A STUDY FOR PROFILING MATHEMATICS TEACHERS REGARDING FACTORS AFFECTING PROMOTION OF STUDENTS' METACOGNITION

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A Study for Profiling Mathematics Teachers Regarding Factors Affecting Promotion of Students' Metacognition

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Thesis Abstract

Vuslat Şeker, "A Study for Profiling Mathematics Teachers Regarding Factors Affecting Promotion of Students' Metacognition"

The main objective of this study was to describe mathematics teachers' profiles on factors affecting their promotion of students' metacognition through developing profiling tools. In the light of this aim, four factors from the Framework for Analysing Mathematics Teaching for the Advancement of Metacognition -FAMTAM- (Ader,2009) were used. The factors were (1) teachers' conceptualization of metacognition, (2) teachers' perceptions of students' features and needs, (3) distribution of mathematical authority in the classroom and (4) the external pressure perceived by teachers. The Teachers' Conceptualization of Metacognition Scale, the Teachers' Perceptions of Students' Features and Needs Scale, the Distribution of Mathematical Authority Scale and the External Pressure Perceived by Teachers Scale were developed to reach the aim of the study. The sample consisted of 314 middle and secondary school mathematics teachers. In this study, descriptive, correlational and causal comparative research designs were used. Descriptive statistics were done to explain mathematics teachers' current thoughts on four factors. Correlational analyses were done to investigate the relationships between four factors. Group comparisons based on gender, age, education level, years of experience, teaching level and school types were examined. The results showed that most mathematics teachers conceptualized metacognition in accordance with the commonly accepted conceptualizations in the literature. They were aware of students' features and needs. They supported a learning environment where mathematical authority was exercised by students. However, they perceived high external pressure from various factors influencing their promotion of students' metacognition. Moreover, significant gender differences were observed on teachers' claims about their distribution of mathematical authority, perceived external pressure and conceptualization of metacognition in favor of female teachers. Significant differences according to age and years of experience were observed only on teachers' distribution of mathematical authority in favor of teachers with 20-29 age group and 1-5 years of experience respectively. There were also significant differences on distribution of mathematical authority and perceived external pressure according to teachers' educational background. Teachers with a master's degree supported the distribution of mathematical authority more and perceived less external pressure than teachers with a bachelor degree. In addition, significant teaching level differences were found on each factor in favor of middle school mathematics teachers. Lastly, perceived external pressure and teachers' conceptualization of metacognition also significantly differed on school types. Teachers working at a public school perceived higher external pressure and their conceptualization of metacognition's scores were lower than teachers working at a private school. Implications of the findings and potential ways forward for making better sense of teachers' considerations for promoting metacognition are discussed.

Tez Özeti

Vuslat Şeker, "Öğrencilerin Üst Bilişsel Becerilerinin Geliştirilmesini Etkileyen Faktörler Üzerine Matematik Öğretmenlerinin İncelenmesi"

