mentioned above in a mathematically significant way.

In another example, Heaton (2000) studied on her own teaching style and saw that it was easy to make students involve in a classroom discourse in which they state and share their ideas about mathematics. However, she understood that to lead the mathematical discourse effectively, she needed to get new understandings in this area and continue to improve herself. Furthermore, Cazden's (2001) research specifically have tried to bring descriptions to classroom discourse and involved analysis of it.

Focusing on investigating the vocabulary that first graders used, Ping's (2001) study aimed to support the discourse and communication in boundaries of mathematics. Their participation to discourse constitutes the basis of the study. Results indicated that classroom discourse would be accepted as a tool for

learning and as an indicator of identity. Furthermore, teachers' being models has a critical effect on children's attitudes toward communication by the way teachers' usage of mathematical language. Additionally, Casa's (2004) doctoral dissertation focused on teachers' decision-making in discourse practices in elementary level mathematics classrooms. Results of the study indicated that teachers should examine and understand the purpose, the nature, and the requirement of discourse. To provide students an environment in which they would discuss and prove mathematical solutions, strategies and ideas, teachers expected to learn how to question them in a way of engaging in discussions; and how to guide the classroom discourse. Also importance of making connections in and outside to mathematics have been highlighted again with this study.

Additionally, findings of Kelly's (2007) study showed that teachers' engaging in conversations which leads the lesson to provide a classroom discourse with students are at the center of it; students seemed to have more interest in asking and answering questions. They spent more effort to involve in education process. Therefore, it is more likely to see occurrence of classroom discussions. Moreover, when the class discussions increase, differences between low and high-achieved students explicitly decrease.

In a similar study, Pierson (2008), wanted to examine the relationship between patterns of classroom discourse and mathematics learning. Focus of her study was interactions that occur between teachers and students to describe and discover meaningful patterns of their discourse. With usage of classroom level measures, she tried to investigate the relationship between discursive patterns and students' mathematical achievement. Based on the results, she concluded classroom discourse and discussion patterns occurring as a necessity of discourse, affect and lead students' learning in a way of developing achievement (Pierson, 2008).

Similarly, Novinger (1999), Klihis (2003), Richards (2004), Miranda (2004), Thomas (2005) and Munkhjorgal (2006) specifically focused on mathematical classroom discourse and concluded that discourse has critical effect on students' learning in a positive way.

2.4. What Happens in Turkey?

As it is mentioned above, the new elementary mathematics program that started to be used in 2005 has been brought out to complete the deficiencies and to catch the developments in mathematics educations around the world.

Since the new program has been developed, many researches have been conducted and many articles have been published which are mainly interested in the quality and the success of it. It would be significant to give some information about them before the studies focused on classroom discourse.

When the literature has been considered in Turkey, there have been research studies, thesis and articles focused on analysis of new mathematics curriculum (Babadoğan, & Olkun, 2005; Soycan, 2006; Bulut, & Koç, 2006a; Bulut, & Koç, 2006b; Bulut, 2007; Koç, Işıksal, & Bulut, 2007; Güven, & Orbeyi, 2008; Orbeyi, 2007; Umay, Akkuş, & Duatepe, 2006). Some of these studies have tried to compare the program with other countries' curriculum (Arık, 2007; Kaytan, 2007).

Investigating it, Bulut and Koç (2006a) stress that teacher and student roles defined over again in the new program. In the article, expectations from students are stated as their talking, asking, discussing, and understanding, problem solving, thinking, and deciding independently. Program wants students to engage in education process, as physically and mentally active individuals. Same document points out teacher's role by indicating the principle "each student can learn mathematics", which constitutes base for the new curricula. According to the given statement, teacher should be learning, leading, motivating, listening, fostering students to think and ask, and getting responsibility, improving personal and professional abilities.

In their article, which examines the new mathematics program, Bulut and Koç (2006b) state that one of the most important effects on students' learning mathematics meaningfully, is their active engagement in education process both mentally and physically. Furthermore, as they share their ideas and results after an activity, this understanding would be powerful. Here, usage of different kinds of

representation models, acquire importance. In statement, first of all students are expected to express their ideas and solutions both orally and by writing. In addition, their using graphics, symbols, drawings, models are to enhance this understanding and meaningful learning.

Comparing two of them, previous mathematics curriculum was based on behaviorist theory. However, the new is considered as a reform based one (Umay Akkuş & Duatepe, 2006). Moreover, Babadoğan and Olkun (2006) summarized the differences between old and new elementary mathematics curriculum given table below. It would be helpful investigate the table to get some insights about what kinds of changes have been made in the program related to classroom practices, specifically related to classroom discourse. Additionally, it would be a useful tool to provide information for teachers, which makes them realize what they need to change in their teaching activities and classroom practices.

Table 2. 1 Comparison of Prior and New Mathematics Programs (Babadoğan & Olkun, 2006, p.3)

OLD	NEW
• Elementary school mathematics curriculum for grades 1 through 5 contains 1249 behavioral objectives were very uniform and dull. Both the textbook writers and the teachers are restricted to make very limited decisions. • The content for 4^{th} and 7^{th} grade is too dense to follow for students considering their development. • Teaching methods, techniques, and strategies are not student centered. • Content is organized based on how to teach • There are few sample activities that require the use of manipulatives. • There are overlapping content in other subject areas. • There are few examples of realistic mathematics. • There are limited number of alternative assessment techniques, extracurricular activities, research and projects. • All students are expected to exhibit the same performance, with no local flexibility or individual differences. There is little room for students to choose from the alternatives. • There is little mention about developing positive attitude in students.	• There are 368 learning outcomes that summarize the knowledge and skills for students to develop. These outcomes can be obtained through different learning activities. So, the textbook writers and teachers are relatively freer to produce or choose activities. • The content is distributed evenly from grade 1 through grade 8. • Teaching-learning activities prepared to parallel to learning outcomes require student centered methods, techniques and strategies. • Content is organized based on how students learn. • Almost all of the sample activities show how to use manipulatives for students' construction of knowledge. • There are connections to other subject domains. • Daily use of mathematical knowledge is emphasized. • Alternative assessment techniques, extracurricular activities, research, and projects are included. • Respect for individual differences, different learning and thinking styles is suggested. There is more room for students to choose from alternatives. • There is more emphasis on how to develop positive attitude towards mathematics and on student motivation.

Considering the comparison table above, Babadoğan and Olkun (2006) argued the changes in skills. To give an example; communication, making

connections, reasoning and problem solving skills, which constitute the basis of mathematical classroom discourse, are emphasized by Babadoğan and Olkun (2006). Since the table above, does not directly relate to classroom discourse, it explains the expected classroom environment in the new program, which is also one of general characteristic of classroom discourse.

In addition to this issue, classroom discourse has an important place in national exams. As an example, "Öğrenci Başarılarını Belirleme Sınavı (Level Determination Exam-LDE)" has been conducted by Educational Research and Development Directorate (EARGED). This exam is made in every three-year period including questions from determined lessons. While in 2004, examination had questions from "English" and "Computer Usage Skills"; in 2002 and 2005, aim was to obtain success levels of "Turkish", "Mathematics", "Science and Technology" and "Social Sciences". The report of 2005 study was published in May 2007 (MoNE-EARGED, 2007). Although LDE try to examine different skills and to obtain the quality of education in several dimensions, most important part doubtlessly is the one that looking for elements of classroom discourse. This is the widest and single project interested in "What happens in classes?" in Turkey. Below information about results of 2005 LDE is given related to report that published in 2007.

In 2005, 1088 mathematics teachers (428 women, 660 men) participated in project. In questionnaires, they were asked 19 questions related to classroom activities and discourse. Following table gives the results of that part.

Table 2. 2 Opinions of Mathematics Teachers on Frequency of Their Usage of Discursive Practices in Classes (MoNE-EARGED, 2007, p.17)

Etkinlik		Sıklık: Hiç	Ara sıra	Çoğu zaman	Her zaman	Toplam
27. Dersi ben anlatırım.	Sayı	10	87	722	270	1090
	Yüzde	0,9	8,0	66,2	24,8	100
28. Dersi öğrenciler anlatır.	Sayı	262	748	66	3	1080
	Yüzde	24,3	69,3	6,1	0,3	100
29. Öğrenciler, dersteki konularla ilgili kendi aralarında tartışma yapar.	Sayı	70	702	278	33	1086
	Yüzde	6,4	64,6	25,6	3,0	100
30. İşlenen konularla ilgili soruları öğrencilerimle tartışırım.	Sayı	16	301	591	181	1089
	Yüzde	1,5	27,6	54,3	16,6	100
31. Konuyla ilgili değişik alıştırmalar içeren çalışma kağıtları üzerinde öğrencilerime çalışmalar yaptırırım.	Sayı	47	435	407	198	1087
	Yüzde	4,3	40,0	37,4	18,2	100
32. Derste işlenen konularla ilgili örnekler ve alıştırmalar yaparım.	Sayı	7	38	351	690	1087
	Yüzde	0,6	3,5	32,3	63,5	100
33. Derslerde küçük grup çalışması yaptırırım.	Sayı	218	612	194	58	1085
	Yüzde	20,1	56,4	17,9	5,3	100
34. Problem çözümünde öğrencilerime rehberlik ederim.	Sayı	3	55	509	515	1083
	Yüzde	0,3	5,1	47,0	47,6	100
35. Öğrencilerim tahtada yazılanları defterlerine geçirir.	Sayı	12	73	347	654	1086
	Yüzde	1,1	6,7	32,0	60,2	100
36. Öğrencilerimin ilgi ve yetenekleriyle ilgili gözlemler yaparım	Sayı	13	231	509	333	1088
	Yüzde	1,2	21,2	46,8	30,6	100
37. Öğrencilerin yanlışlarını düzeltirim.	Sayı	3	94	404	581	1082
	Yüzde	0,3	8,7	37,3	53,7	100
38. Eğitim-öğretimle ilgili öğrencimden, veliden vb. bilgi alırım.	Sayı	68	477	385	150	1080
	Yüzde	6,3	44,2	35,6	13,9	100
39. Müze, kütüphane, park vb. gibi yerlere geziler düzenlerim.	Sayı	662	354	37	22	1075
	Yüzde	61,6	32,9	3,4	2,0	100
40. Öğrencilerimden işlenen konularla ilgili günlük hayattan örnekler bulmalarını isterim.	Sayı	22	392	471	200	1087
	Yüzde	2,0	36,1	43,3	18,4	100
41. Derste konunun gerektirdiği teknolojik araç ve gereçler kullanırım.	Sayı	83	412	379	207	1082
	Yüzde	7,7	38,1	35,0	19,1	100
42. Gösteri deneyleri yaparım	Sayı	318	522	166	46	1055
	Yüzde	30,1	49,5	15,7	4,4	100
43. Öğrenciler deneyleri küçük gruplar halinde yapar.	Sayı	457	451	109	24	1044
	Yüzde	43,9	43,2	10,4	2,3	100
44. Sınıfta önemli gördüğüm konuları yazılı kaynaklardan yüksek sesle okurum	Sayı	123	416	350	185	1078
	Yüzde	11,4	38,6	32,5	17,2	100
45. Öğrencilerime grup projeleri yaptırırım.	Sayı	350	544	135	38	1070
	Yüzde	32,7	50,8	12,6	3,6	100

Related to report some comments can be drawn as; mostly teachers prefer direct teaching method in their lessons, students sometimes involve in discussions with each other, teachers mostly discuss with students about their questions on given subject, students rarely study on worksheet, students rarely work in small groups, students usually write in their notebooks what they see on the board,

teachers always correct their students' mistakes without giving chance them to find themselves, teachers mostly want their students to give examples from daily life situations, and students rarely work on group projects in lessons. (MoNE-EARGED, 2007)

Looking at the results listed above, teacher- centered education seems to be dominant in classroom environment. Teachers' giving lessons most of times means that students have very little chance to talk to each other about subject. Moreover, students' writing only the things they see on the board means, they cannot decide and organize what to write in notebooks. Without being the only reason, this shows clearly, why we have a lack of knowledge and success in our education system.

Also in same study, students' questionnaires had 18 questions asking about classroom activities and trying to obtain the frequency of using discursive activities. Following table gives results.

Table 2. 3 Students' Opinions on Frequency of Usage of Discursive Practices in Classes (MoNE-EARGED, 2007, p.19)

Etkinlik		Sıklık				Toplam
		Hiç	Ara sıra	Çoğu zaman	Her zaman	
47. Dersi öğretmen anlatır.	Sayı	2008	11253	43791	36277	94327
	Yüzde	2,1	11,9	46,4	39,2	100
48. Dersi öğrenciler anlatır.	Sayı	12265	64395	13440	3957	94327
	Yüzde	13,0	68,3	14,2	4,2	100
49. Öğrenciler, kendi aralarında dersteki konuları tartışırlar.	Sayı	15258	53399	19809	5561	94327
	Yüzde	16,2	56,6	21,0	5,9	100
50. Öğretmen işlenen konuları öğrencilerle tartışır.	Sayı	9898	34647	33965	15474	94327
	Yüzde	10,5	36,7	36,0	16,4	100
51. Öğretmen çalışma kağıtları dağıtarak bunlar üzerinde tartışma yaptırır.	Sayı	21275	40987	23017	8586	94327
	Yüzde	22,6	43,5	24,4	9,1	100
52. Derste işlenen konularla ilgili örnekler ve alıştırmalar yapılır.	Sayı	3361	17200	37914	35454	94327
	Yüzde	3,6	18,2	40,2	37,6	100
53. Derste küçük grup çalışması yapılır.	Sayı	24889	47589	15963	5408	94327
	Yüzde	26,4	50,5	16,9	5,7	100
54. Öğretmen problemi çözmede öğrencilere rehberlik eder.	Sayı	6727	24295	37006	25816	94327
	Yüzde	7,1	25,8	39,2	27,4	100
55. Tahtada yazılanları defterlerime geçiririm.	Sayı	1894	6517	20045	65487	94327
	Yüzde	2,0	6,9	21,3	69,4	100
56. Öğretmen öğrencilerden her birinin ne yaptığıyla ilgilenir.	Sayı	6357	27536	34642	25379	94327
	Yüzde	6,7	29,2	36,7	26,9	100
57. Öğretmen öğrencilerden yanlışlarını bulup düzeltmelerini ister.	Sayı	3128	16379	34262	40185	94327
	Yüzde	3,3	17,4	36,3	42,6	100
58. Öğretmen öğrencilerin daha iyi öğrenmelerine yardımcı olur.	Sayı	2541	8010	25344	58025	94327
	Yüzde	2,7	8,5	26,9	61,5	100
59. Öğretmenimiz konuları daha iyi anlamamız için müze, kütüphane, park vb. gibi yerlere geziler düzenler.	Sayı	52421	29733	7999	3692	94327
	Yüzde	55,6	31,5	8,5	3,9	100
60. Öğretmen işlenen konularla ilgili günlük hayattan örnekler bulmamızı ister.	Sayı	11732	42991	28112	11028	94327
	Yüzde	12,4	45,6	29,8	11,7	100
61. Derste konunun gerektirdiği tepegöz, video, slayt, bilgisayar gibi araç ve gereçler kullanılır.	Sayı	21879	38788	22732	10870	94327
	Yüzde	23,2	41,1	24,1	11,0	100
62. Derste konunun daha iyi anlaşılması için harita, yer küre, geometrik şekiller, cetvel gibi araç ve gereçler kullanılır.	Sayı	6734	28667	34823	23582	94327
	Yüzde	7,1	30,4	36,9	25,0	100
63. Fen Bilgisi deneylerini öğretmen yapar.	Sayı	12278	31229	30059	20207	94327
	Yüzde	13,0	33,1	31,9	21,4	100
64. Fen Bilgisi deneylerini öğrenciler yapar.	Sayı	22707	44144	18840	8114	94327
	Yüzde	24,1	46,8	20,0	8,6	100

Considering the table above, it would be state that in Turkey, exploratory teaching and memorization are still dominant in mathematics classrooms (Bulut, 2007). Therefore, there has been something wrong with classroom practices. Despite the theoretical importance of student participation (Hiebert & Wearne, 1993) and also there have been efforts to bring innovations to math education in Turkey, teacher-centered instruction continues to dominate elementary and secondary classrooms.

A study, which was similar to LDE, was conducted by Şahin (2005). This was not one that directly based on classroom observation, but was a survey study interested in examining students' and teachers' perceptions about learning environments of mathematics classes. While 50 elementary mathematics teachers assigned teacher questionnaires, 200 elementary students are assigned to rate their perceptions about mathematics lessons. Students were questioned about their ideas on participating in classroom activities. Teachers were required to answer questions about the reasons of limitations of activities practiced in classroom and about their expectations from students connected to mathematical content. Although not being an observational one, the study has power in giving information about mathematical classroom discourse related to teachers and students' perceptions.

In the Şahin (2005), when the students' answers discovered, it seemed to continue with teacher dominated classroom activities. Students conclude that teachers always show and teach how to solve a problem and they generally work on the board under the guidance of their teacher rather than working together with classmates on a problem. They expose to write what they see on the board and always are given too much homework. Students' statements are showing that there has been a lack in discussing on problems, working on mathematical projects both with each other and with teacher. They think that teachers very rarely give chance or provide opportunities to have discussions on real life situations related to mathematical concepts. Moreover, usage of computers or projectors in mathematics lessons is in very less frequency, nearly none.

According to student thoughts, new content area- especially at the beginning- is based on teacher explanations, concepts, rules, definitions etc. These given results constitute a sign of deficiencies in classroom discourse; also show that how wrongly new curriculum being practiced in classroom environments (Şahin, 2005).

When the teachers' results are interpreted from the same study, their belief is to control students homework whether it is done or not rather than collecting and correcting. In common, teachers choose the way of correcting homework giving explanations about solutions or right answers. They rarely give long-termed projects for students; choices are generally in ways to give worksheets or practices from textbooks. Similar to student answers, teachers also said they frequently want students to work and argue on problems or use projectors or computers in their lessons. It would be stated that teachers have not realized and understood the importance of classroom discourse when the results are explored again. Furthermore, they really do not know what the reform mathematics and the new elementary mathematics program expects from them.

Finally, Doğan (2006) studied on classroom practices in a general view rather than focusing on narrow aspects. Similar to current study, he designed an observational study. That study included three sixth grade classrooms from public schools. He observed mathematics lessons throughout a few mathematics units. In his study, Doğan (2006) tried to obtain a lesson pattern from the sixth grade elementary mathematics classrooms. Results of this study showed that traditional methods, which meant teacher-dominated classroom environment, had been used in mathematics lessons. He could not obtain a specific pattern for lessons. Additionally, he concluded that classroom practices were away from new approaches. From this point, it can be stated that Doğan's (2006) study supported classroom discourse has not being practiced.

Although results of studies mentioned above would provide information about practice, success or quality of new curriculum; they are not sufficient to demonstrate the realities of classroom practices. Written words do not mean

anything if they are not practiced. Education programs are accepted as the same and it is useless to get success except practicing them. Still there is lack of information come from studies, which have mainly focused on inside of the classrooms. In other words, it could be deduced that our system is needed more research based on classroom observation to get more insights about the current condition of mathematics classroom environment and reach an acceptable quality in mathematics education.

2.5. Summary

To sum up, review of literature above explained what a classroom discourse is and what it specifically means for mathematics. In addition, the reviewed literature can be viewed as evidence to explanation of why classroom discourse has become very important in mathematics classes and increasing interest on classroom observation related to this.

When studies are considered, we see that most of them have been conducted in other countries, U.S. is at first hand. Turkey's condition differs from them with critical deficiencies in qualitative studies based on classroom discourse. Though there have been efforts for conducting studies to get insights and make decisions about both classroom activities and elementary mathematics program, these are based on quantitative style which requires statistical data analysis. Most of them have not interested in classroom observation and specifically discourse of mathematics, which creates the gaps in literature about this subject.

In this context, this study aims to provide data about classroom discourse by observing a classroom for a while. Related to observation subject, this study aims to fill one of those gaps by trying to give detailed information about what kind of practices are being occurred in mathematical classroom discourse of a fifth grade elementary classroom; and acceptability of these discourse practices by mathematical content and new elementary curriculum. Moreover, results of the current study would be helpful for new coming researchers to have an insight about the classroom discourse. Additionally, this study would be helpful for teacher educators by providing data to determine the deficiencies of teacher practices in classroom discourse.

CHAPTER III

METHODOLOGICAL FRAMEWORK

3.1. Introduction

In this chapter, the research approaches used in the study will be explained. Second, information is given about participants, data collection, and data analysis methods. Third, trustworthiness will be clarified. Finally, limitations of the study and the observer biases are reviewed in given order.

3.2. A Qualitative Research Approach-Case Study

Since the aim was to focus on discourse practices of a classroom with all class members, a qualitative approach was suitable for this study. The design of the project is observative, exploratory, and interpretive (Aleksandrowicz-Pedich, DraghicescuIssaiass & Sabec, 2003). This framework calls for an observational approach to data collection that involves description of everyday practices in the natural settings of related field and an effort for discovery of the significance of actions in those events.

Merriam (1998) defined the qualitative research as an umbrella, which covers different aspects of inquiry; by this way, it helps us to understand and explain the phenomena in its natural settings. In another definition, Patton (1985) stated that the qualitative research "is an effort to understand situations in their uniqueness as part of a particular context and the interactions there" (p.1). In that means, qualitative research gives opportunity to study in detail (Patton, 1990). Since, this study aimed to understand and evaluate the mathematical discourse practices in their natural settings, by limiting the determination of observation context, the researcher tried to provide an in-depth study on issues.