Bu araştırmanın temel amacı matematik öğretmenlerinin öğrencilerin üst bilişini teşvik etmelerini etkileyen faktörler açısından incelenmesidir. Bu amaç doğrultusunda, Üstblişsel becerileri geliştirme amaçlı Matematik öğretimini çözümleme modeli (Framework for Analysing Mathematics Teaching for the Advancement of Metacognition),FAMTAM'ı oluşturan dört faktör kullanılmıştır (Ader,2009). Bu faktörler: (1) öğretmenlerin üst bilişi nasıl kavramsallaştırdığı, (2) öğretmenlerin öğrencilerin özellik ve ihtiyaçlarını algılaması, (3) matematiksel otoritenin sınıf içinde dağılımı ve (4) öğretmenlerin hissettiği dış baskılardır.Bu amaç doğrultusunda Öğretmenlerin Üst bilişi Kavramsallaştırması Ölçeği, Öğretmenlerin Öğrencilerin Özellik ve İhtiyaçlarını Algılaması Ölçeği, Matematiksel Otoritenin Sınıf İçinde Dağılımı Ölçeği ve Öğretmenlerin Hissettiği Dış Baskılar Ölçeği geliştirilmiştir. Örneklem 314 ortaokul ve ortaöğretim matematik öğretmeninden oluşmaktadır. Bu çalışmada tanımlayıcı, korelasyon ve nedensel karşılaştırma araştırma desenleri kullanılmıştır. Matematik öğretmenlerinin üst bilişi teşvik etmesini etkileyen faktörlere göre nasıl bir profil çizdikleri tanımlayıcı istatistikle incelenmiştir. Faktörler arasındaki ilişkiler için korelasyonel istatistik kullanılmıştır. Ayrıca cinsiyet, yaş, eğitim seviyesi, deneyim, öğretim seviyesi ve okul tipi değişkenleri için grup karşılaştırılması yapılmıştır. Bulgular, öğretmenlerin üst bilişi alan yazında yaygın olarak kabul gören hususlarla paralel olarak kavramsallaştırdığını, öğrencilerin özelliklerinin ve ihtiyaçlarının farkında olduklarını, matematiksel otoritenin öğrenciler tarafından kullanıldığı bir ortamını desteklediklerini göstermektedir. Fakat öğretmenler üst bilişi teşvik etme noktasında öğretim pratiklerini yüksek seviyede etkileyen dış baskılar hissettiklerini belirtmişlerdir. Ayrıca, matematiksel otoritenin dağılımı, hissedilen dış baskı ve üst bilişin kavramsallaştırılması üzerine kadınlar açısından anlamlı cinsiyet farklılıkları gözlemlenmiştir. Anlamlı yaş ve deneyim farklılıkları, sırasıyla 20-29 yaş grubu öğretmenleri ve 1-5 yıl deneyime sahip öğretmenler açısından sadece matematiksel otorite üzerinde gözlemlenmiştir. Matematiksel otoritenin dağılımı ve hissedilen dış baskılar üzerine de anlamlı eğitim seviyesi farklılıkları vardır. Matematik otoritenin yüksek lisans mezunu öğretmenler tarafından daha çok desteklendiği ve dış baskıların daha az hissedildiği ortaya çıkmıştır. Ayrıca ilköğretim matematik öğretmenleri açısından anlamlı öğretim seviyesi farklılıkları her bir faktör için bulunmuştur. Son olarak, hissedilen dış baskı ve öğretmenlerin üst bilişi kavramsallaştırması, matematik öğretmenlerinin çalıştığı okul tiplerinde anlamlı olarak farklılaşmaktadır. Devlet okulunda çalışan öğretmenler daha fazla dış baskı hissetmekte ve üst bilişi kavramsallaşmasındaki puanları özel okulda çalışan öğretmenlere göre daha düşüktür. Öğretmenlerin üst bilişi teşvik etme konusundaki düşüncelerini daha iyi anlam kazandırmak adına bulgular ve olası yollar/süreçler tartışılmıştır.

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I dedicate this thesis to

my mom and dad

for their unconditional love and constant support.

I love you dearly

CONTENTS

TABLES

FIGURES

CHAPTER 1

INTRODUCTION

In recent years, there has been an emphasis on metacognitive development in addition to the transfer of knowledge in education (Jager, Jansen, & Reezigt, 2005). As Flavell (1979) stated metacognition can be seen as a predictor of learning. In general, it can be defined as "individuals' ability to understand and manipulate their own cognitive processes" (Reeve & Brown, 1985, p.343). Flavell (1979) also defined metacognition as the regulation of and knowledge about cognitive activities.

Metacognition is comprised of two components; metacognitive knowledge and metacognitive skills (Veenman, Van Hout- Wolters & Afflerbach, 2006). Metacognitive knowledge can be explained as one's declarative knowledge about self, task and strategy (Flavell, 1979). However, metacognitive knowledge could be neither constructed without domain-specific knowledge (Veenman, VanHout-Wolters, & Afflerbach, 2006) nor used effectively without metacognitive skills (Veenman, Wilhelm, & Beishuizen, 2004). Metacognitive skills help learners to use their metacognitive knowledge, since metacognitive skills are about the procedural knowledge on how to regulate the cognition (Veenman et al., 2006). They can be listed as monitoring, planning, evaluating and control of cognitive activities.

Mathematics can be seen as an abstract and complex subject matter for learners. However, in its complexity, the complexity of real life situations can be seen. Understanding of mathematics is related to the conceptualization of real life problems in which people are the learners who need to choose a strategy for solving these problems effectively like in mathematics (Özsoy & Ataman, 2009). Understanding of mathematics depends on knowing how to deal with a problem, since problem solving is the main component of mathematics (Van De Walle, Karp, & Bay-Williams, 2010).

Metacognition has an important place in mathematics education (Lucangeli & Cornoldi, 1997). It appears in early stages of problem solving process with accurate representations and the planning of problem solving (Desoete & Veenman, 2006). Jacobse and Harskamp (2012) stated that metacognitive activities improve students' mathematical learning. Poor mathematical problem solving can be improved through integrating metacognition into learning environments (Desoete , 2007). Hence, teachers must arrange learning environment where learners are encouraged to learn mathematics through metacognition (Lombaerts, Engels, & Athanasou, 2007).

Hartman (2002) emphasized the importance of teachers' own metacognitive reflection on their teaching process and their thoughts about development of students' metacognition. As Lombaerts, Engels and van Braak (2008) stated, teachers' beliefs about promoting metacognition in classrooms should be taken into consideration before explaining the ways of promotion of metacognition in classrooms. The reason is that teachers' beliefs might affect the ways they use an instructional pedagogy (Lombaerts, Engels, & van Braak, 2008). Shraw, Crippen and Hartley (2006) claimed that teachers' epistemological beliefs are important in order them to adapt curricular and pedagogical implications regarding metacognitive development.

Teaching of metacognition by teachers in order to improve students' problem solving has been suggested previously by Desoete (2007). Accordingly, experiencing mathematics freely does not contribute to students' learning much. The role of teachers on students' development of metacognition causing an improvement in problem solving skills of learners is very important (Hartman, 2002). For the development of students' metacognition, there are various ways for teachers to use with respect to the needs of students and the learning environment. Metacognitive development of learners through using different teaching methods is an important educational outcome. In order to reach such a significant aim, the promotion of metacognition should be examined in a broader sense. For example, why teachers promote or not promote metacognition in their classrooms should be considered in order to help teachers to create effective learning environment (Lombaerts, Engels, & van Braak, 2008).

Several factors affecting teachers' promotion of metacognition or self-regulation emerged (Dignath-van Ewijk & van der Werf, 2012; Lombaerts, Engel & van Braak, 2008; Lombaerts, Engels, & Vanderfaellie, 2007). In most studies, three different determinants namely, teacher characteristics, school context characteristics and pupil characteristics were described as factors affecting teaching practices of teachers on promotion of self-regulation (Lombaerts, Engels, & van Braak, 2008). Teacher beliefs, previous teaching experiences and educational experiences are given as teacher characteristics that affect the introduction of metacognition in teachers' teaching practices. Furthermore, curricular changes, timetables, number of students, textbooks, the relationship among teachers are certain examples for school context characteristics. Lastly, pupil characteristics affecting teaching practices on stimulation of metacognition or self-regulation are cognitive and metacognitive abilities of learners.

A framework about factors affecting teachers' promotion of students' metacognition in mathematics teaching environment was developed (Ader, 2009). It is called the Framework for Analysing Mathematics Teaching for the Advancement of Metacognition (FAMTAM). The aim of this framework is to describe mathematics teachers' promotion of metacognition with respect to specific factors. The framework consists of four factors stated as (1) teachers' conceptualization of metacognition, (2) teachers' perceptions of students' features and needs, (3) distribution of mathematical authority in the classroom and (4) external pressures perceived by teachers (Ader, 2009).