Use of this type of observational perspective attempts to understand the quality of classroom discourse in mathematics lessons and the communication among students and the teacher; and the quality and appropriateness of the questions, which were presented and solved in the classroom with respect to the mathematical context.

Merriam (1998) discusses that a qualitative researcher is mainly interested in the meaning underlying people's experiences constructed in their lives (Merriam, 1998). Considering the Merriam's (1998) definitions and features of qualitative research types, this study would be classified as a qualitative case study.

In her definition, Merriam suggests that:

> "A case study design is employed to gain an in-depth understanding of the situation and meaning for these involved. The interest is in process rather than outcomes, in context rather that a specific variable, in discovery rather than confirmation*."* (p.19).

As it is stressed in this suggestion, the current study aims to go deep in classroom environment to draw a full view picture of it to try to see what is happening related to the discursive activities there. In Corcoran, Walker, and Wals (2004), it is supported that case studies mainly focus on investigating common practices with critical analysis techniques. Similarly, Yin (1994) stressed the real life environment by saying; "A case study is an empirical inquiry that investigates a contemporary phenomenon within its real life context ..." (p.13). Case studies are powerful in examination of relationship between real world experiences and the theory of practice (Breslin & Buchanon, 2008). In this connection, the current study is a case study since it aims to observe and explain the classroom practices with respect to classroom discourse; and obtain the relationships between theory and real life experiences of these discursive practices.

Related to definitions, Merriam (1998) suggested that a case, "could be a person such as a student, a teacher, a principle; a program; a group such as a class,

a school, a community; a specific policy; and so on" (p.27). In this study, the aim was to observe and interpret classroom discourse of mathematics lessons of a regional elementary boarding school. A fifth grade classroom was the case of the study.

3.3. Participants and Setting of the Study

Related to features of a qualitative research study, number of participants was limited. Since the aim is not to generalize the findings, the study was conducted in a public elementary school in Kızılırmak that is a town of Çankırı city. There are two schools in that district; one of them was chosen to participate in study by applying a convenient sampling method. The criteria for convenience were having easy contact, the usage of existing participants and their voluntary involvement in the study. In selection of participated teacher, also the same method was applied, with a criterion of using existing participant owing to have only one-fifth grade classroom and only one teacher.

As an addition, this school was chosen, because of its populated students and having its own more expert teachers. During the course of the study, the researcher observed a fifth grade classroom from this elementary school. Data collection procedure was based on classroom observations. Ensuring the honesty and privacy of participants, they were assigned forms that indicate their willingness to involve in study and pseudonyms were used both for people and for school.

At the time for selection of participants for the study, the researcher started to work as an elementary mathematics teacher in that district. Having an easy contact and to adjust the observation process, the school which is mentioned in the current study was selected.

School District: The school is placed in the center of the Kızılırmak a town of Çankırı city. The population of this town is approximately 2000 or lower.

The settlement population is very few in center part; more population is consisted by villages. Agriculture constitutes the main income in the distinct. Education is not considered as an important issue. In general, people do not support education; furthermore, they are against their daughters to have an education. Moreover, students coming from villages, get their first five year of elementary education in combined-classes where one to fifth graders studies altogether. In addition, there is a continuing replacement of teachers, thus, it is possible students' having five different teachers in one lesson for only one school year. As a result, the education quality and students achievement is in very low-levels.

There are three schools in the district, one is high school, and other two are elementary schools. While other school is very small with very few students and teachers, the participated school is larger with more students.

School community: School is made up with students generally from lower social backgrounds. Students come from the villages around Kızılırmak. In 554 students, 150 students are from the Kızılırmak, other come from the villages around the town. This is a boarding school for boys. It has a capacity of 150 boarding students. However, related to inappropriate conditions for students, 60-70 students prefer to stay there for winter months, not more. The education level and students achievements are in very low-levels. Additionally, the participant school has lack of educational materials, especially the technological ones. For instance, students have no chance to get computer lessons in a computer laboratory, related to a few computers, which had already broken down.

The classroom: The participating classroom had 38 students in total with 23 females and 15 males. The classroom was consisted of students from middle and lower socio-economic backgrounds. According to teacher's explanation, the achievement was better in former year. She stated, the time when study was conducted, a village school was closed and students came in that class. This situation made the class more crowded and affected the lessons and consequently the students' achievement.

The classroom had a teacher desk, a blackboard, four boards on the wall; and tables and chairs for students. Each student's having his/her own table and chair would be considered as an advantage for them, when compared to sitting on desks. Boards were used to exhibit the chosen works or projects of students. Figure 3.1 shows the seating plan of the classroom.

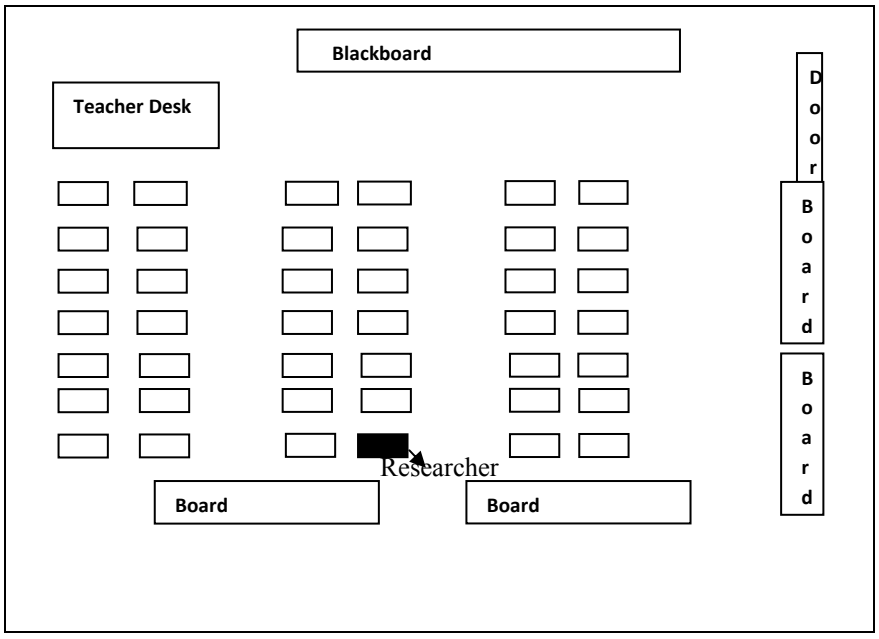


Figure 3. 1 The seating plan of participated classroom

The classroom's teacher was 33 years old and had been teaching from one to fifth grades for 5 years. This was not her profession in real. She stated that her graduation is from chemistry education- means she was a chemistry teacher indeed. However, they had chance to change their field of work; and she preferred to work as an elementary teacher of first part. When the researcher asked the reason for her changing working field, she stated that she liked children very much and was not sorry for her decision. In her first three years, she worked in a village of same town and for two years had been working in the participated school. This meant that she knew the district very well.

3.4. Data Collection Procedure

In this study, data was collected by classroom observations. In this part, the information about the process will be presented. In the following part classroom observations will be mentioned.

3.4.1. Classroom Observations

The researcher involved in observation process as a non-participant observer; and sat on one student chair-table in the middle row at the backside of the classroom. This choice was related to aim of getting an overall picture of classroom with all students and teacher. Researcher always remained at the same position throughout the process, as a non-participant observer sitting at the backside and taking notes of the discursive activities of classroom.

During classroom observation, an observation form was used as a guide for the process. This form was derived and reorganized from another one, which was developed by Chicago Mathematics and Science Initiative (CMSI). To get permission for usage of this guide, an e-mail was sent to the Chicago Math and science Initiative with suggestion of former supervisor, later the researcher started to use this guide. The Initiative states that they adapted the form, from RTOP, Lenses on Learning Observation Guide, and SVMI Classroom Observation Guide in September 1, 2006. They explained the "Mathematics Classroom Observation Guide" was designed to support observation and conversation about learning in a mathematics classroom. This guide expected to support an observation that focuses on the key mathematical ideas in the lesson, student experiences designed to address those ideas, and evidence of student understanding. Moreover, an observer is not expected to see all of the components in one lesson, but over time, evidence related to all questions should emerge (CMSI, 2007). The original form is added in Appendix A. This guide included too many questions and aspects of the classroom discourse; it was not possible to observe all these aspects by only one observer. Studying with the former supervisor, a new form was revised, which was included less questions when compared to original one. This new

document used for observation and analysis of mathematical classroom discourse, is presented in Appendix B. In observation process, the role of the form was to guide researcher in deciding to get field notes from which aspect. Its importance was related to data analysis process that will be explained in next section. In CMSI Mathematics Classroom Observation Guide Directions for use meaning of each question, and the aspects that a researcher should look for while using this guide, is explained clearly. Following the selected questions from this guide will be explained, related to their statements.

The classroom discourse was observed in two dimensions, as student learning and teacher moves. First, questions for students learning will be explored; and in second part, the questions that focus on teacher will be highlighted.

3.4.1.1. Focus on Student Learning

This part also divided into two dimensions; as "content" and "learning."

3.4.1.1.1. Content

Content case is interested in mental activities that student engaged in during lessons. Their problem solving process, justifying their answers, explaining ideas, etc. would be considered in this case.

1. In what kinds of mathematical thinking are students engaged?

In the guide, students' engagement in procedural thinking is explained as their problems that involve procedures or standard algorithms. An example is given as "the standard procedure for comparing fractions by first getting a common denominator, and then comparing the numerators." (CMSI, 2007, p.7) Another example would be suggested as making operations after learning addition, subtraction, multiplication, or division.

The Initiative explained, students' engagement in conceptual thinking relates with students' developing conceptual understanding of the mathematical

ideas. As an example, they can use equally divided bread to understand fractions as visual models, or they can learn equations by using scales.

Problem solving practices should be away from being non-routine processes. Samples may include word problems or experiments etc; rather than being traditional in which students working on low-level problems on the board. As an example, they can act in a small scenario, which is based on shopping process to learn four-basic operations.

In justification process, students are expected to justify their solutions. As an example, they can "prove that a number trick works by using variables to show that it is true for all cases." (CMSI, 2007, p.7)

Explanations and examples are suggestions of CMSI Initiative. These examples can be increased by a careful observation of classroom, more specifically deeper observation of students' behaviors.

2. *How do connections made to other disciplines and real-world situations promote understanding of the mathematical ideas?*

The students are expected to find and make connections to other disciplines or real-life situations. For example, after understanding the proportion, they can use similar triangles to find the height of a building (CMSI, 2007). Another example would be the usage of ratio to make a model of a building, or to draw a sketch of a room.

3. *How are connections made to prior work in the mathematics class?*

This question looks for demonstration of familiarity between procedures and concepts, which developed in their prior work. For instance, they can solve a new problem by connecting the ideas to prior problems they have solved. (CMSI, 2007) Another can proof her/his idea with a connection to the knowledge from previous years.

3.4.1.1.2. Learning

Learning case is interested in students' physical activities practiced during lessons. Their participation to the discussions, solving problems, and usage of representations are discussed in this topic.

4. Are students actively engaged?

This question aims to investigate whether all students focus on the work of exploring, understanding, and solving mathematics problems. Students' engagement means that they involve in experiments of classroom discourse. Their attention should focus on the mathematics problem. In addition, they may participate in a whole class discussion or in a group work. They can work together to find and explain alternative solution strategies would be given as an example (CMSI, 2007).

5. How are students justifying their answers, offering alternative solution strategies, or demonstrating that their strategies work?

This question looks for justification of students' answers or demonstration of their strategies work. Students are required to prove these strategies by operating the found reasoning in solutions. They may notice patterns while solving problems, and use this reasoning to justify their thinking; and it is possible their recognizing the connections between mathematics problems.

As an example, "one can use reasoning to solve 99 + 76 by creating a new problem: 100 + 75 = 175. This demonstrates the student's understanding of an equivalent addition expression can be formed by increasing one addend by 1 and decreasing the other addend by 1:

$$x + y = (x+ 1) + (y – 1)$$

Students' demonstration of their strategies work may be operated in variety of ways as, using drawings, diagrams, models, graphs, equations, written explanations, examples" (CMSI, 2007, p.9)

6. *How do students use a variety of representations – models, graphs, drawings, manipulatives, and writing – to demonstrate their understanding of mathematics?*

These question looks for whether students are comfortable using a variety of representations depending upon the problem or situation. As an example, one focus of the question is to obtain whether usage of calculators or models are easily accessible (CMSI, 2007).

7. *Do the interactions reflect collaborative relationships and peer support, and promote understanding of the mathematical ideas?*

In group works, students collaborate with others to solve problems and share ideas. They build on each other's ideas and share responsibility for solving problems. It is important that each member of the group should be willing to help other members to understand the solution, and each of them should be able to demonstrate understanding of the problem (CMSI, 2007).

3.4.1.2. Focus on Teacher Moves

This part also divided into two dimensions; as "content knowledge and pedagogy" and "creating learning environment". In this connection, her facilitating connections to other disciplines, real world situations and prior knowledge, assessing prior knowledge and student understanding, encouraging alternative solution strategies, proof and justification, and resources are constituted the base for teacher observation.

3.4.1.2.1. Content Knowledge and Pedagogy

This case interested in teacher's presentation of knowledge. The teachers are expected to use appropriate methods during mathematics lessons. In the following part the questions gathered from CMSI (2007) were presented related to aim of the study.

1. How does the teacher facilitate connections to other disciplines and real-world situations, and to prior work in the mathematics classroom?

The teacher should facilitate connections by drawing on students' prior knowledge and experiences. Additionally, teachers are expected to provide

opportunities to help students make connections, both to their prior work in the mathematics classroom and to real-life. For example, they may be encouraged to connect a lesson to operations in natural numbers to experiences with money (CMSI, 2007); or another example would be connection to real life experiments by conducting small inquiries in learning usage of tables and graphs.

2. How does the teacher assess prior knowledge and student understanding, and use that information to make instructional decisions?

A lesson, which starts with questions, makes the teacher assess prior knowledge and understanding of students'. By using the students' answers, (s)he connects this prior knowledge to that lesson (CMSI, 2007). For example, in a lesson on perimeters of regular polygons, students may be encouraged to remember features of basic regular polygons. This recall makes them to construct new knowledge in easier way.

3. How does the teacher both encourage alternative solution strategies, proof and justification, and challenge ideas in order to promote understanding?

The teacher's usage of questioning and encouraging rich student explanations, both verbally and in writing, is the most important point in this process. Moreover, (s)he encourages students to build on each other's thinking and foster for justifying their thinking with questions: "Why is this true? Do others agree? Why or why not? Can you provide examples? Will this always work?" (p. 12-13) The teacher is expected to listen to students' ideas; enhance, and move forward mathematical discussions through questions; encourage alternative explanations and solution strategies, and foster students to justify their ideas or solutions. Lastly, a teacher has the responsibility of encouraging students to listen carefully, and criticize other's thinking (CMSI, 2007).

3.4.1.2.2. Creating a Learning Environment

This case interested in teacher's organization and guide of classroom environment. This process was expected to fit the features of classroom discourse.

In the following part, questions gathered from CMSI (2007) form was presented.

4. What does the teacher do to encourage communication and move discussions forward?

To provide a permanent discussion environment and to encourage classroom discourse, the teacher is expected to use open-ended questions, and give students opportunities. (S)he should help students build new knowledge on other's opinions through questions; further, should encourage students to respond to each other. The teacher should have a role of guider of learning, rather than the only presenter of the knowledge (CMSI, 2007).

5. In what ways does the teacher encourage students to respect the mathematical thinking of other students?

A teacher is expected to listen to all students, and make others listen and respond to each other's thinking; they should provide an classroom discourse environment in which each individual's ideas are valued. The teacher should listen and accept various strategies and explanations in the discourse-based classroom. All students should have opportunities to share their thinking, and to respond to other's work (CMSI, 2007).

6. How does the teacher encourage students to use their peers as resources?

In this process, importance of group work has a primary role. The teacher should organize groups to work together to solve problems; to support and question each other. By giving directions and suggestions, make them turn to each other with questions before approaching her or him CMSI, 2007).

After these explanations of the observation questions, the information about the observation process will be presented.

In classroom observations, field notes were taken with an interest to teacher moves and student learning, as it was clearly presented above.

In brief, students were viewed whether if they, justifying their answers, offering alternative solution strategies, and demonstrating whether their strategies

work, engaging actively, using a variety of representations – models, graphs, drawings, manipulatives, and writing – to demonstrate their understanding.

Related to the statement of Merriam (1998), for gathering rich data it is important to focus on various aspects of classroom practices –specifically discourse in this study. However, it is not possible to observe a classroom discourse with its all aspects, whatever a researcher uses for data collection as a method. No one can completely observe everything in classroom (Merriam, 1998).

During one lesson, the effort was to record the flowing with all determined aspects in guidance of prepared form and to record the whole practices of discourse by writing, with an interest to mentioned form. The required data was recorded while unnecessary data was not. For instance, while looking for students' interactions, the researcher tried to catch mathematical quality, which is a necessity of discourse.

3.5. Observation Duration and Observed Units During the Study

Data collection process started in September 15, 2008 and was completed in January 19, 2009. The classroom was observed on Mondays every week and for five weeks, it is observed both on Mondays and on Wednesdays at the third lessons of students' school day. The reason for selecting Mondays was related to researcher's free time. The researcher had one free lesson time and used it for the observation process. However, for observation on Wednesdays, school management gave permission. This special observation times were limited only for five weeks, not any more. Related to educational program, the class normally had four mathematics lessons in a week. Since the researcher had a full working schedule in that completed education year, she had never had a chance to observe the classroom, in all mathematics lessons in a week. The number of observed lessons was 20 in total. Repetition of classroom discourse practices made researcher sure about the observation time was enough for having appropriate and sufficient data.

The program of mathematics lessons was taken from the teacher for the first term of that education year. The reason was to make comparisons with the planned time and their following this plan. In general, the lessons were parallel to obtained plan and time schedule. Rarely, they would not have complete the subject of related lesson, and had to continue in following. In most cases, these incomplete parts consisted of solving problems and giving homework. For instance, in September 17, they would have not been given homework because of insufficiency of time. In addition, in some lessons, although the time was over, teacher kept them in to give homework. Overall, the teacher was careful and successful in usage of time. During the observation process, students studied the following curriculum units in given order:

Table 3. 1 Observed Lessons and Observation Dates

Date Of Observation	Subject of Lesson	Number of Observed Lesson
September, 15	Natural Numbers with 7, 8, 9 digits	1
September, 17	Addition of 5 digits natural numbers	1
September, 22	Subtraction of 5 digits natural numbers	1
September, 24	Subtraction of 5 digits natural numbers	1
October, 6	Mean	1
October, 13	Table and schema	1
October, 15	Probability	1
October, 20	Subtraction of two natural numbers that have 7 digits at most	1
October, 22	Exponential numbers	1
October, 27	Division of natural numbers and guessing	1
October, 31	Multiple step operations of natural numbers	1
November, 10	Fractions	1
November, 17	Ratio	1
December, 1	Addition of fractions	1
December, 3	Subtraction of fractions	1
December, 15	Symmetry	1

December, 23	Proportion	1
December, 30	Polygons	1
January, 12	Measure of length	1
January, 19	Measure of liquids	1

3.6. Analysis of Recorded Data

Two main steps were used for analysis of collected data; first for observational field notes. Second step was to make an overall commentary of collected data with respect to mathematical classroom discourse. During the analysis of data, the researcher worked with three mathematics teachers to ensure validity.

The interpretation of observational data process started with first meeting with other mathematics teachers. At the beginning, field notes of one lesson were read. Each teacher got own coding tables; and papers for writing comments and explanations for each lessons. After reading a whole lesson notes we filled up the coding schemes that were prepared separately for student learning and teacher moves. These coding schemes were a table version of classroom observation form that the researcher organized. The aim for using a table form was to code related data in an order. While coding each case, each teacher wrote own interpretations and examples for that case to the comment sheet at the same time: for example, after reading the lesson of October 13, the process of investigating students' discourse practices was started. As an example after reading the question "How are connections made to prior work in the mathematics classroom?" each of the coder teachers looked for whether there was any practice related to this case. If an example was found for this, a tick was put on the table, and wrote what the example was on the commend paper. If there was no example for the issue, a cross was put on the table and passed to following case. After completing the analysis of each lesson on our own, we compared our tables and comments. We looked for whether there were any different responses; if there was, we discussed for reaching a consensus.

In general, there was not a big disagreement between us. In some points, if one of us did not understand another's comment, we explained our opinions and reasons to each other. All cases were evaluated by following the same procedure. At the end of the separate analyses of teacher and students discourse practices, we examined tables carefully as a whole, and read again our own interpretations to make a general interpretation of students' and teacher's discourse practices.

Finally, by combining these comments, we decided the pattern of this classroom's mathematics discourse.

3.7. Limitations of the Study

One limitation of the study would be caused from the aim of the study. Since the purpose is to gain a deep understanding the mathematical discourse, one school's one fifth grade classroom with students and teacher was observed. Related to these limited number of participant it would not be possible to generalize the results to other cases. Findings of the researcher are limited with the only one classroom, which is observed. While the number of participants creates limitation and the aim of this study is not to generalize the findings; it also may constitute a strength by the way getting a deep understanding of a mathematics discourse practices.

Another limitation would be a possible change in the teacher's and students' actions related to the researcher's being in classroom as a non-participant. Their manners would differ when compared to the normal conditions. However, length of the observation process and the researcher's visiting the classroom more than one lesson; possibly, made the classroom members accept the researcher as a member of that environment, and behave naturally.

Being only one non-participant observer created a difficulty in gathering data. This would have caused not to collect some observational data, which may have occurred in a different position while the researcher focuses on another. To deal with this kind of inadequacy, the researcher limited the observation area as possible to collect complete and meaningful data, which fits with observation guide.