This study was conducted with middle and secondary school mathematics teachers in order to draw a profile of mathematics teachers on factors derived from the FAMTAM through developing profiling tools. To reach this aim, four profiling tools addressing the four factors in FAMTAM were developed and validated. Furthermore, how the data collected with the tools described teachers' profiles according to variables related to the teachers were also studied, particularly in the light of findings from the literature. The factors affecting promotion of metacognition within FAMTAM were supported by related literature (key concepts: conceptualization of metacognition: Flavell, 1979; students' features and needs: Jaworski, 1992; mathematical authority: Schoenfeld, 1992; external pressures: Lombaerts et. al., 2007; 2009).The study is significant since there is limited study on factors affecting promotion of metacognition. With this study, supporting and hindering factors regarding promotion of metacognition may be determined. Furthermore, although there are a number of studies on this subject, profiling of teachers on such factors has not been encountered. It is believed that this study may be useful in informing teachers, teacher educators and administrators on how to start integrating promotion of students' metacognition in mathematics classroom.

CHAPTER 2

LITERATURE REVIEW

Metacognition Defined

Metacognition has emerged as a construct in 1970s by the conceptualization of Flavell (Dinsmore, Alexander, & Loughlin, 2008). Its importance in educational settings has been obvious since education has been defined not only as cognitive processes such as transfer of learning, but also by metacognitive processes (De Jager, Jansen, & Reezigt, 2005). Metacognition is seen as an important factor for effective learning (Desoete, 2007; Veenman, et al., 2006). Metacognition was conceptualized firstly by Flavell as

> One's knowledge concerning one's own cognitive processes and products or anything related to them … Metacognition refers to the active monitoring and consequent regulation and orchestration of these processes in relation to cognitive objects on which they bear, usually in the service of some concrete goal or objective (as cited in Garafolo & Lester, 1985)

Flavell's (1979) definition of metacognition was accepted as highly interrelated with the concept of cognitive processes. Metacognition is also defined by other researchers (Dean & Kuhn, 2003; Veenman et al., 2006) in a cognitive perspective. Basically, metacognition is defined as thinking about thinking or "awareness and management of one's own thought" (Dean & Kuhn, 2003, p.2). It can be also defined as "higher order cognition about cognition" in which cognitive activities are related with metacognitive activities by the processes of monitoring and evaluation (Veenman et al., 2006, p .5).

Nelson (1996) defined metacognition as a model of cognition. It is a model in which cognitive processes are monitored at nonconscious levels through individual goals and at conscious-level providing people with reflection and analysis of individual actions or plans and their results (Efklides, 2008). Nelson (1996) described the model as:

> Information flowing from the object-level to the meta-level is called monitoring and informs the meta-level about what state the object-level is in. Second, information flowing from the meta-level to the object-level is called control and informs the object level about what to do next. Third, the meta-level has some kind of model containing both a goal and the ways in which the meta-level can use the object-level to accomplish that goal (p.105).

In order to understand the model of metacognition, firstly object-level and meta-level components of this model and the processes between these components should be explained. First of all, object-level represents cognition and meta-level is defined as "Meta refers to a change of position, a sense of going beyond or to a second order or higher level" (Larkin, 2010, p.3). With the combination of two, or the flow between meta-level and object-level, metacognition is constructed. In this regulatory process, metacognitive control components such as selection of a strategy, allocation of time and so on, and metacognitive monitoring such as ease of learning judgments, judgments of learning, judgments of confidences take place (Nelson, 1996). Meta-level is important since a learner can use learning outcomes or processes in an environment outside from learning acquired.

The Components of Metacognition

To make the definitions more meaningful, the components of metacognition should be explained. In Flavell's (1979) model of metacognition and cognitive monitoring, he explained four components for the monitoring process in cognitive actions; metacognitive knowledge, metacognitive experiences, goals (or tasks) and actions (or strategies). Moreover, Zimmerman and Moylan (2009) stated metacognition as knowledge, awareness and regulation of one's thinking. It is a very common distinction that metacognition can also be mentioned with respect to knowledge of cognition and regulation of cognition which are supplementary to each other (Ku & Ho, 2010; Shraw, 1998). The components of metacognition can be categorized in three parts with respect to literature (Efklides, 2008). In the following parts, three important facets of metacognition as metacognitive knowledge (MK), metacognitive experiences (ME) and metacognitive skills (MS) are given in order to understand metacognitive notions.

Metacognitive Knowledge

Flavell (1979) defined metacognitive knowledge as a class for monitoring of cognitive processes with the interactions between three other classes as ME, goals and actions. It consists of knowledge about self, task and strategy (Flavell, 1979). Ku and Ho (2010) explained it as "knowing one's cognitive processes, such as knowledge about oneself as a thinker, characteristics of existing task and about which strategies are required to carry out for effective performance" (p. 252). Metacognitive knowledge about person includes "nature of oneself and other people as cognitive processors" (Flavell, 1979, p. 907). In addition, Efklides (2008) also mentioned metacognitive knowledge about goals in order to explain its necessity when one is faced with specific tasks or situations in which one should know what kind of goals can be set and attained.

There are also different types of metacognitive knowledge in addition to Flavell (1979)'s categorization of metacognitive knowledge. Shraw (1998) explained them as "declarative knowledge refers to knowing about things; procedural knowledge refers to knowing how to do things. Conditional knowledge refers to knowing the why and when aspects of cognition" (p. 114). With the interactions of declarative, procedural and conditional knowledge of metacognition from different sources, metacognitive knowledge is not constant, it is changing with respect to metacognitive processes (Efklides, 2008).

Metacognitive Skills

Efklides (2008) described metacognitive skills as "constituting the control function of metacognition, that is, what person deliberately does to control cognition" (p.79). Therefore it is about control of actions and strategy use in which learners know the strategies and how to use them; then apply the strategies when it is necessary (Efklides, 2008; Veenman et al., 2004). It is similar to regulation of cognition since it also includes control of students' learning with a set of activities (Shraw, 1998). The skills or activities can be listed as orientation strategies, planning strategies, strategies for regulating cognitive processing, strategies for checking a planned action, strategies for evaluation of an outcome of a task, strategies for recapitulation and self-regulation (Efklides, 2008). It is related with metacognitive knowledge since without metacognitive strategy knowledge, "one cannot check one's outcome of a calculation without comparing the outcome with an estimation of it, or recalculating the outcome in another way" (Veenman et al., 2006, p.5). In another perspective, metacognitive knowledge could be neither constructed without domain-specific knowledge (Veenman et al., 2006) nor used effectively without metacognitive skills (Veenman et al., 2004).

Metacognitive Experiences

Metacognitive experiences are described as “any conscious cognitive or affective experiences that accompany and pertain to any intellectual enterprise” (Flavell, 1979, p.709). It consists of metacognitive feelings, metacognitive judgments or estimates and task-specific knowledge within cognitive process (Desoete & Veenman, 2006; Efklides, 2008). Feeling of knowing, familiarity, difficulty confidence and satisfactions are some examples for metacognitive feelings. Metacognitive judgments or estimates can be exemplified with judgment of learning, estimate of time, estimate of correctness of a problem (Efklides, 2001, 2008). Task-specific knowledge is related to metacognitive knowledge used while dealing with a task (Efklides, 2008). Therefore, metacognitive knowledge is explained as a product of metacognitive experiences (Efklides, 2008; Flavell, 1979). It is related also with metacognitive strategies or goals in a way that “they can lead you to establish new goals and revise or abandon old ones” (Flavell, 1979, p. 908). Therefore, it has an effect on the activation of metacognitive skills which control behaviors of learner (Efklides, 2008). Lastly, it helps learners to monitor or control their learning process and motivates them for further learning experiences (Desoete & Veenman, 2006).

When three facets of metacognition are considered, it is inevitable to describe them in a non-relational way. Without successful use of metacognitive skills, there could not be new and useful metacognitive knowledge (Veenman et al., 2006). However, without metacognitive experiences, activation of metacognitive skills and having new metacognitive knowledge become harder. Metacognitive experiences can be conceptualized as a buffer between metacognitive knowledge and metacognitive skills. Interaction between metacognitive knowledge and skills can take place successfully with the help of this buffer. This buffer helps learner to go back and forth between offline metacognition which can be given as metacognitive knowledge and online metacognition that is about executing metacognitive processes using metacognitive skills.