3.8. Trustworthiness

In this section, the issues of validity and reliability will be addressed.

First issue is validity about trustworthiness of study. Merriam (1998) writes "internal validity deals with the question of how research findings match reality. How congruent are the findings with reality? Do the findings capture what is really there? Are investigators observing or measuring what they think they are measuring?" (p.201). Merriam (1998) states some strategies according to her research to improve internal validity. First is about the usage of numerous sources for data collection, examiners, and techniques to validate results. In addition, Patton (2002) mentions that this process makes the study stronger by defining it in a way using variety of data and methods. In this study, data is gathered through observational field notes. Second strategy is interested in collecting the data over a period until the practices become to be repeated again. Patton's (1990) statement points out the duration of observation time depends on aim of the study and not having a specific time limit for completing observation process. Related to this explanation and since the aim of this study is to draw a general picture of mathematical classroom activities, rather than observing lessons throughout a unit, lessons from different units were observed to obtain and examine variety of discourse practices. To provide meaningful data observation process continued during a whole school term. It took four months and fourteen weeks (some weeks two lessons were observed) to complete process. Thus, observation duration would be considered sufficient for increasing the validity of the results. Additionally for ensuring validity, the conversations were presented directly in the results chapter. This was provided information about 'what happens?' in the classroom without any changes. This provided evidence for validity. Finally, for ensuring the validity, a researcher is expected to ask colleagues to interpret the findings of study. In this study, researcher studied with other mathematics teachers to examine findings.

In addition to those explained in internal validity, improving knowledge and familiarity with the observation environment before the real process and

making sure the participants about the honesty of study, would be considered. First, for ensuring honesty, teacher was given detailed information about the aim and content of the study, both orally and in written. Furthermore, similar written documents were given students' parents to inform them about the study. Parents signed the consent forms, which are proof of willingness. Secondly, researcher started to visit classroom in the first week of semester to make participants familiar with observation process. These visits were done for two lessons in first week.

External validity mainly concerns with the findings of a study whether they can be applied to other conditions (Merriam, 1998). In providing external validity, generalizability becomes main concern of a study. In qualitative approaches, "transferability" can be used to refer as the same meaning. There are various views on issue of generalizability. Merriam (1998) states "the issue of generalizability centers on whether it is possible to generalize from a single case, or from qualitative inquiry in general, and if so in what ways? According to Patton's (2001) suggestion generalizability depends on the selected and studied case in a qualitative case study. Although, the aim of the study is not to generalize findings, for enhancing the generalizability of a study, some methods are suggested by Merriam (1998). Related to those strategies, in current study, the nature of the classroom environment is explained clearly, so that researchers can compare these features with other similar settings. Additionally, although the aim of the study does not include it, some taken steps would be helpful for enhancing the possibility of generalizing to other situations. Related to the explanations rich and thick descriptions of settings and participants, researchers' role and biases, information about data collection and data analysis methods are given in this chapter.

Second issue is about the reliability of a study. Reliability concerns whether the results of the study could be replicated. More clearly, the question of getting same results when the study is repeated (Merriam, 1998). In the same part, she makes a good explanation about the focus of reliability by saying, "the

question then is not whether findings will be found again but whether the results are consistent with the data collected" (p.20). Related to ensuring reliability, Merriam (1998) suggested some strategies that investigator would use. A researcher should give information about the theory underlying the study, descriptions of participants and social environment of them. In addition, researchers are expected to explain their relationship with participants of the study. It is also suggested to making definitions of important terms related to study. In this context, the theory underlying this study articulated in previous chapter. Definitions of terms were included in Chapter 1. Although the researcher has practiced her profession in same school, she started to work in there at the same time she started the observation and data collection. The participant teacher or students had not been known before. During the process, the relations with the participated teacher developed in a very formal way, since her giving importance to reality of data and knowledge from study. Additionally, the collected data was coded by other three mathematics teachers. This was an attempt to provide inter rater reliability.

Finally, observer biases would be clarified for ensuring validity. From this view, all mentioned life experiences and insights would have an unavoidable influence on the process of data collection. Being aware of the other internal and external factors that affect education quality, researcher tried to be away from judging teacher's and students' behaviors and practices as possible. Reversely, while taking observation notes, more effort was spent in not reflecting her own view.

CHAPTER IV

RESULTS

The purpose of this study was to investigate some characteristic of mathematical classroom discourse. The results of the study were based on the qualitative data obtained from observational field notes. Results are presented under two major categories, these are (1) students learning and (2) teacher moves. Each of these two major categories is divided into two sub categories in themselves. Students learning category is divided as content and learning; and the category of teacher moves is divided as content knowledge and pedagogy and creating learning environment.

4.1. Organization of Chapter Results

Since the purpose of the study is to evaluate some characteristics of mathematical classroom discourse of fifth grades, data was collected by visiting a fifth grade classroom of a public school during twenty lessons, to observe them in their natural settings and get observational field notes of classroom experiences.

In the analysis of collected observational data, students' learning and teacher moves were investigated separately related to their being different cases. While doing this, each category was divided into subcategories in itself. Determination of these main and subcategories were done related to CMSI Observation Guide (2007), other research studies about the mathematical classroom discourse (McCrone, 1997; McCrone, 2005, Casa, 2004) and researcher's obtained features of classroom discourse during observation process.

Presentations of the results of observational data were done in two ways. First, obtained subcategories of related main category were given in a table, which included numbers and percentages of data. Then, obtained sample dialogues and lesson parts were presented for each subcategory.

4.2. Analysis of Student Learning

In this part, results of student learning case were presented. As mentioned in CMSI (2007); student learning part is interested in obtaining; activities that students are engaged in during mathematics courses and features of these activities in lessons. Moreover, their having chances to express their opinions about subjects, abilities of finding alternative solution strategies to problems, proving those strategies work, using various representations as solutions of problems or as proofs for demonstration of their understanding issues were evaluated. Additionally, students' participation; and abilities of involving in classroom activities or group work was investigated under the same topic.

This part was divided into two subcategories in itself as, related to content and learning. At first, a general view of student learning case was presented in a table below. This table indicated the number (how many times these cases were observed) and percentage of obtained examples from observational field notes related to each case. Then, each of these subcategories was evaluated separately with samples from observed lessons.

4.2.1. Results of Content Case

According to CMSI (2007), content case specifically focused on the mental activities of students during the process of lessons. Their thinking, understanding, constructing knowledge issues were evaluated under the topic of content.

In this part, each of the subcategories of content case was investigated separately by presenting examples to related case from observed lessons. At first, it would be significant to have a closer look at the table of student learning from the view of content case.

Table 4. 1 Obtained categories for content subcategory of student learning case

Results of content case	Number of observed lessons	Percentage
Categories for Content		
Procedural thinking	20	100%
Conceptual thinking	3	15%
Problem solving	9	45%
Traditional (Routine)	9	45%
Justification	5	25%
Giving examples from daily life	3	15%

From the Table 4.1, it is possible to see that students engaged in procedural thinking during observation process. As it was defined in chapter III, procedural thinking refers to the traditional, teacher dominated classroom practices and experiences. Additionally, table indicates that the problems were solved in classroom by following traditional methods of teaching. Following examples was presented related to results above.

First issue is about the procedural thinking of students. This feature of content was seen in twenty lessons, which equals to the total number of observed lessons. The sample dialogue below constitute example for this context. This part is chosen from the lesson of 'addition with five digits natural numbers'.

The teacher wrote the following operation on the board.

$$\begin{array}{r} 3\,6\,8\,4\,\_ \\ 2\,\_\,7\,7\,3 \\ +\,1\,4\,\_\,4\,9 \\ \hline \_\,10\,\_\,8 \end{array}$$

Teacher: Let's do altogether. Watch me carefully. What if we add 9 to 3?

Class: 12

Teacher: Ok. Which number we need to add to get 8?

Class: 6

……

The session continued by following same procedure. The teacher asked and students gave responses. The teacher did the operation. After this example they solved a similar question by following the same procedure.

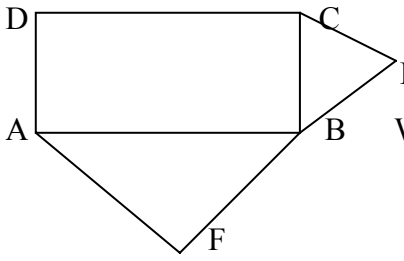
Another example related to same context is chosen from the lesson of polygons on December 30, 2008. Students were familiar with the subject from the previous lesson and from the fourth grade. The lesson started with an introduction of teacher to the subject "triangles" as following:

Teacher: Today we will learn the kinds of triangles .We have three types of triangles. First, one is equilateral triangle, which has three equal edges. We find the perimeter of it by multiplying one edge by 3." *(She drew the picture and wrote the formula on the board)*

"Second, one is isosceles triangle with only two equal edges. We find the perimeter by multiplying one of equal edge with two and adding the different edge to it." (*She drew the picture and wrote the formula on the board)*

"And the last one is scalene triangles with no equal edges. We find the perimeter by adding up all edges." *(She drew the picture and wrote the formula on the board)*

During teaching session, the teacher presented the subject directly without asking any questions to the students. Similarly, following dialogue is another example of polygons unit from the same lesson. The question was the following:



BEC equilateral, P= 12 cm

ABF equilateral, P= 24 cm

What is the perimeter of ABCD rectangle?

This time the teacher called a student to the board who understand the question.

Teacher: Ok .First read the question. What do you understand?

Student A: We are given two equilateral triangles with their perimeters and are asked to find the perimeter of rectangle.

Teacher: That is good. Now look at the picture. These two triangles will help us to find the perimeter of rectangle. What is the feature of equilateral triangle that will help us here?

Student A: It has two equal edges.

Teacher: No, no ,no. Be careful. It has three equal edges.

After this speech, the teacher took the board pencil and started to solve the question by explaining to the classroom.

As a final example, following lesson part would be presented chosen from the lesson of 'multiple step operations'. This lesson was based on making operations, which included two different ones; for instance, in an operation there were addition and subtraction at the same time. The lesson started with teacher's introduction.

Teacher: We learned the four types of operations in previous lessons. Now, we will combine them in one operation. Write the operation that I write on the board. *(She wrote the following operation on the board)*

$(7\times136) + 9 =?$

Teacher: In this kind of operation, first we interested in numbers in the parenthesis. Let's operate this altogether. (*Teacher asked and students answered. She wrote on the board, students wrote in their notebooks. They completed the process by this way).*Is there anyone who did not understand? *(Silence)* Ok. Now, I will write a new one. Write it on your notebooks. We will solve this question together again.

After the practice, they started the problems about the division operation. They solved two problems in total through the end of the lesson. Teacher solved the first one step by step on the board, by asking students and getting answers. A student came to the board to solve the second problem. While the student was solving the problem on the board, others were working on it, in their places.

Second issue is about the conceptual thinking of content. During the observation process, this feature was seen for three times. As it was defined in methodology part conceptual thinking refers to students' developing conceptual understanding of the mathematical ideas (CMSI, 2007). As an example, they can use equally divided bread to understand fractions as visual models, they can learn from experiments, or they can learn equations by using scales. Briefly, it can be defined as making abstract context more concrete for meaningful understanding. Following samples demonstrate this issue.

The teacher came to the lesson carrying a small cloth bag with marbles in it. The lesson started with a recall from the previous lesson. They had started the subject in that lesson which the researcher did not observe. After her summarizing the issue, she put the bag on her table and continued:

Teacher: We have eight red, four orange, and two yellow marbles in this bag. Now, I want to make a random selection from it. Which color marble do you think have the highest probability of coming out?

Class: Red

Teacher: What is the reason for this? Yes, Batuhan.

Student A: The number of red marbles is more than others.

Teacher: All right. Whose probability is least than others?

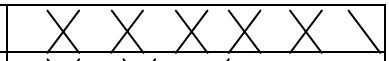
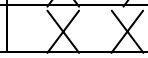
Class: Yellow.

Teacher: Reason? Yes, Berna.

Student B: Because, its number is fewer than others.

Teacher: Now, let's try and see if we are right.

After this dialogue, she made totally 20 random selections from the bag; and drew the following tally table on the board:

Red	
Orange	
Yellow	

Teacher: This practice helped us to prove our statement. You see we had red marbles at most and yellow marbles at least as result of our random selection. What we did here? How do you define our activity?

Student C: You took out marbles from the bag.

Teacher: Yes, we call this situation as an "experiment" in probability.

Looking at the sample above, practice of that kind of experiment can be considered to make students engage in conceptual thinking, since it made the subject of probability more concrete.

Third is about the problem solving activities. As it is mentioned previous chapter problem solving practices should be away from being non-routine processes. Samples may include word problems or experiments etc; rather than

being traditional in which students working on low-level problems on the board (CMSI, 2007). As an example, they can have small roles in a small scenario, which is based on shopping process to learn four-basic operations. According to the table, it is obtained that solving problems by following traditional methods placed classroom discourse practices for 9 times. Examples were presented below about the issue.

The lesson based on solving problems since they had already learned the subject in the previous lesson in which the researcher did not participate. Before getting start, teacher mentioned about the subject briefly to make students remember. Following is an example part of the lesson.

Teacher: Yes, all of you remembered the subject, now we will solve questions to provide a better understanding. Listen to me carefully.

"If we get 2 kg butter using 5 liter milk, with 15 liter milk how much kg butter do we get?"

Teacher: Have you all understood the question? First, think about the amount of the butter. In the new situation, do you think the amount of butter will increase or decrease?

Class: It will increase.

Teacher: Canan. Tell me the reason for the increase for butter.

Student A: Because; in the second situation, we use much more milk when compared to first.

Teacher: Ok. I will solve the first question to make you understand better. You will solve these kinds of question by using three ways. First, you can organize the given data like this *(explained by writing on the board):*

5 liter milk	2 kg butter
15 liter milk	? kg butter

Teacher: Here, you will multiply the two known number and divide it to another one. In the second way, you will write a ratio as:

5/ 15= 2 /?

Can you see the ratio between 5 and 15?

Class: Yes. It is 1/ 3

Teacher: So the same ratio will be between 2 and which number?

Class: 6

Teacher: Ok. The third way is using the "multiplication of inner and outer terms"

$\frac{5}{15} = \frac{2}{?}$

$15*2 = 5*?$ $\rightarrow ? = 6$ kg

Teacher: Is it okay? You will use one of these three ways in your exams also.

In this example, teacher followed a way of questioning method, which was followed by direct teaching. They solved four problems throughout the lesson. Students came to the board to solve them, they were required to use the ways that the teacher wanted them to use. At the beginning of the problem solving process, teacher asked students about the amount of butter in new situation. By this way, students first had a chance to see in what ways they would think to solve it.

Results indicated that students were involved in justification for five times during the observation process. However, in only one of them, a student justified his/her answer. In other times, the teacher developed the justification as a process of teaching session; students were only involved in them. In justification process, students are expected to justify their solutions. As an example, they can "prove that a number trick works by using variables to show that it is true for all cases." (CMSI, 2007, p.7) In the following dialogue, an example was presented for the issue. The sample was chosen from the lesson of 'demonstration of exponential number'.

After a summary of previous lesson and introduction of the subject, the teacher drew a house on the board. The house had three windows and three small windows on each big one. By asking questions to the students teacher made them to see the total number of windows of the house. She demonstrated that:

$3\times3=9$ or $3\times3=3^2$

Then the teacher added two more same houses to the prior one.

Teacher: How many big windows do these houses have?

Class: Three

Teacher: How many small windows do the each big window has?

Class: Three

Teacher: So, how many windows do these houses have in total?

Some Students: 27

Teacher: Why, do you think that? Or How did you get that answer?

Student A: In this example, we have three houses. Other cases are the same as with the previous one. It is enough multiply the previous result with the new number of houses. So if we multiply the 9 to 3 we get the total number of windows in the second situation.

As a final category about the content, the issue of giving examples from daily life was mentioned. Before presenting the samples from this context, it would be significant to mention about making connections to real world situations, connections to other disciplines and connections to prior work. Focus of these issues was presented in chapter III as; the students are expected to find and make connections to other disciplines or real-life situations. For example, after understanding the proportion, they can use similar triangles to find the height of a building (CMSI, 2007). Another example would be the usage of ratio to make a model of a building, or to draw a sketch of a room.

To sum up, these features of content expect students transfer the knowledge learned in mathematics lessons, to other situations and find practice areas for them.

Table 4.1 indicated that students did not engage in these kinds of connections. Rather, they found examples from daily life for three times. Following a sample was presented for related issue.

The teacher made an introduction by asking students if they heard the term "ratio" before.

Student A: I have heard from my sister. She mentioned about it several times while she was working.

Student B: I have heard from my father. He is a carpenter and he uses this term regularly while doing this work.

The teacher asked girls whether they had ever observed their mother while they were cooking. If yes, how they were doing it. She was willing to hear students using the term "ratio"; or she wanted to obtain their prior knowledge on the issue.

Student C: I always watch my mother while she is baking cake. She uses ingredient according to some ratio. For example, I know that she adds three glasses of flour for one glass of milk.

Student D: I also know that my mother cooks rice with a ratio of two glasses of water for one glass of rice.

Teacher: All of your examples were very good and true. Ok, now. What about maps? Who has an idea about them? Do you think that the areas of the countries or cities are the same as you see in the map also in reality?

Student E: No, map designers make them smaller.

Teacher: Do you think that they do this job randomly?

Student E: I don't think so. They should use a particular ratio.

Teacher: Ok. They use ratio; for example when we look at our map on the wall, we see a ratio of 1/ 100 000. Ok, know I will write the descriptions and then the questions on the board. Just watch and listen to me carefully.

Looking from a general view to the case of content, Table 4.1 indicated that students were generally engaged in procedural thinking that indicates traditional methods of teaching according to CMSI (2007). Furthermore, students rarely met experiences that provided them a conceptual understanding of mathematics. Additionally, solving problems were practiced by following traditional educational methods, which did not have the features defined in CMSI (2007). Moreover, students did not have chance or opportunities to make justification. As a final point, they did not transfer the gained knowledge by making connections to real world situations, to other disciplines or to the prior work. They only found examples from daily life in limited number of lessons.

4.2.2. Results of Learning Case

Since the aim of the study was to observe the students' practices in the classroom during the mathematics courses; learning case mainly focused on the physical activities of students during these courses. According to CMSI (2007), students' participation levels, offering alternative solution strategies to the problems and proving whether those strategies work, using various representations for demonstrating their understanding of mathematical content were investigated. Moreover, their relationship between classmates from the aspects of sharing ideas and collaborative working issues were evaluated under the topic of content (CMSI, 2007).

In this part, each of the subcategories of learning case was investigated separately by presenting examples to related case from observed lessons. At first, it would be significant to have a closer look at the table of student learning from the view of learning case.

Table 4. 2 Obtained categories for learning subcategory of student learning case

Results of learning case	Number of observed lessons	Percentage
Categories for Learning		
Active engagement	10	50%
Justification of answers	1	5%
Alternative solution strategies	1	5%
Using representations Schemas	1	5%

Looking at the Table 4.2, the issue of students' active engagement would be investigated in the first hand. As it is defined in CMSI (2007), active engagement refers to whether all students focus on the work of exploring, understanding, and solving mathematics problems. Students' engagement means that they involve in experiments of classroom discourse. Their attention should focus on the mathematics problem. In addition, they may participate in a whole class discussion or in a group work. Their working together to find and explain alternative solution strategies would be given as an example to this issue (CMSI, 2007).

Table 4.2 indicated that students were observed or considered as actively participating to the classroom discourse experiences for 10 times, which is half of the total observed lessons. In the following sample, active participation of students can be seen.

The probability lesson was started with the teacher's introduction the subject. She gave pointed papers to students and mentioned the lesson would have been activity-based. She wanted students to draw squares on their papers.

Teacher: I want you to draw one diagonal of your squares. First, tell me the meaning of the term "diagonal". Yes, Burak. (*There were only a few raising hands).*

Student A: A line, which is drawn from the corner of our figure.

Teacher: Remember from last year. Did we make such a definition? (*Silence for a while. They knew the meaning, but cannot define it in mathematical terms.)* Ok. Who wants to show what a diagonal is? Berna, come to the board. *(Student came)* Now, draw a square and one of its diagonal.

Student drew what she had wanted; and then the teacher told the definition of diagonal for students. After students had written the definition, all students draw one diagonal of their squares.

Teacher: All right, now fold your squares from these diagonals and tell me what happened to them? Who wants to answer?

Student B: The pieces are the same.

Teacher: That's right. Each of pieces equals to other. We define these "symmetry lines". Now write the definition. (*She told and student wrote).* Now, look at your squares whether it is possible to find another symmetry lines. Yes, what do you think? Is there anyone that found other symmetry lines?

Student C: Another diagonal is the one of symmetry lines.

Teacher: Good. What else? *(A few students raised their hands.)*

Student D: If we fold from middle of the square straightly, not diagonally, we get two equal pieces again.

Teacher: Perfect. That's right. Now, I want you to draw all symmetry lines of your squares with colored pencils; then you will tell me the total number. How many diagonals did you find?

Class: Four

Teacher: Yes, a square has four symmetry lines in total. Now, I will draw an equilateral triangle on the board; write it in your notebooks.

Participation of students was in high levels in this lesson. Students involved in different activities in addition to procedural. They reached the rule with an activity. This was a practice including justification and proof. An increased interest of students was observed. This was the first classroom activity required the participation of whole class. Except for a few students, most of them tried to do and understand what teacher expected. Furthermore, this was a lesson with more student-student interaction. The activity was the first that made students ask questions and communicate with each other.