Metacognition and Self-Regulation

Self-regulation can be given as an interaction between person, environment and behavior (Dinsmore, Alexander, & Loughlin, 2008). This interaction is explained as "the reciprocal determinism of the environment on the person, mediated through behavior" (Dinsmore, Alexander, & Loughlin, 2008, p. 393). It is defined as "self-generated thoughts, feelings, and actions that are planned and cyclically adapted to the attainment of personal goals" (Zimmerman, 2000, p.14). It provides learners with evaluating and adjusting their progress of learning through feedbacks from their previous learning experiences (Cleary & Chen, 2009). It is explained as a cyclic feedback process including forethought process, performance control and self-reflection process which are the components of self-regulation model of Zimmerman (2000). The phases influence each other; forethought results in action (performance control process) which affects the process of self-reflection (Perels, Gürtler, & Schmitz, 2005).

Forethought process includes goal setting and strategic planning as well as motivational beliefs such as goal orientation, self-efficacy, intrinsic and extrinsic motivation (Perels et al., 2005). It is important to activate goal setting, planning and motivational beliefs while starting a task since these strategies help people to pass to next process which is called performance control process. In performance control processes, there are two components as self-control which provides learners to attain attention control, self-instruction, task strategies, and self-observation which is about monitoring one's own learning (Cleary & Zimmerman, 2004). Perels, Gürtler and Schmitz (2005) also stated that this phase is about acquiring and applying learning strategies strategically. This stage is important because for the next step it helps learners to evaluate their progress through monitoring how the strategies are used effectively by the learners; therefore in the process of self-reflection, there are self-judgment and self-reaction processes. Self-judgment includes self-evaluation and causal attributions which provide learners to judge their progress in terms of a goal or a result (Cleary & Zimmerman, 2004).

Zimmerman (1990) explained self-regulated learners with respect to metacognitive aspects in the cyclic process above as "learners plan, set goals, organize, self-monitor and self-evaluate at various points during the process of acquisition" (p.5).Therefore, metacognition can be given as an important part of self-regulation (Dinsmore, Alexander, & Loughlin, 2008; Veenman et al, 2006; Zimmerman, 2000). Although there has been a discussion in the literature about whether self-regulation or metacognition subordinate to the other (Veenman et al., 2006), metacognition has not been only emphasized cognitively as in Flavell's conceptualization, self-regulatory aspects of metacognitive mechanism can also be mentioned (Dinsmore et al., 2008). Efklides (2009) stated that regulation of cognition is performed not only through cognitive regulatory loop, but also affective regulatory system. Furthermore, in metacognition studies the relationship between will, behavior and metacognition has also been investigated (e.g. Mayer, 1998).

As it can be seen above, metacognition can be defined or explained in different perspectives. Therefore, the conceptualization of metacognition can be perceived as problematic (Hacker, 1998; Veenman et al., 2006). However, in literature, the definition of metacognition is generally given with the notions as "knowledge of one's knowledge, processes, and cognitive affective states and the ability to consciously and deliberately monitor and regulate one's knowledge, processes and cognitive and affective" (Hacker, 1998, p.11). In addition, self-regulation or monitoring and control skills are given terms that should be used when metacognition is defined (Schoenfeld, 1992).

Metacognition within Broader Learning Theories

Where metacognition stands in current learning theories is a discussion topic for researchers (Azevedo, 2009). Fox and Ricoscente (2008) stated metacognition within the theoretical framework as "with regard … to knowledge of others and objects (for Piaget), or to the use of language (for Vygotsky)" (p.375). In this section, metacognition is examined through Piaget's Cognitive Theory and Vygotsky's Social Development Theory.

Within Piaget's Cognitive Theory, learning occurs through developmental stages. In these processes, it is necessary to have "awareness of, interaction with and attempts to control both objects and others in the environment" (Fox & Ricoscente, 2008, p. 378). In Piaget's theory, metacognition involves a conscious awareness about knowledge of one's own thought processes; "metacognitive thought is conscious, intentional, intelligent, logically or empirically falsifiable, and verbally communicable" (Fox & Ricoscente, 2008, p. 378). As Fox and Ricoscente (2008) stated , it starts to develop when a child moves into formal operation in which the child is ready to act as an adult; "organizing and systematizing her thinking about thinking, perceiving and choosing among multiple possible courses of action" (p. 381).