Second issue is justification case of learning process. As it was mentioned previous part, students are expected to justify their answers or solutions in meaningful way. Results indicated that students produced justification to their

answers only one time during the observation process. The sample from the lesson was presented previously in 'content' part.

Third, students' offering alternative solution strategies to the problems will be evaluated. This feature expects students realize or find a pattern in a problem, or solve it by using models, graphs, schemas, tables, diagrams. In the Table 4.3, it is seen that only one time a student offered an alternative method to solve a problem. Following this example will be presented.

In the 'subtraction' lesson, the students practiced operations on the board. Then they continued with solving problems that include subtraction. The teacher read the problem and students wrote it on their notebooks.

Teacher: Is there anybody who has an alternative solution to make our operation easier? Remember, what we use in these kinds of problems.

Student A: We can draw a schema to make our operations easier.

Student drew the schema on the board. The schema was a simple rectangle which was divided into rows and columns. He wrote the given data in these rows and columns separately.

This example demonstrated the usage of schema as an alternative solution method to a problem.

The sample presented above, additionally, constitutes an example for usage of representations case. In this case, the Table 4.2 indicated that students used these kinds of methods only one time as drawing a schema, which is presented above. There were not any other obtained data related to this issue.

To sum up the 'learning' case, it can be deduced from the findings that students did not always actively participated in classroom discourse practices. They did not find or offer alternative solutions to problems, and prove that those strategies work. Related to 'content' case, it can be concluded that students' involvement in procedural teaching-learning practices had also significant effect on their realization of other aspects of discursive experiences.

4.3. Analysis of Teacher Moves

Since the study aimed to observe the ongoing process in the mathematics courses from the aspects of classroom discourse, teacher practices provided essential data for the study. In this part, results of teacher moves case were presented. Teacher moves part is mainly interested in obtaining the ways of teacher's orchestration of the mathematical discourse. Specifically, this case focuses on teacher's making connections to other disciplines, to real life situations or prior work in mathematics classes; or facilitating students in this way, ways of assessing the students' understanding or knowledge from prior work, foster students' producing, realizing different solutions and prove or justify their answers. Additionally, since teachers are responsible for guidance of learning environment, they are expected to encourage mathematical communication and follow the ways that move discussions forward, and finally, designing and controlling the relationship between students during the classroom practices.

According to CMSI (2007), this part was divided into two subcategories in itself as, related to content knowledge and pedagogy; and creating learning environment. At first, a general view of teacher moves case was presented in a table below. This table indicated the number (how many times these cases were observed) and percentage of obtained examples from observational field notes related to each case. Then, each of these subcategories was evaluated separately with samples from observed lessons (CMSI, 2007).

4.3.1. Results of Content Knowledge and Pedagogy

Related to aim of the study, this part evaluated the data that collected about the content knowledge and pedagogy of the teacher. This case specifically focused on the teacher's operating mental activities of students during the process of lessons. The teacher's making connections to the other disciplines, to prior work and to real life situations, giving examples from daily life related to subject of the lesson issues were evaluated under the topic of content. Further, her fostering students in these ways, was evaluated in the interested area of the same context (CMSI, 2007).

In this part, each of the subcategories of case was investigated separately by presenting examples to related case from observed lessons. At first, it would be significant to have a closer look at the table of teacher moves from the view of content knowledge and pedagogy case.

Table 4. 3 Obtained categories for content knowledge and pedagogy subcategory of teacher moves cases

Results of Content Knowledge and Pedagogy	Number	Percentage
Categories for Content Knowledge and Pedagogy		
Connections to other disciplines	4	20%
Giving or facilitating examples from daily life	8	40%
Connections to real world situations	2	10%
Connections to prior work	2	10%
Assessment of prior knowledge and students understanding		
Want students find examples	3	15%
Want students solve problems/make operations	10	50%
Encourage alternative solution strategies	-	-
Encourage proof and justification	5	15%

Looking at the Table 4.3, it would be meaningful to investigate the issues of making connections under one topic. As it was explained in chapter III, the teacher should facilitate connections by drawing on students' prior knowledge and experiences. Additionally, teachers are expected to provide opportunities to help students make connections, both to their prior work in the mathematics classroom and to real-life. For example, they may be encouraged to connect a lesson to operations in natural numbers to experiences with money (CMSI, 2007); or another example would be connection to real life experiments by conducting small inquiries in learning usage of tables and graphs. Making connections to real world situations requires students transfer the gained knowledge to the other areas and practice them in related area.

Table 4.3 indicated that, in 8 observed lessons teacher gave examples from daily life or encouraged students in this way. In addition, in 2 lessons, she made connections to the prior work, in 2 lessons to real world situations and in 4 lessons to the other disciplines.

In the following samples from observed lessons, obtained examples for these issues was presented respectively.

Teacher: Today, the subject is measure of liquids. Let's talk about the importance of liquids in our lifes. We use them in many places. Especially, they have a critical role in daily nutrition. Give me examples, where do we use liquids in our nutrition. *(Students gave examples in an order)*

Student A: Water

Student B: Milk

Student C: Fruit juice

Student D: Oil

Student E: Yogurt drink

Teacher: Good examples. Now, I want examples from the usage areas of liquids except for nutrition.

Student F: Cologne

Student G: Petrol

Teacher: What do we use for liquids to keep them?

Student A : Glass

Student B: Tin box

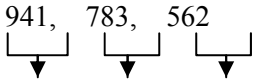
Student C: Cartoon box as milk boxes we buy. …….

The dialogue above constitutes an example for the case of giving examples from daily life and also for connections to other disciplines, since teacher mentioned about the importance of liquids in our nutrition, which is a subject area of 'Science and Technology' lesson.

In the lesson of 'Subtraction of five digits natural numbers', the teacher organized a small problem scenario, which required students do shopping. Practiced scenario included a student's buying notebooks and pencils from a shop. This activity made students to transfer the knowledge of subtraction to the practices of real life.

Following dialogue was chosen from the lesson whose subject was 'natural numbers'.

Teacher: Now, I want you to tell me numbers and I will write them on the board. (*She wrote the following number on the board by getting from students*)



? Students knew the name of these divisions from 4th grade.

Teacher: To name our new division, remember your prior knowledge. How did we name the other two divisions? Be careful with places they have. How would we call new division?

Class: Millions division

Teacher: Good. Let's find the number and place values of the number.

This was an example for usage of prior knowledge. Because, teacher guided her students to remember how they had named the thousands and ones divisions when they were in fourth grade.

Another issue about the content knowledge and pedagogy is teacher's ways of assessing the students' prior knowledge and understanding of mathematical content. A lesson, which starts with questions, makes the teacher assess prior knowledge and understanding of students'. By using the students' answers, (s)he connects this prior knowledge to that lesson (CMSI, 2007). For example, in a lesson on perimeters of regular polygons, students may be encouraged to remember features of basic regular polygons. This recall makes them to construct new knowledge in easier way.

Table 4.3 indicated that the teacher mostly used solving problems and making calculation operations. According to table, 10 times teacher used these methods, which equals to half of the observed lessons. Related example was

chosen from the lesson of 'addition of fractions'. After teacher's presentation of subject with an example, they continued with making similar operations on the board. After completing these operations, teacher read a problem and wanted students to write it on their notebooks. With these experiences, the teacher aimed to assess the students' understanding of the subject.

Additionally, the participated teacher wanted students to find examples about the subject as an assessment way to obtain their understanding. These practices were obtained for 3 times during the process.

In the probability lesson, teacher wanted students to find examples about the 'certain' and 'impossible' events, after learning the subject.

Student A: Fishing in the classroom is an impossible event

Student B: It is a certain event to see the environment is lightened, when we wake up in the morning.

With this way, teacher aimed to obtain the students understanding about the certain and impossible events in probability.

Another issue is about teacher's encouragement of proof and justification of students. As it was mentioned in previous chapter, the teacher's usage of questioning and encouraging rich student explanations, both verbally and in writing, is the most important point in this process. Moreover, (s)he encourages students to build on each other's thinking and foster for justifying their thinking with questions: "Why is this true? Do others agree? Why or why not? Can you provide examples? Will this always work?" (CMSI, 2007, p. 12-13) The teacher is expected to listen to students' ideas; enhance, and move forward mathematical discussions through questions; encourage alternative explanations and solution strategies, and foster students to justify their ideas or solutions (CMSI, 2007).

During the observation process, the examples were obtained five times in total. As an example to this situation, following dialogue may be presented:

……

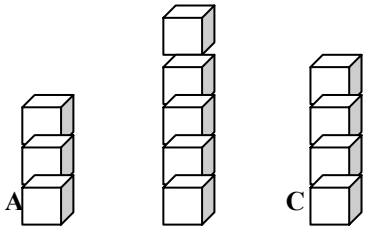
Teacher: Assume that three of you got following marks from mathematics exam. I want to find the mean of the achievement.

Student A: 3

Studednt B: 5

Student C: 4

Teacher: Let's demonstrate these marks with cubes.



Teacher: How many cubes are there in total?

Class: 12

Teacher: Ok. How many students are there?

Class: Three

Teacher: Yes. If I add three marks and divide them with three, I find the mean. Who will explain the reason for using division here? What this operation means to you?

Student D: We conduct division when we want to find how many parts a person gets. Therefore, we need to divide total of notes to number of people, to obtain which marks each of them gets.

In this example teacher was trying to make students to confirm the reason for using "division" to find mean. By asking about the usage of division, she reminded them the real meaning of this operation. Therefore, she made students to confirm the real meaning of "mean", pointing out that was underlying the meaning of division operation.

From a general view, the results from the case of content knowledge and pedagogy indicated that the teacher rarely made connections to the other disciplines, to real world situations and to prior work in mathematics classes.

Additionally, she frequently gave examples from daily life or encouraged students in this way. The percentage of the fostering the proof and justification of students remained in low-levels. Mostly, the teacher preferred to assess students understanding and prior knowledge by using traditional problem solving and calculation operation methods.

4.3.2. Results of Creating Learning Environment

According to CMSI (2007), the case of creating learning environment focuses on the teacher's leading the classroom practices of discourse. Her organization of activities, classroom discussions, ways of make students respect and listen others' ideas during this interaction process, was investigated under the topic of creating learning environment. It would be significant to have a closer look at the number and percentages of obtained results of related subcategory of this content.

Table 4. 4 Obtained categories for creating learning environment subcategory of teacher moves case

Results of creating learning environment	Number	Percentage
Categories for creating learning environment		
Encourage communication-move discussions forward		
Question-answer method	10	50%
Organizing competition	2	10%
Designing mathematical scenarios	2	10%
Designing activities	2	10%
Encourage students to respect others mathematical ideas	1	5%

Table 4.4 indicated that teacher mostly (for 10 times) used question-answer method to encourage classroom communication. The teacher designed activities for 2 times, competitions for 2 times and scenarios for times. All of these experiences were considered to have a feature of enhancing the interaction between students.

First, an example from question-answer method was presented, and then others were mentioned respectively.

As it was presented in previous chapter, to provide a continuous discussion environment and to encourage classroom discourse, the teacher uses open-ended questions, and gives students opportunities. (S)he should help students build new knowledge on other's opinions through questions; further, should encourage students to respond to each other. The teacher should have a role of guide of learning, rather than the only presenter of the knowledge (CMSI, 2007).

Teacher: Yes I have mentioned about the probability. Now, let's think that Kemal's mother is alone at home that is there is nobody except her. When the telephone ring what is the probability of her answering it? *(She asked approximately 20-25 students who were raising their hands for their responses and the common answer was a probability of 100%.)*

Teacher: Ok. Why do you say that the probability would be 100%?

SERKAN: Because, there is nobody except his mother and anyone cannot answer the phone.

Teacher: Ok. This situation has a 100% probability, or we can say certain event. Now, tell me, what is the probability of a pregnant woman's having a girl baby?

This time only a few responses from the classroom that said the probability is 50%, because they could not think about the gender, most of them considered the possible number of the babies.

DERYA: Why we said that 50%probability, we cannot be sure that whether she will have one baby or twins.

Teacher: No, no, no. We talk about the gender not the number of babies.

This sample demonstrates the usage of question-answer method in classroom discourse practices.

Additionally, a classroom activity was designed in symmetry lesson, which can be considered to increase the interactions between students and their communication with the teacher.

Teacher organized small competitions, mathematical scenarios and activities for two lessons for each other. For example, in one lesson teacher designed a small shopping scenario for students to provide deeper understanding

about ‘four basic operations with natural numbers’. Additionally, in one lesson they placed in a classroom competition about ‘the fastest completing the operations written on the board’

Finally, a teacher has the responsibility of encouraging students to listen carefully, and criticize other’s thinking. In this way, for one time the teacher organized a problem solving session. The problem was aimed to assess the abilities of making calculations with four basic operations. One student solved it on the board with the help of other students. The teacher did not involve in the process in any way. This lesson session made student listen and respect others opinions, and learn from those ideas.

CHAPTER V

DISCUSSION

5.1. About the Discussion Part

Since the purpose of the study was to evaluate some characteristics of mathematical classroom discourse of fifth grades, data was collected by visiting a fifth grade classroom of a public school during twenty lessons, to observe them in their natural settings and get observational field notes of classroom experiences.

Discussion part was presented in four parts; these were (1) discussion on students learning, (2) discussion on teacher moves, (3) recommendations and (4) implications for further studies. First and second categories were divided into two sub categories in themselves. Students' learning category was divided as content and learning; and teacher moves category was divided as content knowledge and pedagogy and creating learning environment.

5.2. Discussion on Students' Learning

In this part, discussion of students' learning case was presented. As mentioned in CMSI (2007); student learning part was interested in obtaining; activities that students are engaged in during mathematics courses and features of these activities in lessons. Moreover their having chances to express their opinions about subjects, abilities of finding alternative solution strategies to problems, proving those strategies work, using various representations as solutions of problems or proofs for demonstration of their understanding issues were evaluated. Additionally, students' participation; and abilities of involving in classroom activities or group work was investigated under the same topic.

5.2.1. Discussion on Content Case

As it is stated in CMSI (2007), content case specifically focused on the mental activities of students during the process of lessons. Their thinking, understanding, and constructing knowledge issues were evaluated under the topic of content.

In the current study, results from collected data indicated that students were generally engaged in procedural thinking which is defined as one traditional method of teaching mentioned in CMSI (2007). Students rarely met experiences that provided them a conceptual understanding of mathematics. Additionally, solving problems were practiced by following traditional educational methods, which did not have the features defined in CMSI (2007). Moreover, students did not have chance or opportunities to make justification. As a final point, they did not transfer the gained knowledge by making connections to real world situations, other disciplines or the prior work. They only founded examples from daily life in limited number of lessons. These results were not consisted of the features of classroom discourse explained in research studies (Lampert, 1989; Sfard, 2001).

Literature showed that one important feature of classroom discourse is the interaction between students. The math classroom is expected to be a community where classroom teacher fosters thinking, talking, agreeing, and disagreeing (NCTM, 1991, 2000). According to NCTM (2000), the teacher should provide students with powerful math problems to solve together and students are expected to justify and explain their solutions. The main aim is to extend students' own thinking. These features are expected to enhance mathematical interaction in the classroom. However, in the current study, it was obtained that students did not involve in these practices during the observation process. They were rarely encouraged to justify or explain their own solutions, and results weren't consistent with a discursive classroom according to CMSI (2007).

These results would be based on the teacher's teaching method. She may not have created an environment in which students shared or discussed their ideas or solutions with others. Another reason might be related to the features of

mathematics questions presented by the teacher. They may not motivate students to think in alternative ways, or make them try different strategies of solution. Moreover the crowdedness of the classroom could have prevented the teacher from involving in these kinds of activities, because of the hesitation of losing the control. A final reason may be caused from a possible lack of teacher's pedagogical knowledge about creating and leading this kind of environment.

The issue above leads the discussion to the quality of math questions. Problems should allow kinds of solutions, or many problem-solving strategies. In addition to NCTM (2000), Bruce (2007) states that math problems can be regarded as powerful when they take students from the procedural and regular computational process into complex thinking practices. Practices that emphasize student interaction improve both problem-solving and conceptual understanding without any loss of computational ability (Bruce, 2007). Math questions should let students find various problem-solving strategies.

In this situation, the role of teacher is crucial again, in preparing and organizing tasks in ways for providing students to construct mathematical understanding meaningfully by participating practices of discourse. In new elementary mathematics curricula the characteristics of math questions and the process is defined as following:

> "In problem solving process the important point is the way of solving the question, not only finding the answer. The way they use to solve the question, whether they use any pictures, diagrams or tables and the aim of using them should be emphasized." (MoNE, 2005, p.11)

The chosen math questions should be related to the issues that students meet in their daily life and should be related to activities practiced in school (NCTM, 2000). By this way, students' gaining mathematical knowledge and skills will be more meaningful and it will be easier to use this knowledge in other fields.

According to the results of current study, students did not meet the assumptions of quality mathematics questions, which defined in MONE (2005) at

all. They did not discuss and share ideas about a problem. Justification and problem solving processes were rarely placed in classroom. Furthermore, it was indicated that the questions which were solved in the classroom focused on practicing the procedures. Results were not consistent with a discursive classroom environment according to CMSI (2007). Thus, it can be deduced that classroom discourse were not practiced in terms of content case of students learning. These results may be due to the teacher's wrong choices in questions. She may have chosen questions which were required low-level thinking that students did not need to think other strategies (NCTM, 2000); or these questions could be solved with basic operations, so they did not need to use different representations (Bruce, 2007). Another reason may have caused from a possible lack in the understanding of students about process. Their regular classroom practices may not have included these kinds of activities. They may not have used to work on problems by discussing and changing ideas or using various representation models. So they might have been in a contradiction with their regular habits and new approaches (McCrone, 2005).

5.2.2. Discussion on Learning Case

Since the aim of the study was to observe the students' practices in the classroom during the mathematics courses; learning case mainly focused on the physical activities of students during these courses.

According to CMSI (2007), the participation levels of students, offering alternative solution strategies to the problems and proving whether those strategies work, and using various representations for demonstrating their understanding of mathematical content were investigated. Moreover, their relationship between classmates from the aspects of sharing ideas and collaborative working issues were evaluated under the topic of content (CMSI, 2007).

In the 'learning' case, it was deduced from the findings that students did not always actively participate in classroom discourse practices. They did not find

or offer alternative solutions to problems, and prove that those strategies work. Additionally, related to 'content' case, it was concluded that students'

involvement in procedural teaching-learning practices had also significant effect on their realization of other aspects of discursive experiences. When the literature is considered, it is clear that active participation has an important effect on shaping the nature of classroom discourse. For instance, results of Hiebert and Wearne's (1993) study showed that there was a relationship between instructional approaches -used in classroom practices, which have critical role in shaping the nature of classroom discourse- and students' learning . Additionally, the results of Clement's (1997) study showed that engaging in conversations, questioning students, probing them for alternative solution strategies, making them to work in groups or in pairs, using manipulatives provided an environment for students to get a deeper understanding. Related to these explanations, it can be concluded that results from the current study did not meet the assumptions of discursive classroom again.

An important thing from these analyses with respect to information above is that students didn't have so many chances to think deeper to find new or different solutions to questions and share them with the classroom, because there was not a classroom environment that provided by the teacher. Classroom discourse was mainly based on traditional dialogues between teacher and students. More specifically, a pattern was determined for this classroom as follows; first teacher taught the subject (with its descriptions, mathematical concepts, formulas); wrote a question about the subject and solved it for children to make them understand better; she emphasized the procedure for how they would solve other questions and finally other questions were written on the board and students came to board to solve them, but generally student who came to solve the problem used the way which teacher had told him or her to use. According to researchers (Yackel & Cobb, 1996; Yackel, 2002), these features are a sign of classroom in where the members are practicing traditional methods. Thus, it can be concluded that the participated classroom had shown the characteristics of a traditional one.

Additionally, these obtained observational data were parallel with Doğan's (2006) study. Results of this study showed that traditional methods, which meant teacher-dominated classroom environment, had been used in mathematics lessons. Similar to the current study, he could not obtain a specific pattern for lessons. Additionally, he concluded that classroom practices were away from new approaches. From this point, it can be stated that Doğan's (2006) study supported that classroom discourse has not been practiced.

During the observation process all the lessons was mainly based on this pattern. Sometimes there were small discussions when the examples were given about the subject or someone did not understand any particular issue or question. By asking a simple question, a classroom discussion can be started and this would make students see their thinking abilities and develop their skills of sharing ideas, agreeing and disagreeing with peers and mainly communicating in mathematical language (Clement, 1997). In order to take place in a discussion, classroom (both social and mathematical) norms need to be established so students feel comfortable with explaining and justifying their responses. Establishing this classroom culture can be done by expecting students to explain and justify their answers, whether they are correct or not; emphasizing the importance of contributing to the discussion by explaining their strategy rather than producing correct answers and expecting students to listen to others' explanations (McGraw, 2002; NCTM, 1991; Peng, 2009; Rojas- Drummond & Mercer, 2003)

In the following part, results from teacher activities will be argued.

5.3. Discussion on Teacher Moves

Since one of the aims of this study was to observe the ongoing process in the mathematics courses from the aspects of classroom discourse, teacher's practices provided essential data for the study.

In this part, discussions on teacher moves case were presented according to the results. Teacher moves part was mainly interested in obtaining the ways of teacher's orchestrating ability of the mathematical discourse. Specifically, this

case focused on teacher's making connections to other disciplines, to real life situations or prior work in mathematics classes; or facilitating students in this

way, ways of assessing the students' understanding or knowledge from prior work, foster students' producing, realizing different solutions and prove or justify their answers. Additionally, since teachers are responsible for guidance of learning environment, they are expected to encourage mathematical communication and follow the ways that move discussions forward, and finally, design and control the relationship between students during the classroom practices.

5.3.1. Discussion on Content Knowledge and Pedagogy

Related to the aim of the study, this part evaluated the data that were collected about the content knowledge and pedagogy of the teacher. This case specifically focused on the teacher's operating mental activities of students during the process of lessons. The teacher's making connections to the other disciplines, to prior work and to real life situations, giving examples from daily life related to subject of the issues of the lesson were evaluated under the topic of content. Further, her fostering students in these ways was evaluated in the related area of the same context (CMSI, 2007).

From a general view, the case of content knowledge and pedagogy indicated that the teacher rarely made connections to the other disciplines, to real world situations and to prior work in mathematics classes. She also rarely gave examples from daily life or encouraged students in this way. The percentage of the fostering the proof and justification of students remained in low-levels. Mostly, the teacher preferred to assess students' understanding and prior knowledge by using traditional problem solving and calculation operation methods.

Considering the literature, Lampert's (1990) study examined the kind of reasoning abilities that occured during mathematical classroom discourse when students and teacher engaged in. This study was an example of importance of

making connections to real world situations and other disciplines during teaching-learning process. In that study, students and teachers worked on some problems that were generally related to real world situations. With these changes in classroom discourse, students' performances clearly improved on tests. However, in the current study the situation was reverse as mentioned above. Practices which included examples of making connections to other disciplines and giving examples from real world situations were in very limited numbers.

Additionally, observational data from the current study showed that the same teaching and practicing procedure was followed during the observation process. Parallel to Doğan's (2006) study; the teacher first talked about the subject and then solved questions about the subject. The classroom had a characteristic of teacher-dominant. The teacher generally did not create a classroom environment with the participation of all of the students. Although they had chance to talk and they were flexible about explaining the ideas, they gave answers to the questions only when asked by the teacher instead of constructing their own process or finding different strategies to solve the questions. However, when the literature was considered, Ping's (2001) study indicated that classroom discourse would be accepted as a tool for learning and as an indicator of identity. Furthermore, teachers have a critical effect as models on children's attitudes toward communication in the usage of mathematical language. Additionally, Casa's (2004) doctoral dissertation focused on teachers' decision-making in discourse practices in elementary level mathematics classrooms. Results of the study indicated that teachers should examine and understand the purpose, the nature, and the requirement of discourse. To provide an environment for students in which they would discuss and prove mathematical solutions, strategies and ideas, teachers expected to learn how to question them in a way of engaging in discussions; and how to guide the classroom discourse. Also the importance of making connections in and outside to mathematics have been highlighted again with this study.

The role of the teacher should be as defined in new Elementary Mathematics Curriculum. In that source, teachers are expected to motivate

students, develop appropriate activities and practice in classroom; make students thinking and discussing (MoNE, 2005).

Deficiencies in teachers' content knowledge and pedagogy are possibly related to her being a chemistry teacher indeed. This may have created an obstacle for adopting herself to teach in the first part of elementary education.

When the literature and the results from the current study was compared, it can be concluded that the classroom environment did not have the standards and features defined in literature, thus the teacher's practices did not satisfy the requirements of discursive classroom. One of these results would have caused from teacher's not being ready for the lesson. The teacher had to plan everything before the lesson. These plans should include the examples for that day's subject. Preparing plans for lessons would be helpful for teacher while giving examples from daily lives or other disciplines (CMSI, 2007). Another reason would be based on teacher's possible lack in awareness of importance of making connections to prior lesson subjects, or other disciplines and real world situations (CMSI, 2007). Mathematics teachers should give or make students see the answer of question 'where I will use mathematics in my daily life'. As a final reason, it can be said that teacher would have chosen the direct teaching method without trying any alternative techniques (NCTM, 2000). This interpretation can be supported by Hiebert and Wearne's (1993) study which was focused on the importance and effect of classroom discourse on students' learning process of mathematical concepts. They compared the traditional and discourse-based approaches to obtain whether there was any linkage between classroom practices and learning mathematics. Results of their study showed that there was a relationship between instructional approaches used in classroom practices. From this point, it can be deduced that the usage of traditional teaching techniques caused the deficiency in classroom practices.

5.3.2. Discussion on Creating Learning Environment

In this part, teacher's practices about classroom discourse environment will be discussed related to observational data.

According to CMSI (2007), the case of creating learning environment focused on the teacher's leading the classroom practices of discourse. The teacher's organization of activities, classroom discussions, ways of making students respect and listen others' ideas during this interaction process were investigated under the topic of creating learning environment.

Additionally, in CMSI (2007), it is stressed that to provide a continuous discussion environment and to encourage classroom discourse, the teacher uses open-ended questions, and gives student opportunities. S/he should help students build new knowledge on other's opinions through questions; furthermore, s/he should encourage students to respond to each other. The teacher should have a role of guide of learning, rather than the only presenter of the knowledge (CMSI, 2007). Moreover, a teacher has the responsibility of encouraging students to listen carefully, and criticize other's thinking (CMSI, 2007).

According to the results of the study, the teacher organized small competitions, mathematical scenarios and activities for two lessons for each other. Additionally, for one time the teacher organized a problem solving session. This lesson session made students listen and respect each other's opinions, and learn from those ideas. These can be examples for creating communication and discussion environment. However, when ongoing process of lessons were considered, it was obtained that they could not engage in this kind of environment.

About this issue, Bruce (2007) states that to make students involve in meaningful mathematical discussions and discourse practices, the point is to help them to understand "what does the understanding of mathematics mean?" and "What does doing mathematics mean?" Importance of the primary role of the students should be at the center in this condition. However, it does not mean that teachers will not be responsible for the mathematical activities anymore (Bruce, 2007). Reversely, their responsibilities have increased by facilitating classroom argumentations and activities in which students try to express their own mathematical understanding. Essence of the situation comes from teachers'

awareness of students' different strategies and complementation of mathematical arguments in a way which students would have chance to develop their drawing inferences and reasoning abilities. Parallel to this view, results of the study can be interpreted as a possible lack of teacher's awareness about the importance of her primary role creating discursive classroom environment. Maybe, she might continue to believe the usefulness of teacher-centered teaching methods; or believe that creating a discussion environment may have a negative effect on coordination of classroom and on attention of students. Additionally, parallel to Şahin's (2005) study, the teacher frequently wanted students to work and argue on problems. According to Şahin (2005), these teachers have not realized and understood the importance of classroom discourse when the results are explored again. Furthermore, they really do not know what the reform mathematics and the new elementary mathematics program expects from them. Parallel to his view, in the current study, a possible lack in the participant teacher's understanding of classroom discourse may have not fit the expectations of mathematics curriculum from teachers. This contradiction may have caused the deficiency in discursive practices.

McCrone (1997, 2005) states that, another issue is math teachers' having a number of challenges in trying to get a better quality student interaction or talking in mathematics language, which is a crucial element for creating a classroom discourse. One is the complexity of trying to teach mathematics in ways they did not experience as students. Most of in-service teachers did not practice or learn new approaches to the mathematics throughout their education process. In this context, they have failed or avoided of using these methods in their lessons, and insisted to continue what they had learned. Parallel to this view, when the graduation year of the teacher was considered, she may be having some problems while using new approaches. New approaches might differ from experiences they practiced as students. As most of in-service teachers, she might not have practiced new approaches in the mathematics throughout her education process. In this context, she may have failed or avoided of using these methods in her lessons.

According to Bruce (2007), another issue is a possible discomfort with teacher's level of math knowledge and a possible lack of the opportunities of the professional development that makes teachers avoid of adopting math language strategies. In addition, how teachers and students use the mathematical language in classroom discourse is another area of research (Bruce, 2007). Considering the results of this study it may not be possible to comment that the teacher's mathematical knowledge or lack in her self-confident caused the absence of math talk, but it was possible to say that she was not using mathematical language used in the classroom. This may be based on a possible lack in her knowledge in using mathematical language in lessons.

Looking from general view, results of the study did not meet the assumptions of the discursive classroom when compared to literature (McCrone, 2005; MoNE, 2005; NCTM, 2000). Most of the requirements of mathematical classroom discourse defined in the literature were not obtained with observational data. Essential characteristics of discourse -according to literature- were not provided by the participated teacher. These may be due to various reasons. One reason would be based on the teacher's trying to teach mathematics by using the methods that she did not practice while she was a student. A possible lack in her professional development opportunities would be an obstacle to adopt new approaches (Bruce, 2007). Furthermore, time is another factor. The teacher had to complete defined curricular demands. So this would have made her avoid using other strategies which were required most of the time (Bruce, 2007).

As a final point, the necessity of teacher's being a model for students to understand what's going on mathematics classroom encourage them to justify their solutions and make them learn to take responsibility; in brief the necessity of increasing responsibility of teacher's role in a discursive classroom may have created a reason for being away from creating such a classroom environment (Bruce, 2007).

5.4. Summary of Discussion Part

Considering the results of the study some conclusions can be drawn.

Interpretation of observational data has shown that traditional teaching methods have continued to dominate in elementary mathematics lessons with respect to discursive practices. Furthermore, teachers do not have the real knowledge of improvements in education of mathematics and the changes in educational curriculum.

In general, the lessons were organized around the teacher's statements, not students'. Students usually engaged in thinking those statements based on mathematical procedures, presented directly by teacher. Students did not have ability and chance to find alternative solution strategies for problems; to justify/prove them in classroom environment; to listen, understand and respect the others' ideas to construct new mathematical knowledge.

Additionally, they generally practiced the lessons in similar ways. These were results of their engaging in tasks, which required low-level thinking, rather than high-level ones. Teacher presented subject, solved a sample example to make students understand the issue, and wrote questions for them.

Teacher seemed to spend valuable effort to make connections to the real world situations in a few subjects; moreover, she presented some subjects with inter-disciplinary examples; for instance, introducing the subject of "measurement of liquids" with a linkage to "science and technology". However, students did not have abilities of finding these linkages on their own; they mostly needed the guidance of the teacher. They found a few examples from daily life, only if they were familiar with the subject from previous year, under the directions of teacher again. Both the teacher and students did not use the prior knowledge to construct new one; furthermore, the teacher did not spend effort to foster students in this way.

It was not possible to observe the usage of variety of demonstration methods during the research process, except for teacher's making some experiments with concrete materials a few times; for instance, while students were learning the subject of "transformation between compound fractions and mixed fractions", the teacher brought a cake to the classroom. These were appropriate

and meaningful activities for providing an in-depth mathematical understanding. Additionally, it was considered helpful for students' involvement in conceptual thinking. However, the crowdedness of the classroom and teacher's losing the control in that environment caused failure in reaching the determined objectives. Moreover, teacher spent effort to organize some classroom activities for a few times, again the similar reasons constituted handicaps for her purpose. The reason for teacher's loss of control would be predicted as her being a chemistry teacher in real, and not having the knowledge of pedagogy for the age of fifth grades.

Another point obtained from data was the quality of questions and problems practiced during the lesson sessions. The characteristics of questions and problems required students to practice the rules and procedures of mathematical content, rather than foster their mental activities by getting involved in high-level thinking.

During the observation process, the teacher had a main role of directing students in the way she wanted. Students usually did not have chance to suggest new ideas or solution to the questions, because of their requirement of using particular ways chosen by their teacher. For instance, when she called students to the board to solve questions, none of the students solved the problem without the directions of her. They wrote or solved what they saw on the board. The teacher should have provided opportunities to the students to make each of them an active problem solver. An effective and expert teacher should design activities or experiences that enable students to achieve designated objectives and should orchestrate students' work. These activities should be based on the ways in which students develop real mathematical understanding (NCTM, 1991). This is only possible by creating an effective classroom discourse on mathematics. However, the results of the study demonstrated the reverse in practice. Students were not seen as active problem solvers. It can be obtained from the simple classroom dialogues presented above in which the teacher was seen as solving questions written on the board in most times. The main concern seemed to be based on procedures, not the quality of the context. Students should learn the problems by

using particular writing styles (e.g. formulas if they have) and they should do the same in their exam as they did in the classroom (NCTM, 2000).

As a last point, when the literature and the obtained results were compared, it can be concluded that traditional approaches have continued to dominate in participated classroom. In the teaching-learning process, procedural methods were used by the teacher. Classroom discourse was not practiced by classroom members. According to Pierson's (2008) study this classroom would possibly have a low achievement level in mathematics lessons. Because with that study, she concluded that classroom discourse and discussion patterns occurring as a necessity of discourse affected and led students' learning in a way of developing mathematics achievement (Pierson, 2008).

5.5. Implications

This study was conducted to obtain some characteristics of mathematical classroom discourse from selected aspects. The researcher worked with fifth grade students during the study, conducting frequent observations in mathematics lessons. Considering the results of the study, some implications would be suggested for pre-service and in-service teachers and teacher educators.

One implication of this study would be that teachers should be more careful while they are planning their lessons by considering the requirements of new curricula so that they should try to provide more effective classroom discourse and orchestrate in a way to provide students' mathematical understanding in-depth. More activities should be organized for providing chance to participate in them. From the results, it is possible to state that when a lesson is organized around an activity, students' interests increase parallel to this. As they enjoy the lesson, their mathematical understanding predictably improve. However, while an activity is providing an enjoyable learning environment, it should make them reach the aim of the lesson at the same time. In this context, teachers are responsible for leading these activities in a mathematical way; and they need to be careful not to lose the control in class. They should be aware of

the language used in classroom, and also should be able to guide it, since students need to start using the mathematical language from their early years to use it effectively and strongly in later years to share their ideas, to discuss, to agree or disagree with their peers and so on. In addition, the quality of questions should be determined by their levels of making students think and find different solution strategies than their peers and compare them with each other. The questions of a discursive classroom environment should make them think deeper on the issue, try to see the connections with prior knowledge and use it.

Looking at the results of study, it can be stated that mathematics teachers play an important role in process and content of classroom discourse. Observational data from the study showed that teachers should be active as well as students to orchestrate the class effectively, to encourage children to involve in discourse community and to create a learning environment parallels with curriculum goals. They need to be aware of the necessity of improving their own content knowledge and pedagogy. To support this improvement, it is inevitable to follow and learn changes and new approaches that have developed in the field of education, specifically about the teacher role in classroom. Related to this, they need to change their teaching and participation methods. In this context, McCrone (1997) states that teachers are responsible for constructing classroom environments which enhance mathematical discussion. Moreover, they need to choose appropriate tasks for classroom discourse. Furthermore, teachers should be aware of the usefulness of their questions, whether they facilitate students' mathematical understanding. As an essential role, they also need to listen to the students' ideas to make them work with each other; and participate in classroom activities and discussions. Similarly, Forman and Cazden (1985) mention that students can only learn by communicating and interacting and by using mathematical language in a meaningful way under the appropriate guidance of their teacher.

Another important implication would be suggested for the teacher education system in Turkey. All teachers know that there are discrepancies

between “what they learned during university education” and “what they have practiced in real life” (Bulut, 2007). This condition is same for the issue of classroom discourse. Mathematics teachers usually do not think or do not have any idea what a classroom discourse is. At the time of their start of working, they face with choosing the most appropriate way for an effective teaching. It would be possible to construct classroom environments in which they (pre-service teachers) learn to involve in mathematical discourse, and get familiar with it (Bulut, 2007). Moreover, they would have a meaningful understanding of mathematical concept presented to the students in using methods that are more appropriate. Doubtlessly, this would be provided only under the guidance of an expert instructor of the issue (Bulut, 2007). Further, instructor would make them work in groups, and help to recognize the aspects of collaborative working, since the deficiency of group working is in high levels related to teachers having insufficient abilities in guiding and controlling these kinds of activities.

To sum up, it is possible to create classroom environments in which pre-service mathematics teachers learn to conduct and participate in a discourse. Lessons would be added to the universities’ teacher education programs in this way. This opportunity makes them get familiar with the issue and practice in easier way during their profession (Doğan, 2006). The same experiences also may be presented to the in-service mathematics teachers, since most of them do not have the real knowledge of the improvements in education, and their changing roles. Moreover, many of them still insist on continuing their teaching practices by using traditional methods. It would be possible to get them in education programs in this way (Bulut, 2007).

5.6. Recommendation for Future Research Studies

This study focused on the nature of mathematical classroom discourse with one-fifth grade classroom. Although, the study is important in providing important information about some aspects of classroom discourse, and demonstrating the deficiencies of these practice to make teachers improve themselves for a more quality mathematics education; some questions would raise about the issue.

One may want to conduct a study comparing two classrooms with respect to mathematical classroom discourse. Their instructors may differ in experiences from this aspect. Another might conduct a similar research to draw a picture of classroom discourse, but studying on different grades; for instance the same content may be conducted on a 6^{th}, 7^{th} or 8^{th} grade classroom separately, or one can try to obtain a general pattern of classroom discourse in second part of elementary education. Moreover, it may be informative to provide a perspective of classroom discourse in mathematics lessons of 1-5 grades.

Another researcher might be interested in one aspect of classroom discourse with an in-depth investigation; for example s/he may look only for group work practices of discourse; it may also provide sufficient information to study on the teacher's methods to guide the discourse activities and their effectiveness on students' learning. Moreover, it might be meaningful to try to investigate the influences on the nature of discourse. These factors might be studied from a general perspective, or separately in a deeper way.

As an example, some research questions may be suggested as; investigation of effects of students' understandings on their roles in mathematical discourse in classroom; the influences of gender differences on classroom discourse in mathematics lessons; the effects of students' social backgrounds on their participation to the discourse in mathematics classes; the effects of usage of appropriate mathematical language on the quality of classroom discourse; and the influences of instructor's abilities of leading classroom discourse on the quality, effectiveness, and appropriateness of it.

A different expectation would be for new-coming researchers who are interested in classroom observation in mathematics lessons. Analyzing the results, they would have an idea what to observe in their study or what aspects they would focus on. Similarly, they would use the results of the study to have insights about "what classroom discourse is?", "how can it be adapted in mathematics lessons?", and "what kind of features should it have?" In addition, each of these questions would constitute a problem statement for a new research itself. More specifically,

they would narrow the observed subject when compared to this study. For instance, they would only conduct a study based on teacher discourse or only based on students discourse. Moreover, they can conduct a study on mathematical concepts, by specifically conducting a research on this issue; for instance, they might look for the effects of these concepts on the mathematical classroom discourse, since the results of the study implicated how the presentation methods of mathematical concepts influenced the quality of classroom discourse. According to observational data, concepts were organized around the teacher's statements. However, the aim of the study was to draw a general picture of classroom discourse in mathematics lessons. One might be interested in this issue in a deeper way.

The participated teacher's being a five-year experienced teacher would constitute another suggestion for a new research. It would be possible to observe one experienced and one less-experienced teacher and compare their leading of classroom discourse.

As a final recommendation would be the choice of a public school and a private school for setting of the study; or two public schools would be chosen. This would be helpful for comparing practices of discourse between different education environments.

The number of suggestions would be increased, since there have not been enough researches in Turkey. While the awareness of quality in mathematics classes and specifically classroom practices have reached increasing levels; furthermore when making changes and improvements in education programs; it should be given same importance and spent critical efforts for increasing the quality and effectiveness of discourse.

Although strong emphasis is given to the new approaches in mathematics education and educators' being against to the traditional approaches due to its being far away from teaching students mathematics meaningfully, the use of that traditional approach is still dominant. Teachers have seemed to be happy and students have been successful with it. This condition may create another research

area to investigate whether new approaches have been understood sufficiently or traditional approach is not bad at all.

REFERENCES

Aleksandrowicz-Pedich, L., Draghicescu, J., Issaiass, D. & Šabec, N. (2003). *The Views of Teachers of English and French on Intercultural Communicative Competence in Language Teaching,* in Lázár, I., Incorporating Intercultural Communicative Competence in Language Teacher Education, European Centre for Modern Languages/Council of Europe Publishing, Strasbourg.

Arık, G. (2007). *İlköğretim Matematik Dersi Öğretim Programı 3–5.Sınıf Sayılar Öğrenme Alanı Kazanımlarının NTCM Standartları Ve Singapur Kazanımlarına Göre Değerlendirilmesi*. Master's Thesis. Gazi Üniversitesi. Ankara.

Au, K. H. (1998). Social constructivism and the school literacy learning of students of diverse backgrounds. *Journal of Literacy Research, 30,* 297-319.

Babadoğan, C. & Olkun, S. (2006). Program development models and reform in Turkish primary school mathematics curriculum. *International Journal for Mathematics Teaching and Learning* (April 13). Retrieved July 8, 2009, from http://www.cimt.plymouth.ac.uk/journal/default.htm

Ball, D. L. (1991) Implementing the Professional Standards for Teaching Mathematics: What's All This Talk about Discourse? *Arithmetic Teacher, 39*(3), 44-48

Ball, D. L. (1993). With an Eye on the Mathematical Horizon: Dilemmas of Teaching Elementary School Mathematics. *Elementary School Journal, 93*(4), 373-397.

Beatty, R. (2001). The relationship among language, classroom discourse, cognitive development, achievement, and vocabulary of developmental mathematics students. *Dissertation Abstracts International,* (UMI No: 3034894).

Breslin, M. & Buchanon, R. (2008). On the Case Study Method of Research and Teaching in Design. *Design Issues, 24*(1), 36-40.

Brophy, J. E. (1999). *Teaching* (Education Practices Series No.1). Geneva, Switzerland: International Bureau of Education. Retrieved June 15, 2009, from http://www.ibe.unesco.org

Brown, C. A. & Borko, H. (1992). Becoming a mathematics teacher. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (p. 209-239). New York: Macmillan.

Bruce, C. D. (2007). *What Works? Research into Practice* (Research Monograph No. 1). The Literacy and Numeracy Secretariat.

Bulut, M. (2007). Curriculum Reform in Turkey: A Case of Primary School Mathematics Curriculum. *Eurasia Journal of Mathematics, Science & Technology Education, 3*(3), 203-212.

Bulut, S., & Koç, Y. (2006a). Yeni İlköğretim Matematik Dersi Öğretim Programına Genel Bakış. *Eğitim ve Ekin Dergisi, 241,* 2-6.

Bulut, S., & Koç, Y. (2006b). Yeni Matematik Dersi Öğretim Programı. *Çoluk Çocuk,* 27-31.

Casa, T. M. (2004). An investigation of teacher decision-making with respect to discourse in the mathematics classroom at the elementary level. *Dissertation Abstracts International,* (UMI No: 3127575).

Cazden, C.B. (2001). *Classroom discourse: The language of teaching and learning.* Portsmouth, NH: Heinemann.

Clement, L. (1997, November 14). *If They're Talking, They're Learning? Teachers' Interpretations of Meaningful Mathematical Discourse*. Paper presented at the Annual Meeting of the American Educational Research Association, Chicago, IL.

CMSI (2007). *Mathematics Classroom Observation Guide: Directions for Use.* Retrieved in March 15, 2008 from http://cmsi.cps.k12.il.us/ViewNews Details.aspx?pid=81&id=7450 .

Cobb, P. (1988). The Tension Between Theories of Learning and Instruction in Mathematics Education. *Educational Psychologist*, *23*(2), 87-103.

Cobb, P., Boufi, A. McClain, K., & Whitenack, J. (1997). Reflective discourse and collective reflection. *Journal for Research in Mathematics Education, 28*(3), 258-277.

Cobb, P., Yackel, E., & Wood, T. (1992). A constructivist alternative to the representational view of mind in mathematics education. *Journal for Research in Mathematics Education, 23*, 2–33.

Cooke, B. D. & Buchholz, D. (2005). Mathematical Communication in the Classroom: A Teacher Makes a Difference. *Early Childhood Education Journal, 32*(6), 365-369.

Corcoran, P. B., Walker, K. E. & Wals, A. E. (2004). Case studies, make-your-case studies, and case stories; a critique of case-study methodology in sustainability in higher education. *Environmental Education Research, 10*(1), 7-21.

Doğan, O. (2006). *A Study on Pattern of 6th grade Elementary Mathematics Lessons*. Master's Thesis, Middle East Technical University, Ankara.

Fennema, E., & Franke, M. L. (1992). *Teachers' knowledge and its impact*. In D. A. Grouws (Ed.), Handbook of research on mathematics teaching and learning (pp. 147-164). New York: Macmillan Publishing Company.

Forman, E. A. (1996). Learning Mathematics as Participation in Classroom Practice: Implications of Sociocultural Theory for Educational Reform. In P. Steffe, P. Nesher, P. Cobb, B. Sriraman, & B. Greer (Eds.), *Theories of Mathematical Learning* (pp. 115-130). Mahwah, NJ: Lea Lawrence Erlbaum Associates.

Forman, E. A., & Ansell, E. (2001). The multiple voices of a mathematics classroom community. *Educational Studies in Mathematics, 46*, 115–142.

Forman, E. A., & Cazden, C. B. (1985). Exploring Vygotskian perspectives in education: The cognitive value of student interaction. In J. V. Wertsch (Ed.).*Culture, communication, and cognition: Vygotskian perspectives* (pp. 323-347). Cambridge: Cambridge University Press.

Gee, J. P. (1996). *Social Linguistics and Literacies*: Ideology in Discourses. London: Taylor & Garvey

Green, K. H., & Johnson, E. L. (2007). Promoting Mathematical Communication and Community via Blackboard. *Problems, Resources, and Issues in Mathematics Undergraduate Studies, 17*(4), 325-337.

Grouws, D. A., & Hiebert, J. (2007). The effects of classroom mathematics teaching on students' learning. In F.K. Lester (Ed.), *Second Handbook of Research on Mathematics Teaching and Learning* (pp. 371-404). Charlotte, NC: Information Age Publishing.

Güven, B. & Orbeyi, S. (2008). Yeni İlköğretim Matematik Dersi Öğretim Programı'nın Değerlendirme Öğesine İlişkin Öğretmen Görüşleri. *Eğitimde Kuram ve Uygulama, 4*(1), 133-147.

Hansen-Thomas, H. H. (2005). Learning to use math discourse in a standards-based, reform-oriented middle school classroom: How Latina/o ELLS become socialized into the math community of practice. *Dissertation Abstracts International,* (UMI No: 3183948).

Harbaugh, A. P. (2005). Authoritative Discourse in the Middle School Mathematics Classroom: A Case Study. *Dissertation Abstracts International,* (UMI No: 3189557).

Heaton, R. M. (2000). *Teaching Mathematics to the New Standards: Relearning the Dance.* New York: Teacher's College Press.

Hicks, D. (1995-1996). Discourse, Learning and Teaching. *Review of Research in Education, 21, 49-95.*

Hiebert, J., & Wearne, D. (1993). Instructional tasks, classroom discourse, and students' learning in second-grade arithmetic. *American Educational Research Journal,* 30(2), 393-425.

Hodge, L. (2008). Student Roles and Mathematical Competence in Two Contrasting Elementary Classes. *Mathematics Education Research Journal, 20*(1), 32-50.

Hoffmann, A. J., (2004). Middle school mathematics students' motivations for participating in whole-class discussions: Their beliefs, goals, and involvement *Dissertation Abstracts International* (UMI No:3146033).

Hufferd-Ackles, K. C., Fuson, K., & Sherin, M. G. (2004). Describing levels and components of a math-talk learning community. *Journal for Research in Mathematics Education, 35*(2), 81-116.

Inagaki, K., Morita, E. & Hatano, G. (1999). Teaching-learning of evaluative criteria for mathematical arguments through classroom discourse: A cross-national study. *Mathematical Thinking and Learning, 1*(2), 93-111.

Kaytan, E. (2007). *Türkiye, Singapur ve İngiltere İlköğretim Matematik Öğretim Programlarının Karşılaştırılması.* Master's Thesis, Hacettepe University, Ankara.

Kazemi, E. & Stipek, D. (2001). Promoting conceptual thinking in four upper-elementary mathematics classrooms. *The Elementary School Journal, 102*(1), 59-80.

Kelly, S. (2007). Classroom Discourse and the Distribution of Student Engagement. *Social Psychology Education, 10,* 331-352.

Klishis, L. A. (2003). The Impact of Students Discourse and Journal Writing on the Mathematics Achievement of Fifth Grade Students. *Dissertation Abstracts International,* (UMI No: 3134542).

Koç, K., Işıksal, M & Bulut, S, The Elementary School Curriculum Reform in Turkey. *"International Education Journal "*, 8, (2007), p.30-39.

Lampert, M. (1989). *Choosing and using mathematical tools in classroom discourse.* In J. E. Brophy (Ed.). Advances in research on teaching, Vol. 1 (pp. 223-264). Greenwich, CT: JAI Press.

Lampert, M. (1990). When the problem is not the question and the solution is not the answer: Mathematical knowing and teaching. *American Educational Research Journal, 27*, 29–63

Lampert, M. & Cobb, P. (2003). *Communication and Language.* In a Research Companion to NCTM's Standards, edited by Jeremy Kilpatrick, W. Gary Martin, and Deborah Schifter. Reston Virginia: National Council of teachers of Mathematics, 2003.

Leonard, J. (1997). Characterizing student discourse in a sixth- grade mathematics classroom. *Dissertation Abstra\cts International,* (UMI No: 9808633).

McClain, K., McGatha, M. & Hodge, L. (2000). Improving Data Analysis Through Discourse. *Mathematics Teaching in the Middle School, 5*(8), 548-553.

McCrone, S. S. (1997). Student Interactions and Mathematics Discourse: A study of the Development of Discussions in a Fifth Grade Classroom. Dissertation Abstracts International, (UMI No: 9730833).

McCrone, S. S. (2005). The Development of Mathematical Discussions: An Investigation in a Fifth-Grade Classroom. *Mathematical Thinking and Learning, 7*(2), 111-133

McGraw, R. H. (2002). *Facilitating Whole-Class Discussion in Secondary Mathematics Classrooms***.** Unpublished doctoral dissertation, Indiana University.

Merriam, S. B. (1998). *Qualitative research and case study applications in education*, San Francisco: Jossey-Boss.

Meyer, D. K., Midgley, C., Patrick, H. & Turner, J. C. (2003). Teacher Discourse and Sixth Graders' Reported Affect and Achievement Behaviors in Two High-Mastery/ High-Performance Mathematics Classrooms. *The Elementary School Journal, 103*(4), 357-382.

Ministry of National Education, Educational Research and Development Directorate. (MEB-EARGED). (2007). *Mathematics Report of Level Determination Examination (LDE) 2005*. Ankara, Turkey: MoNE.

Ministry of National Education [MoNE] (2005). *İlköğretim 1–5 Sınıf Programları Tanıtım El Kitabı*. Ankara, Turkey: MoNE.

Miranda, H. (2004). *Emergence and evolution of mathematics classroom discourses*. Unpublished master's thesis, University of Alberta, Alberta, Canada.

Moore, J. (2002). African American Male Students' Perception of a Mathematics Learning Environment. *Academic Exchange Quarterly, 6*(3), 177-182

Munkhjargal, D. (2006). The relationship between Mathematical Discourse and the Curriculum Creating Process in the Elementary Classroom: A Case Study. *Dissertation Abstracts International,* (UMI No: 3233992).

National Council of Teachers of Mathematics. (1989). *Curriculum and Evaluation Standards for School Mathematics.* Reston, VA: The National Council of Teachers of Mathematics.

National Council of Teachers of Mathematics. (1991). *Professional standards for teaching mathematics.* Reston, VA: The National Council of Teachers of Mathematics.

National Council of Teachers of Mathematics. (2000). *Principles and Standards for School Mathematics*. Reston, VA: The National Council of Teachers of Mathematics.

Nathan, M. J., & Knuth E. J. (2003). A study of whole classroom mathematical discourse and teacher change. *Cognition and Instruction, 21*(2), 175-207.

Novinger, S. (1999). Talking mathematics: Children's acquisition of mathematical discourse in a permeable curriculum. *Dissertation Abstracts International,* (UMI No: 9953887).

Orbeyi, S. (2007). *İlkögretim Matematik Dersi Ögretim Programı'nın Ögretmen Görüşlerine Dayalı Olarak Değerlendirilmesi.* Master's Thesis. Çanakkale Onsekiz Mart University. Çanakkale.

O'Sullivan, M. (2006). Lesson observation and quality in primary education as contextual teaching and learning processes. *International Journal of Educational Development, 26,* 246-260.

Patton, M. Q. (April 1985). *Quality in Qualitative Research*: Methodological Principles and Recent Developments. Invited address to Division J of the American Educational Research Association, Chicago.

Patton, M. Q. (1990). *Qualitative evaluation and research methods*, 2nd ed. Newbury Park: Sage.

Patton, M.Q. (2002). *Qualitative research and evaluation methods*. 3rd Ed. Thousand Oaks, CA: Sage Publications.

Peng, P. (2009). *Cooperative Learning in Chinese English Classrooms*. Master's Thesis, University of Wisconsin. Platteville.

Pierson, J. J. (2008). The relationship between patterns of classroom discourse and mathematics learning, *Dissertation Abstracts International,* (UMI No: 3324548).

Ping, M. C. (2001). Supporting the discourse: First graders communicate mathematics. *Dissertation Abstracts International,* (UMI No: 3014917).

Pirie, S. E. B., & Schwarzenberger, R. L. E. (1988). Mathematical Discussion and mathematical understanding. *Educational Studies in Mathematics, 19,*459-470.

Richards, K. T. (2004). Communication in Mathematics. *Masters Abstracts International,* (UMI No: 1423317).

Rojas-Drummond, S. & Mercer, N. (2003). Scaffolding the development of effective collaboration and learning. *International Journal of Educational Research, 39*, 99–111.

Romberg, T. A. (2001). Designing Middle-School Mathematics Materials Using Problems Set in Context to Help Students Progress From Informal to Formal Mathematical Reasoning.

Sfard, A. (2000). On reform movement and the limits of mathematical discourse. *Mathematical Thinking and Learning, 2(3)*, 157-189.

Sfard, A. (2001). There is more to discourse than meets the ears: Looking at thinking as communicating to learn more about mathematical learning. *Educational Studies in Mathematics, 46*, 13-57.

Shenton, A. K. (2004). Strategies for ensuring trustworthiness in qualitative research projects. *Education for Information, 22,* 63-75.

Sherin, M. G. (2002). A Balancing Act: Developing A Discourse Community in a Mathematics Classroom. *Journal of Mathematics Teaching Education, 5,* 205-233.

Sierpinska, A. (1998). Three Epistemologies, Three Views of Classroom Communication: Constructivism, Sociocultural Approaches, Interactionism. In H. Steinbring, M. G. B. Bussi, & A. Sierpinska (Eds.), *Language and Communication in the Mathematics Classroom* (pp. 30-62). Reston, VA: National Council of Teachers of Mathematics.

Soycan, S. B. (2006). *2005 Yılı İlkögretim 5.Sınıf Matematik Programının Değerlendirilmesi*. Master's Thesis. Uludağ Üniversitesi. Bursa.

Stipek, D., Salmon, J.M., Givvin, K.B., Kazemi, E., Saxe, G., & MacGyvers, V.L. (1998). The value (and convergence) of practices suggested by motivation research and promoted by mathematics education reformers. *Journal for Research in Mathematics Education, 29*(4), 465-488.

Şahin, Ç. (2005). İlköğretim II. Kademesinde Matematik Dersinin Öğrenme-Öğretme Sürecinde Yapılan Etkinliklerin Öğretmen ve Öğrenci Açısından Değerlendirilmesi. *Eğitim Araştırmaları, 18,* 171-185.

Teasley S. D. (1995). The role of talk in children's peer collaborations. *Developmental psychology, 31*(2), 207-220.

Temple, C. (2008). Teaching and Learning Mathematical Discourse in a Romanian Classroom: A Critical Discourse Analysis. *Dissertation Abstracts International,* (UMI No: 3323089).

Truxaw, M. (2004). Mediating mathematical meaning through discourse: An investigation of discursive practices of middle grades mathematics teachers. *Dissertation Abstracts International,* (UMI No: 3144609).

Truxaw, M. P. & DeFranco, T. C. (2005, October). *Models of teaching to Promote Mathematical Meaning: Unpacking Discourse in Middle Grades Mathematics Classes* In Lloyd, G. M., Wilson, M., Wilkins, J. L. M., & Behm, S. L. (Eds.), Paper presented at the 27th annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education, Virginia Tech.

Umay, A., Akkuş, O., & Duatepe, A. (2006). An investigation of 1-5 grades mathematics curriculum by considering NCTM principles and standards. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, *31*, 198-211.

Yackel, E. (2000, July31-August 6). *Creating a Mathematics Classroom Environment that Fosters the Development of Mathematical Argumentation.* Paper prepared for Working Group 1: Mathematics Education in Pre and Primary School, of the Ninth International Congress of Mathematical Education, Tokyo/Makuhari, Japan.

Yackel, E. (2002). What we can learn from analyzing the teacher's role in collective argumentation. *Journal of Mathematical Behavior, 21*, 423-440

Yackel, E. & Cobb, P. (1996). Sociomathematical norms, argumentation, and autonomy in mathematics. *Journal for Research in Mathematics Education, 27*(4), 458-477.

Yin, R. K. (1994). *Case study Research: Design and Methods*. (2nd ed.). Thousand Oaks, CA: Sage

Zolkower, B. & Shreyar, S. (2007). A teacher's mediation of a thinking-aloud discussion in a 6th grade mathematics classroom. *Educational Studies in Mathematics* 65, 177-202.

APPENDICES

APPENDIX A

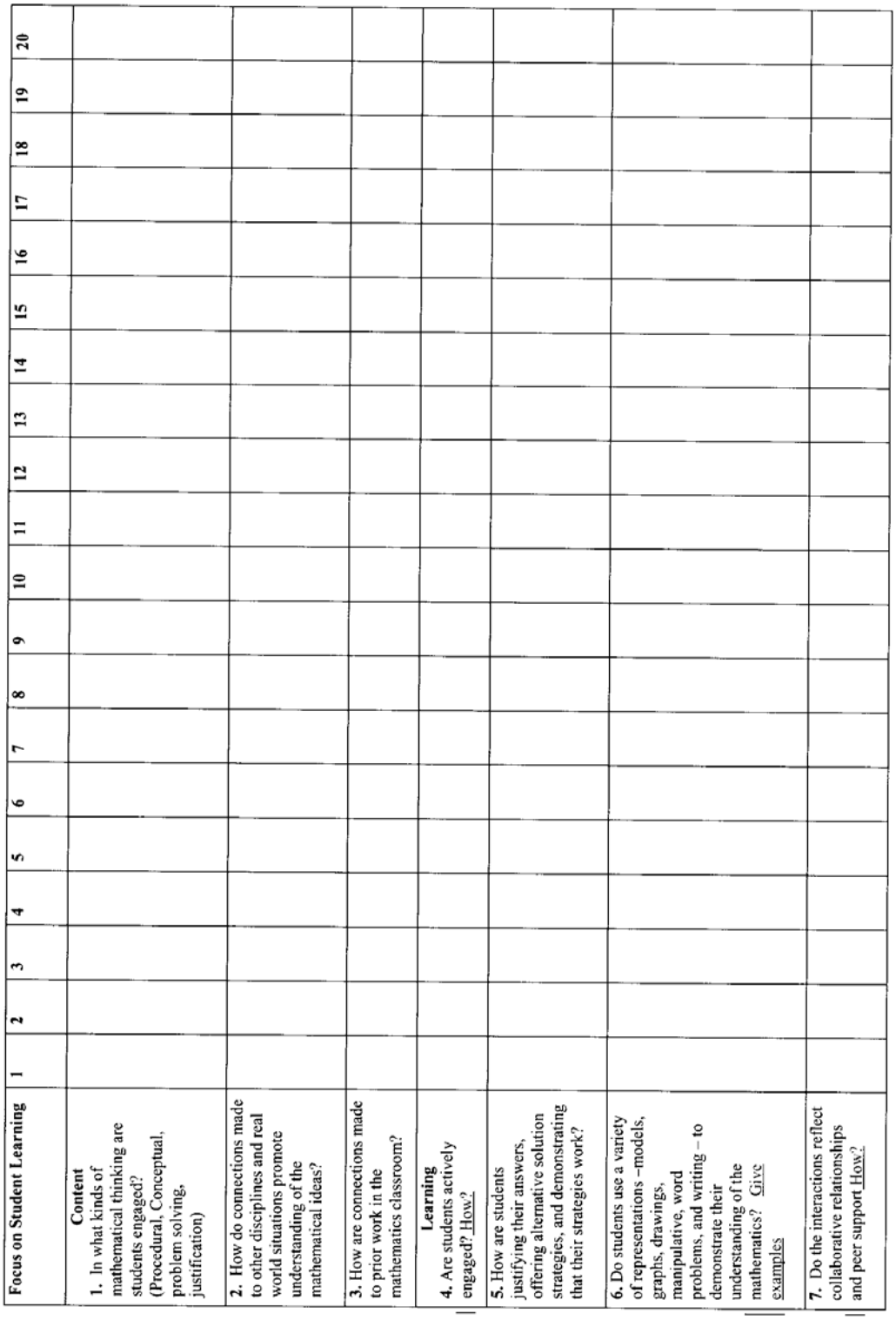
Original Mathematics Classroom Observation Form of CMSI

Part One: Focus on Student Learning	Part Two: Focus on Teacher Moves
Content 1. What are the key mathematical ideas in the lesson? 2. In what kinds of mathematical thinking are students engaged? (Examples – procedural, conceptual, problem solving, justification) 3. How do connections made to other disciplines and real-world situations promote understanding of the mathematical ideas? 4. How are connections made to prior work in the mathematics classroom? **Learning** 5. Are students actively engaged? 6. What is the evidence of understanding of the key mathematical ideas? 7. What misconceptions are arising? 8. How are students justifying their answers, offering alternative solution strategies, and demonstrating that their strategies work? 9. How do students use a variety of representations – models, graphs, drawings, manipulatives, writing – to demonstrate their understanding of the mathematics? 10. Are students reflective about their learning? 11. In what ways do students communicate their ideas, orally or in writing? 12. Is the climate one of respect for students' ideas and one that encourages students to engage in mathematical risk-	**Content Knowledge and Pedagogy** 1. In what ways does the teacher articulate the key mathematical ideas of the lesson? 2. How does this lesson promote understanding of the mathematical ideas? 3. How does the teacher facilitate connections to other disciplines and real-world situations, and to prior work in the mathematics classroom? 4. How does the teacher use a problem-solving context to promote understanding of the mathematical ideas? 5. How does the teacher assess prior knowledge and student understanding, and use that information to make instructional decisions? 6. How does the teacher address misconceptions? 7. What decisions does the teacher make to keep the lesson engaging and moving forward? 8. How does the teacher both encourage alternative solution strategies, proof and justification, and challenge ideas in order to promote understanding? **Creating a Learning Environment** 9. What does the teacher do to encourage communication and move discussions forward? 10. In what ways does the teacher encourage students to respect the mathematical thinking of other students?

taking? 13. Where does the authority of the mathematics reside in the classroom? 14. Do the interactions reflect collaborative relationships and peer support, and promote understanding of the mathematical ideas?	11. How does the teacher encourage students to use peers as resources? 12. How does the teacher promote mathematical risk-taking?

APPENDIX B

B.1. Observational Data Analysis Form (Student Learning)



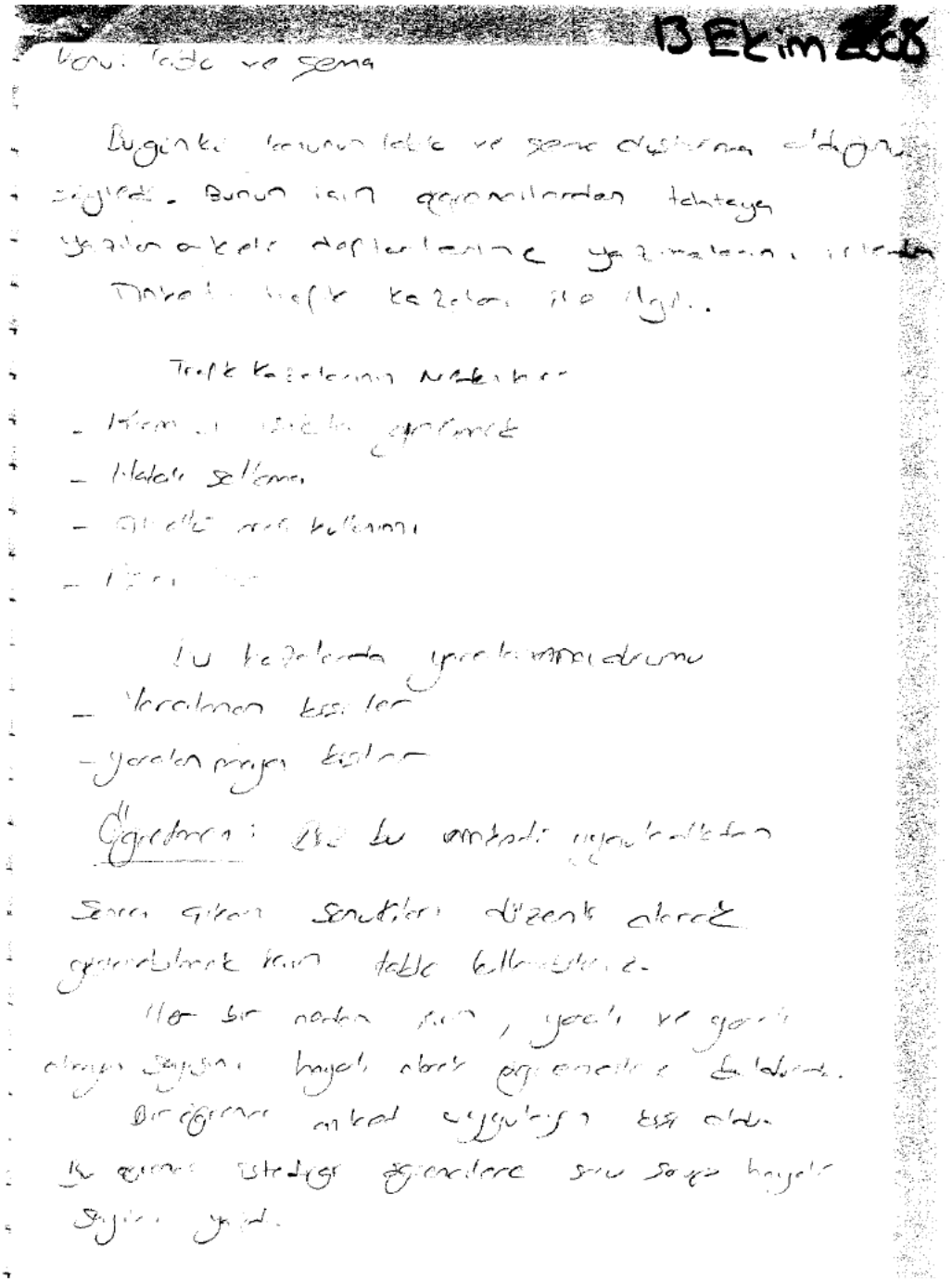
Focus on Student Learning	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Content **1.** In what kinds of mathematical thinking are students engaged? (Procedural, Conceptual, problem solving, justification)																				
2. How do connections made to other disciplines and real world situations promote understanding of the mathematical ideas?																				
3. How are connections made to prior work in the mathematics classroom?																				
Learning **4.** Are students actively engaged? How?																				
5. How are students justifying their answers, offering alternative solution strategies, and demonstrating that their strategies work?																				
6. Do students use a variety of representations –models, graphs, drawings, manipulative, word problems, and writing – to demonstrate their understanding of the mathematics? Give examples																				
7. Do the interactions reflect collaborative relationships and peer support How?																				

B.2. Observational Data Analysis Form (Teacher Moves)

Focus on Teacher Moves	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Content knowledge and Pedagogy **1.** How does the teacher facilitate connections to other disciplines and real world situations, and to prior work in the mathematics classroom?ex																				
2. How does teacher assess prior knowledge and student understanding, and use that information to make instructional decisions?ex																				
3. How does teacher both encourage alternative solution strategies, proof and justification, and challenge ideas in order to promote understanding? ex																				
Creating Learning Environment **4.** What does the teacher to do encourage communication and move discussions forward?ex																				
5. In what ways does the teacher encourage students to respect the mathematical thinking of other students? ex																				
6. How does the teacher encourage students to use peers as resources? example																				
7. How does the teacher promote mathematical risk-taking? example																				

APPENDIX C

A Sample from Filled Observation Sheet of One Lesson



Anket Uygulayan Öğr: Kırmızı ışıkta geçerken yakalanan kaç öğrenci kaçtı. Kaçı kız öğrenciydi.
Öğrenci A: 10 kişi yakalandı.

Anket Uygulayan Öğr: Aşırı hız sonucu alınan kaç öğrenci kaçtı. Kaçı kız öğrenciydi.
Öğrenci B: 1 kişi yakalanmıştır.

Bu esnada her soru için öğretmen öğrenciden aldığı cevapları kaydetti.

Öğretmen: Şimdi bu verileri nasıl düzenleyip farklı okuyacağımızı göstereceğim size de benim gibi düzenleyin.

Cinsiyet / Ceza Puanları	Kırmızı Işık	Hatalı Sollama	Aşırı Hız	Alkollü araç	Toplam
Kız	10	20	35	30	95
Kız değil	5	7	1	2	15
Toplam	15	27	36	32	110

Tabloyu öğretmen çizdi öğrenciler doldurdu. Ancak farklı öğrenciler doldurdu. Kahkahalar öğrenciler kendi cevaplarına yorum yapıyorlardı.

Sular ve Şükrün konuşmaları dikkatimi çekti. Öğretmen.

Yeni örnek için pasajları değiştirdik.

1935 => Okur yazarlık => %19
Kadınlar => %10

1970 => Okur yazarlık => %56
Kadınlar => %42

1990'lı => okur yazarlık => %80
Kadınlar => %71

Bu sefer öğrencilerden öğrencilerin resimlerini istedik.

Bir öğrenci çizdi.

Kaç satır ve kaç sütun olduğunu sordu, kare oluşturabilmek için öğrenci parmak kullandı.

Öğretmeni kare nasıl oluşturduğunu gösteriyor.

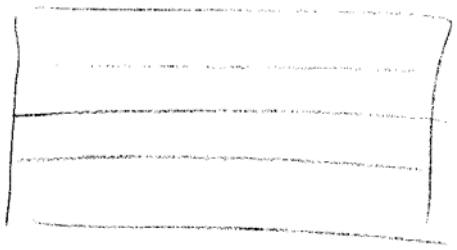
Öğrenci A: 3 satır oluşturduğunu söyledi ve 3 tane çizdi.

Sınıftan "hayır" sesleri geldi.

Öğretmen "hayır" diyerek neden çizdiğini sordu.

Öğrenci B: Çünkü her satır için yazılacak 4 satır.

Öğrenci B çizdiğini tahtaya çizdi. Satırları çiğmesini istedi



Sonra "Peki yan yana sütun oluşturalım!" diye sordu.

Sınıftan farklı sesler.

Öğrenmeden oluşturmamızı, sadece yeni aldık. Sonra:

Öğretmen: Bizim hangi verilerimiz var. Excelle ölçmemiz gerekiyor mu?

Sınıf cevap

Öğretmen: Sonra ne tür sütun. Sonra ne için oluşturacak?

Student 1: Fabrika için

Öğretmen: Sonra?

Student 2: Tüm şirket

Öğretmen: Güzel. O halde fabrika için sütun.

Student 1 devam ediyor

Yıllar	Okuryazar	Türkiye
1935	% 10	% 19
1990	% 82	% 56
1999	% [illegible]	% 82

Bu kısmı okuduktan sonra bir önceki dersteki bahsettiğimiz bilgilerden sonra altta ve sağda kalan bölümlere göre yıl ve okuryazar oranı örneği gerektiğine karar verdiler. Herhangi bir ilişkileri yok. Öğretmen sordu öğrenciler sınıfça cevap verdiler.

Sonra tablodaki nasıl yorumlayacaklarını için diğer öğretmen vardı, konuda diğer verilerden öğrenciler yararlanarak yorumlarda bulundular.

Öğretmen: Bu tabloya göre okur yazar oranında artış olmuş mu?

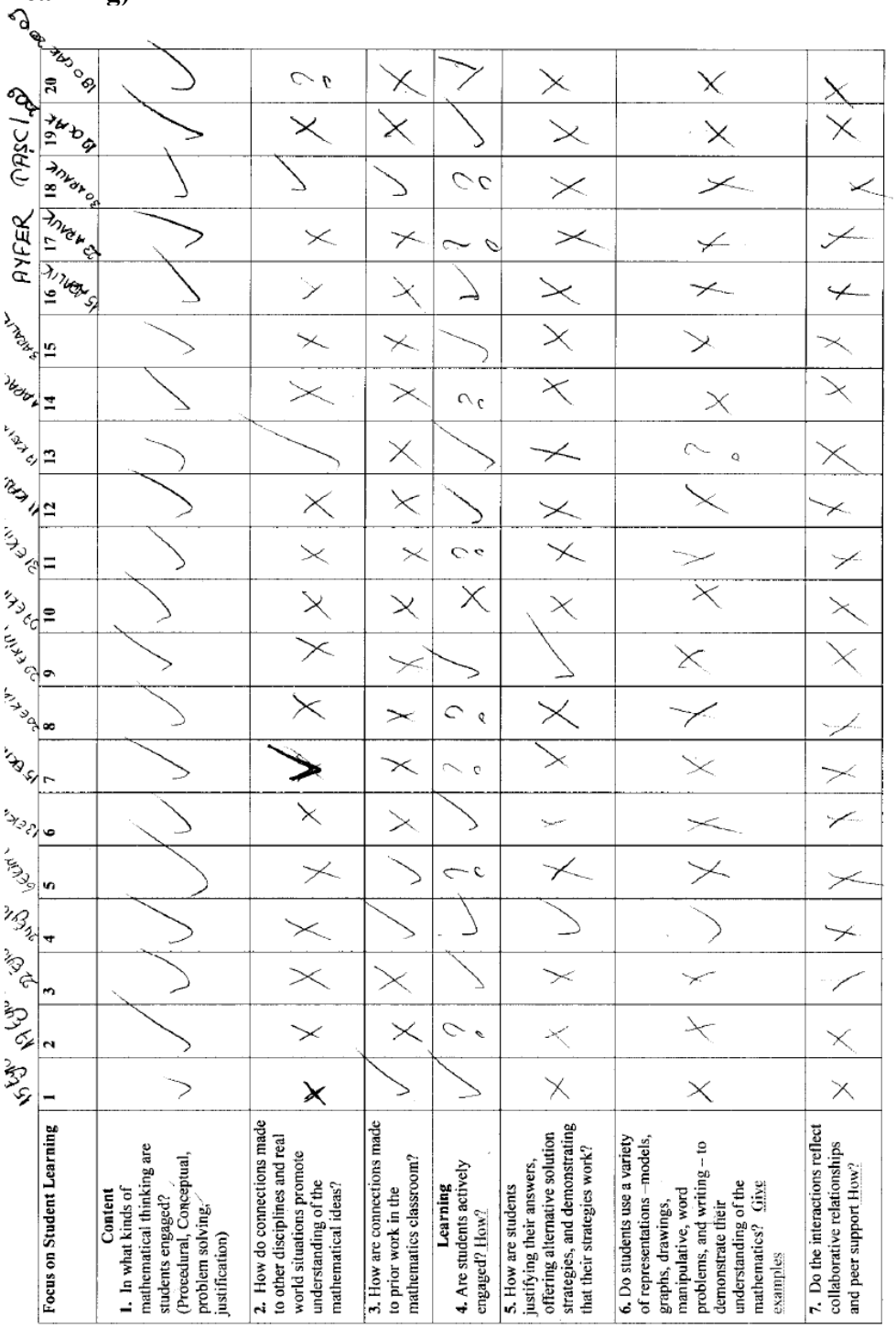
Sınıf: Evet

Bir önceki dakika yazılarda. Öğretmen olarak kaldık ayni kaldı.

APPENDIX D

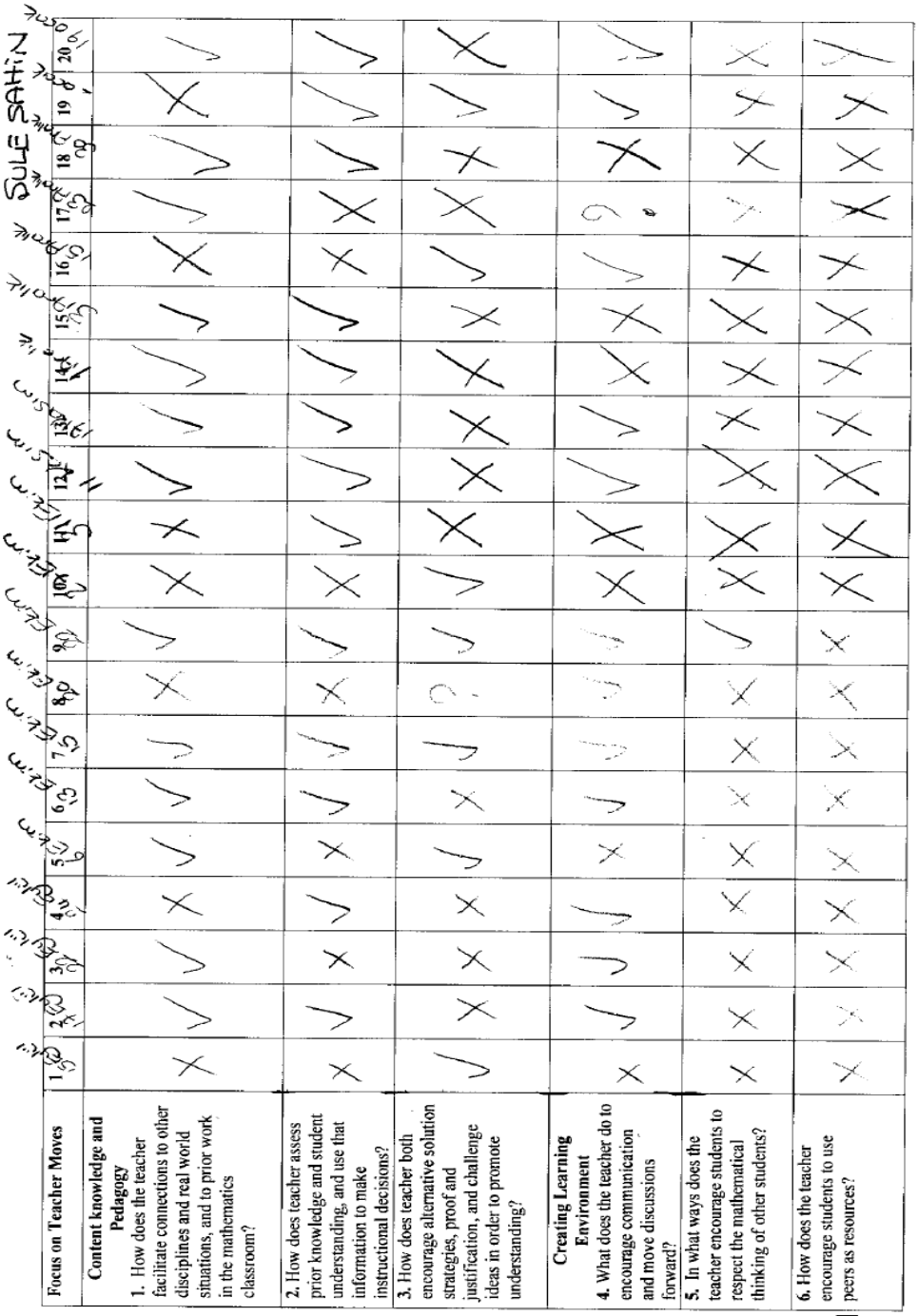
Samples of Filled Data Analysis Form

D.1. A Sample of Filled Observational Data Analysis Form (Student Learning)



Focus on Student Learning	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Content **1.** In what kinds of mathematical thinking are students engaged? (Procedural, Conceptual, problem solving, justification)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2. How do connections made to other disciplines and real world situations promote understanding of the mathematical ideas?	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗	✓	✗	✗	✗	✓	✓	✗	?
3. How are connections made to prior work in the mathematics classroom?	✓	✗	✗	✓	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗
Learning **4.** Are students actively engaged? How?	✓	?	✓	✓	?	✓	?	?	✓	✗	?	✓	✓	?	✓	✓	?	?	✓	✓
5. How are students justifying their answers, offering alternative solution strategies, and demonstrating that their strategies work?	✗	✗	✗	✓	✗	✓	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
6. Do students use a variety of representations –models, graphs, drawings, manipulative, word problems, and writing – to demonstrate their understanding of the mathematics? Give examples	✗	✗	✓	✓	✗	✗	✗	✓	✗	✗	✓	✓	?	✗	✓	✗	✗	✗	✗	✗
7. Do the interactions reflect collaborative relationships and peer support How?	✗	✗	✓	✗	✗	✗	✗	✓	✗	✗	✓	✗	✗	✗	✓	✗	✗	✗	✗	✗

D.2. A Sample from Filled Observational Data Analysis From (Teacher Moves)

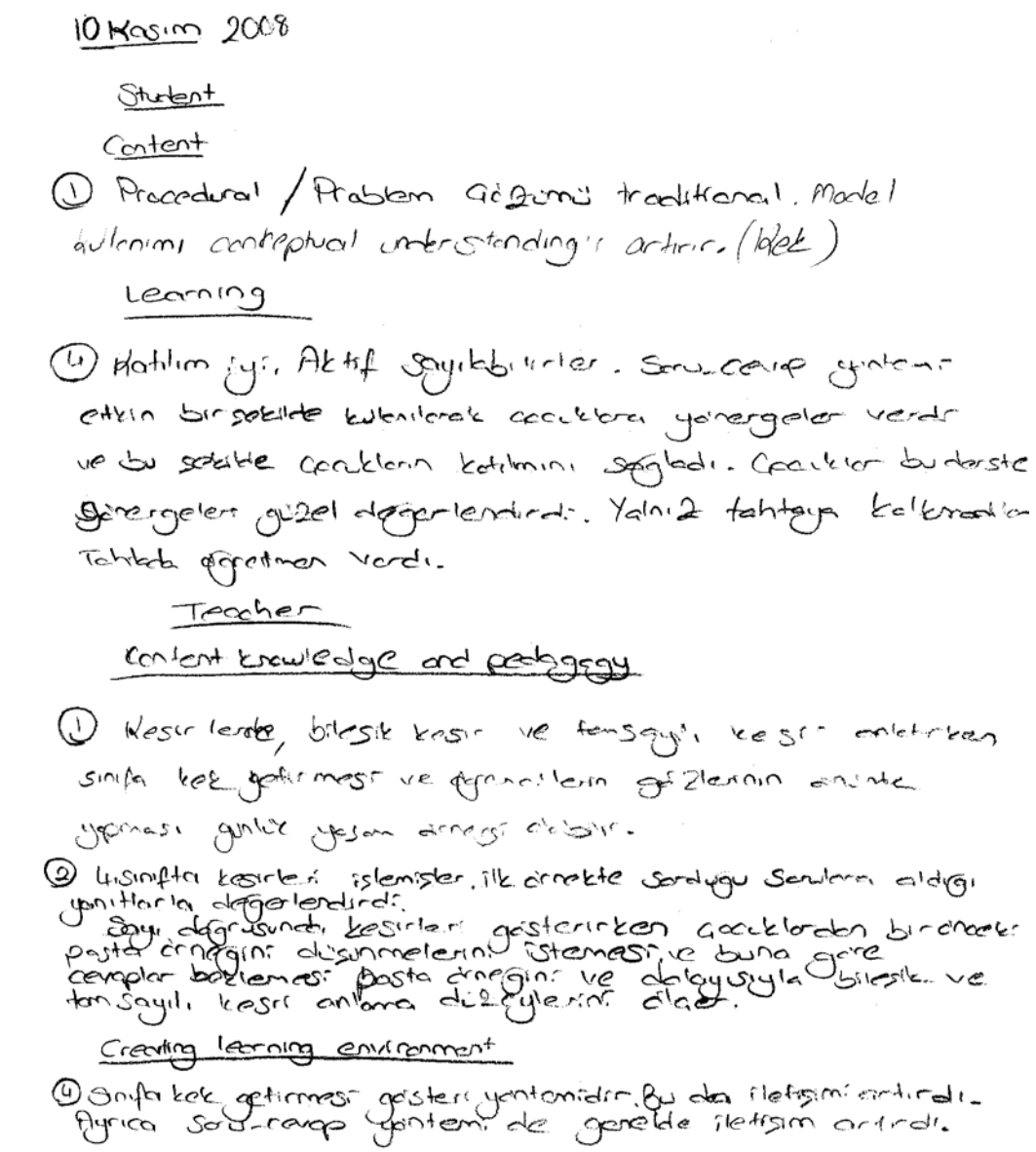


Focus on Teacher Moves	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Content knowledge and Pedagogy **1.** How does the teacher facilitate connections to other disciplines and real world situations, and to prior work in the mathematics classroom?	X	✓	✓	✓	✓	✓	✓	X	✓	X	✓	✓	X	✓	✓	X	✓	✓	X	✓
2. How does teacher assess prior knowledge and student understanding, and use that information to make instructional decisions?	X	✓	✓	✓	X	✓	✓	X	✓	X	✓	✓	✓	✓	✓	X	X	✓	✓	✓
3. How does teacher both encourage alternative solution strategies, proof and justification, and challenge ideas in order to promote understanding?	✓	X	X	X	✓	X	✓	?	✓	✓	X	X	X	X	X	✓	X	X	✓	X
Creating Learning Environment **4.** What does the teacher do to encourage communication and move discussions forward?	X	✓	✓	✓	X	✓	✓	✓	✓	X	X	✓	X	X	X	✓	?	X	✓	✓
5. In what ways does the teacher encourage students to respect the mathematical thinking of other students?	X	X	X	X	X	X	X	X	✓	X	X	X	X	X	X	X	✓	X	X	X
6. How does the teacher encourage students to use peers as resources?	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	✓

APPENDIX E

Samples from Our Interpretations of Each Observed Lesson

E.1 A Sample from Coder A's Interpretation



10 Kasım 2008

Student

Content

① Procedural / Problem çözümü tradisyonal. Model kullanımı conceptual understanding'i artırır. (Ödek)

Learning

① Katılım iyi. Aktif sayıkbirler. Soru-cevap yöntemi etkin bir şekilde kullanılarak çocuklara yönergeler verdi ve bu şekilde çocukların katılımını sağladı. Çocuklar bu derste yönergeleri güzel değerlendirdi. Yalnız 2 tahtaya kalkınca Tahtada öğretmen verdi.

Teacher

Content knowledge and pedagogy

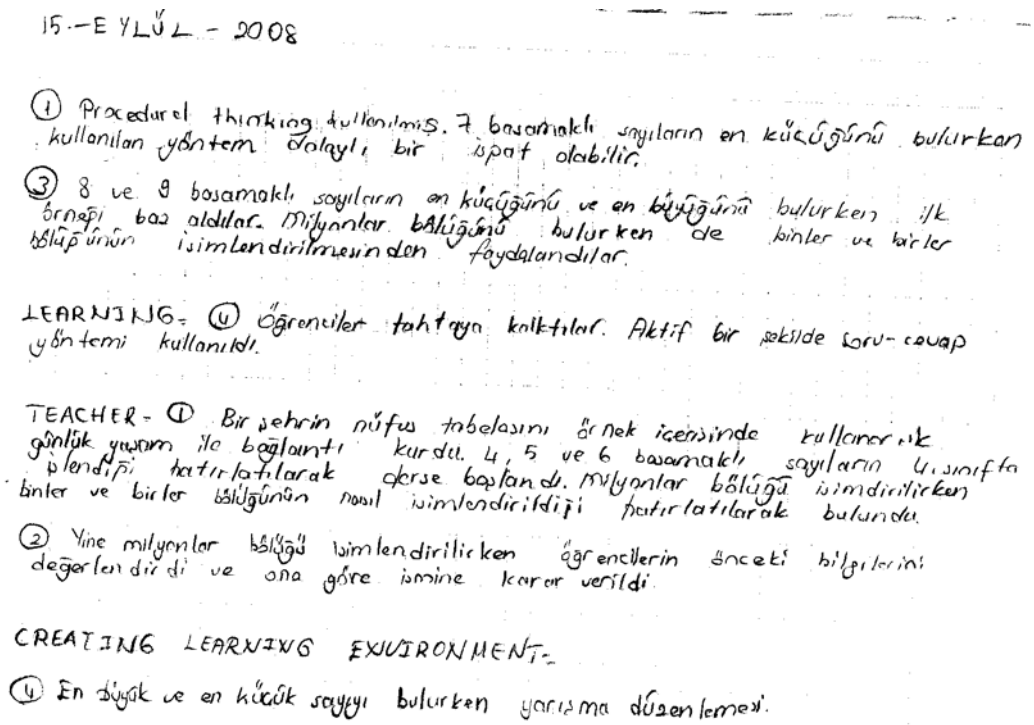
① Kesirlerde, bileşik kesir ve tamsayılı kesir anlatırken sınıfa kek getirmesi ve öğrencilerin eşitlerini yapması günlük yaşam örneği olabilir.

② 4. sınıftaki kesirleri işlemişler. İlk örnekte sorduğu soruların aldığı yanıtlarla değerlendirdi.
Sayı doğrusunda kesirleri gösterirken çocuklardan birer çocuk pasta örneğini düşünmelerini istemesi ve buna göre cevaplar beklemesi pasta örneğini ve dolayısıyla bileşik ve tamsayılı kesri anlama düzeylerini ölçer.

Creating learning environment

④ Sınıfa kek getirmesi gösterici yöntemidir. Bu da iletişimi artırdı. Ayrıca soru-cevap yöntemi de genelde iletişim artırdı.

E.2 A Sample from Coder B's Interpretations



15-EYLÜL - 2008

① Procedural thinking kullanılmış. 7 basamaklı sayıların en küçüğünü bulurken kullanılan yöntem örnekli bir ispat olabilir.

② 8 ve 9 basamaklı sayıların en küçüğünü ve en büyüğünü bulurken ilk örneği baz aldılar. Milyonlar bölüğünü bulurken de binler ve birler bölüğünün isimlendirilmesinden faydalandılar.

LEARNING- ① Öğrenciler tahtaya kalktılar. Aktif bir şekilde soru-cevap yöntemi kullanıldı.

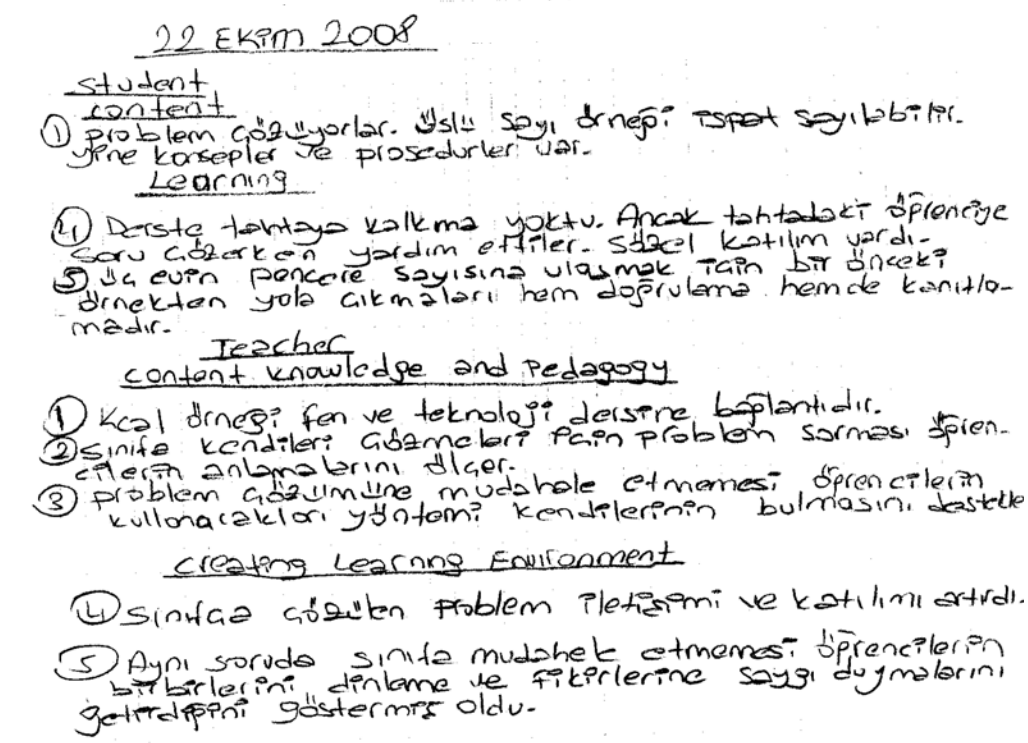
TEACHER- ① Bir şehrin nüfus tabelasını örnek içerisinde kullanarak günlük yaşam ile bağlantı kurdu. 4, 5 ve 6 basamaklı sayıların 4. sınıfta öğrendiği hatırlatılarak ders başlandı. Milyonlar bölüğü isimdirilirken binler ve birler bölüğünün nasıl isimlendirildiği hatırlatılarak bulundu.

② Yine milyonlar bölüğü isimlendirilirken öğrencilerin önceki bilgilerini değerlendirdi ve ona göre isimine karar verildi.

CREATING LEARNING ENVIRONMENT-

① En büyük ve en küçük sayıyı bulurken yarışma düzenlemesi.

E.3 A Sample from Coder C's Interpretations



22 EKİM 2008

Student
content

① problem çözüyorlar. Üslü sayı örneği: İspat sayılabilir. yine kavramlar ve prosedürler var.

Learning

④ Derste tahtaya kalkma yoktu. Ancak tahtadaki öğrenciye soru çözerken yardım ettiler. Sözel katılım vardı.
⑤ Üçgenin pencere sayısına ulaşmak için bir örnek: örnekten yola çıkmaları hem doğrulama hem de kanıtlamadır.

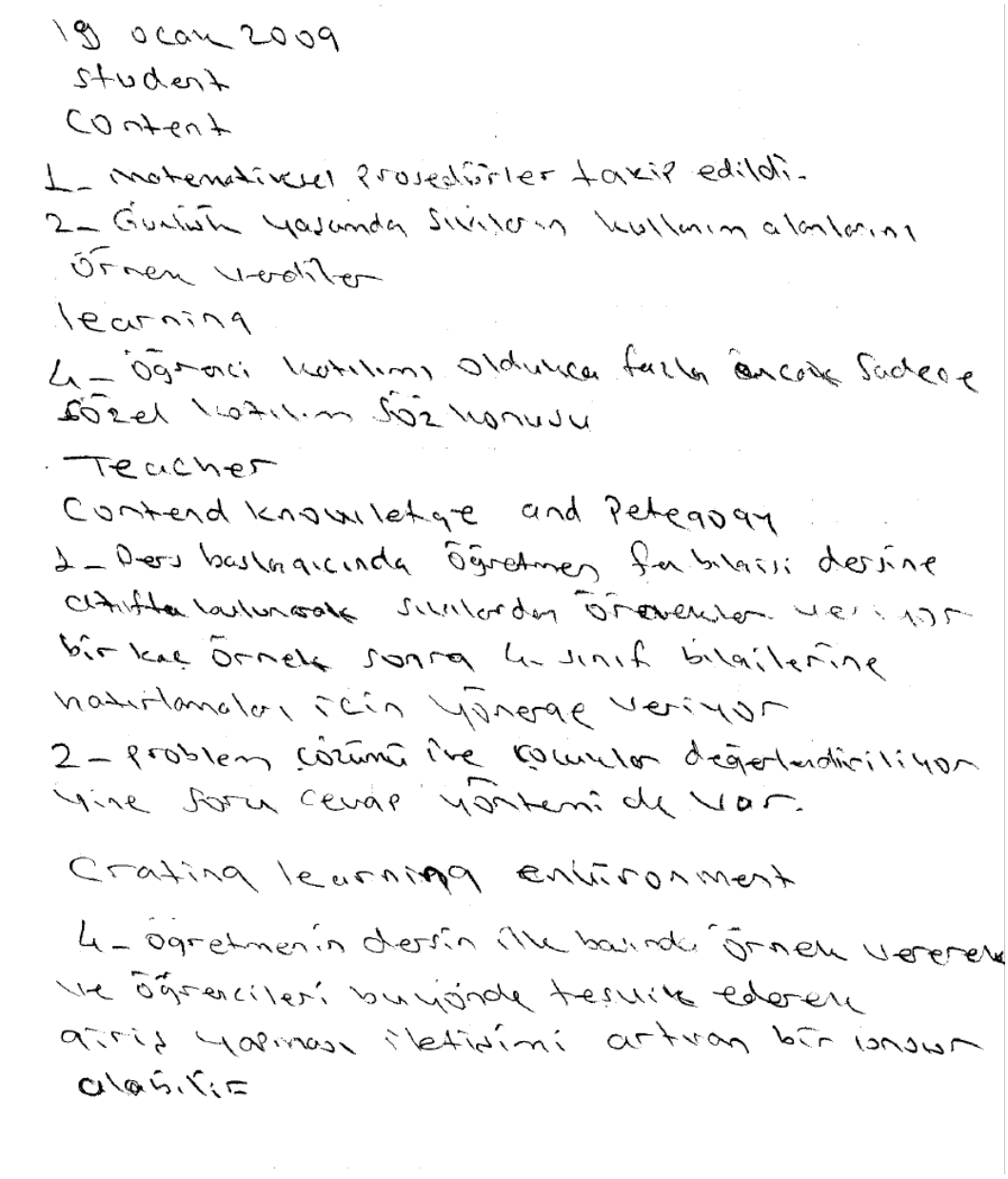
Teacher
content knowledge and pedagogy

① Kesir örneği: fen ve teknoloji dersine bağlantıdır.
② sınıfa kendileri çözmeleri için problem sorması öğrencilerin anlamalarını ölçer.
③ problem çözümüne müdahale etmemesi: öğrencilerin kullanacakları yöntemi kendilerinin bulmasını destekle

Creating Learning Environment

④ Sınıfa çözülen problem iletişimi ve katılımı artırdı.
⑤ Aynı sırada sınıfa müdahale etmemesi: öğrencilerin birbirlerini dinleme ve fikirlerine saygı duymalarını getirdiğini göstermiş oldu.

E.4 A Sample from Coder D's Interpretations



APPENDIX F

Consent Form 1

Veli Onay Mektubu

Tarih

Sayın Veli,

Çalışmayı yürüten kişi, çalışmanın başlığı ve çalışmaya yönelik ön bilgi "Orta Doğu Teknik Üniversitesi, İlköğretim Fen ve Matematik Eğitimi Bölümünde yüksek lisans öğrencisi olarak çalışmaktayım. Yüksek lisans tez çalışması kapsamında 1-7. sınıf öğrencileri ile çalışılması hedeflenmektedir ve bu mektubun yollanış amacı bu çalışmada çocuğunuzun bulunduğu sınıftaki matematik derslerinde iki ders süresince gözlem yapacağım konusunda bilgilendirilmenizdir.

Çalışmanın amacı sınıflarda matematik derslerinin nasıl işlendiği ve Türkiye'de matematik eğitiminin geldiği düzey konusunda bilgi sahibi olmaktır. Araştırmanın sonuçlarına bakılarak matematik eğitiminin artırılması konusunda ne gibi çalışmalar yapılabileceği konusunda yeni fikirler üretilebilecektir.

Yukarıda belirtildiği gibi çocuğunuzun bulunduğu sınıfta matematik dersinde iki ders süresince bulunup öğrenci- öğretmen iletişimini gözlemleyeceğim.

Katılım sonunda, herhangi bir maddi ya da diğer yarar sağlanması söz konusu değildir.

Araştırma boyunca öğrencilerin hiçbir şekilde kimlik bilgileri alınmayacaktır. Herhangi bir ses ya da görüntü kaydı yapılmayacaktır.

Bu çalışmaya katılım gönüllü olup ve arzu edildiği takdirde, herhangi bir yaptırıma maruz kalmadan katılımdan vazgeçme hakkına sahipsiniz. Veli onayının yanı sıra, çocuğun kendi gönüllülüğünün de önemlidir.

Çalışmaya ya da çocuğunuzun katılımına yönelik daha fazla bilgi için başvurulacak kişinin adresi, telefon numarası ve e-posta adresleri aşağıda verilmiştir.

Katkılarınızdan dolayı şimdiden teşekkür ederim.

Araştırmacı: Şule ŞAHİN

Adresi: Kızılırmak Yatılı İlköğretim Bölge Okulu

Kızılırmak/ Çankırı

Yukarıda açıklamasını okuduğum çalışmaya, oğlum/kızım _____'nin katılımına izin veriyorum. Ebeveynin:

Adı, soyadı: _____ İmzası: _____ Tarih: _____

İmzalanan bu formu lütfen sınıf öğretmeni aracılığı ile. Şule ŞAHİN'e ulaştırın.

Çocuğunuzun katılımı ya da haklarının korunmasına yönelik sorularınız varsa ya da çocuğunuz herhangi bir şekilde risk altında olabileceğine, strese maruz kalacağına inanıyorsanız Orta Doğu Teknik Üniversitesi Etik Kuruluna (312) 210-37 29 telefon numarasından ulaşabilirsiniz.

APPENDIX G

Consent Form 2

Orta Doğu Teknik Üniversitesi İnsan Araştırmaları Etik Kurulu

Gönüllü Katılım (Bilgilendirilmiş Onay) Formu

Bu araştırma Orta Doğu Teknik Üniversitesi, Sosyal Bilimler Enstitüsü, İlköğretim Fen ve Matematik Eğitimi Bölümü yüksek lisans öğrencisi Şule ŞAHİN tarafından yapılmaktadır.

Araştırma ilköğretimde yeni program uygulayan matematik sınıflarında, sınıf içi iletişimi yeni matematik programına dayalı olarak gözlemlemeyi amaçlamaktadır.

Matematik eğitimi ile ilgili araştırmalar Türkiye'de henüz yeterli düzeye ulaşmamıştır. Özellikle yeni matematik programının işlerliği yönündeki araştırmalar sınırlı olup elde edilen veriler yetersiz kalmaktadır. Bu konuya yönelik çalışmaların ve elde edilen yeni bulguların artması eğitimciler için konuya yönelik dönüt sağlayacaktır. Bu sayede matematik eğitimindeki kalitenin artırılması yönünde daha fazla neler yapılabileceği konusunda yorumlar yapılabilecektir. Araştırmaya katılımda öğretmen ve öğrenciler açısından herhangi bir potansiyel risk bulunmamaktadır.

Araştırmada katılımcılardan beklenen herhangi özel bir durum ya da davranış modeli yoktur. Araştırmacı sadece iki hafta boyunca matematik derslerine katılacak ve sınıf içi iletişimi gözlemleyecektir. Derslere müdahale etmesi söz konusu değildir.

Araştırmaya katılım gönüllü olup, katılımcıların sonradan vazgeçmesi halinde herhangi olumsuz bir sonuç oluşmayacaktır.

Araştırma sırasında toplanan veriler sadece araştırmacının bilgisi dâhilinde olup gerek diğer katılımcılar gerekse başka şahıslar tarafından bilinmeyecektir.

Araştırma raporunda okul, katılımcı öğrenci ve öğretmenlerin ismi hiçbir şekilde aynen geçmeyecek, isim kullanılması gerekirse takma isim kullanılacaktır.

Araştırma hakkındaki sorularınızı aşağıdaki iletişim bilgileri aracılığıyla araştırmacıya yöneltebilirsiniz.

Şule ŞAHİN
Kızılırmak YİBO Kızılırmak/Çankırı
Tlf: 535 682 28 03
sule_sahinn@hotmail.com

Çalışmanın amacı konusunda bilgilendirildim ve gönüllü katılmayı kabul ediyorum.

İMZA

APPENDIX H

Consent Form 3

T.C.
ÇANKIRI VALİLİĞİ
İl Millî Eğitim Müdürlüğü

Sayı : B.08.4.MEM.4.18.00.03-371/

Konu : Anket Uygulanması

000814 22.01.08

VALİLİK MAKAMINA
ÇANKIRI

Orta Doğu Teknik Üniversitesi Öğrenci İşleri Dairesi Başkanlığının 04.01.2008 tarih ve 133-244 sayılı yazılarında; İlköğretim Fen ve Matematik Eğitimi Anabilim Dalı Yüksek Lisans Programı öğrencisi Şule ŞAHİN'in 2007-2008 Eğitim-Öğretim yılı güz ve bahar dönemlerinde tezi kapsamında "İlköğretim 1-7 Sınıflarda Matematik Derslerinde Sınıf İçi İletişimin Yeni müfredata Dayalı olarak İncelenmesi" çalışmasını Kızılırmak İlçesi Kızılırmak Yatılı Bölge İlköğretim Okulunda 1-7 sınıflarından birer sınıfta her birinde ikişer ders olmak üzere toplam 14 ders boyunca gözlemde bulunması ve 10 öğretmenle mülakat yapması istenmekte olup;

Adı geçen Yüksek Lisans programı öğrencisinin Kızılırmak İlçesi Kızılırmak Yatılı Bölge İlköğretim Okulunda yukarıda belirtilen gözlem ve mülakatı yapması Müdürlüğümüzce uygun görülmektedir.

Makamlarınızca da uygun görüldüğü takdirde onaylarınıza arz ederim.

Durmuş ÖZDEMİR
Millî Eğitim Müdürü

OLUR
22./01/2008

Hakan KUBALI
Vali a.
Vali Yardımcısı

Adres : Cumhuriyet Mh. Park Sk. Hükümet Konağı Çankırı
Ayrıntılı bilgi için irtibat : Kültür Şubesi
Telefon : (0376) 213 15 36 (113) Fax: (0376) 213 10 16
Email : cankirimem@meb.gov.tr
İnternet : http://cankiri.meb.gov.tr
http://www.egitimedestek.meb.gov.tr - http://www.bilgisayarliegitimedestek.org