In the work of Vygotsky's Social Development Theory, learning occurs through social interaction by language. Through social interactions with environment, learner develops reflective awareness and deliberate control (Fox & Riscoscente, 2008). Metacognition is also placed in social interaction through language with consciousness (Fox & Ricoscente, 2008).

According to Vygotsky, when reflective abstraction is formed, when one reaches adolescence, metacognition could be mentioned (Fox & Ricoscente, 2008). However, development of metacognition may start with egocentric speech which is talking aloud by oneself in the presence of other people as an attempt for social interaction since it is about regulating of one's own cognition; planning of solution of a problem (Braten, 1991). Therefore, using such opportunities (e.g. egocentric speech) and adjusting learning environment in a way that repeated practice in a collaborative environment contributes to development of metacognition (Fox & Ricoscente, 2008).

Both Vygotsky's Social Development Theory and Piaget's Cognitive Theory explain how effective learning occurs through metacognition with different foci. Although both theories claim that metacognition can be used in formal operation stage or adolescence, like Vygotsky emphasized, there are certain studies indicating that children at 4-5 years old use metacognitive skills and experience metacognitive activities through social interactions (Whitebread et al., 2009).

Metacognitive Development

Metacognition is a construct/ subject discussed in the areas of psychology, cognitive science and education. After it has been introduced, researchers have been interested in how metacognition develops in human beings and how it could be developed in the educational settings. As Schraw (1998) stated it is important to develop metacognition since it makes people more successful by enabling their cognitive skills used more effectively. In addition, it is stated as significant in terms of its positive relation with critical thinking skills (Ku & Ho, 2010). For better problem solving skills, metacognitive components' contributions could not be ignored (Desoete, Roeyers, & Buysse, 2001).

When it comes to how metacognition can be developed, the onset of its development should be considered. In early studies of metacognition, it was emphasized that metacognitive skills such as monitoring and evaluation start to appear at the age of 8 to 10 (Veenman & Spaans, 2005; Veenman et al., 2004, as cited in Veenman et al., 2006). However, Whitebread and his colleagues (2009) stated that metacognitive development can start at the age of 4-5 years when appropriate task is given to them and appropriate methodology is applied to search for metacognitive skills in children. From the literature, it is understood that metacognitive development is started from early ages. However, it is also stated that metacognitive skillfulness increases with age because of "an acquired repertoire of general skills for managing problem-solving and learning situations" (Veenman et al., 2004, p.105). In order to form such a repertoire from early ages to adulthood, the role of educational settings; especially teacher's roles are important (De Jager, Jansen, & Reezigt, 2005).

Metacognitive development is related with the age of children and practice done in that area (Larkin, 2010). The practice can be provided by effective teachers who "display both empathy and expertise" (Paris & Winograd, 1990, p.10). Shraw, Crippen and Hartley (2006) stated that because of the epistemological beliefs of these teachers which "are related to one's ability to argue persuasively and to use metacognitive skills and knowledge to self-regulate one's learning" (p.126), the curricular and pedagogical implications are adapted in terms of metacognitive development. In addition, the teachers' effective implications such as sensitivity to students' learning process, creating a community in which teachers and students share their ideas and feelings in a respectful environment promote metacognitive development (Paris & Winograd, 1990).

Hartman (2002) described teaching dimensions of metacognition in two parts as teaching with metacognition and teaching for metacognition (meta-teaching). Teaching with metacognition is described as teachers' own metacognitive reflections on their teaching process (Hartman, 2001). Teaching for metacognition focuses on teachers' thoughts about how to develop students' metacognition (Hartman, 2002). Teaching for metacognition is also called as meta-teaching in which it makes children to improve their self-appraisal and self-management skills by exploring their thinking process (Fisher, 1998). It is important for a teacher to use both teaching dimensions of metacognition since the combination of both dimensions of metacognition gives teachers an opportunity to increase metacognition in classroom effectively (Fisher, 1998; Hartman, 2001). The combination provides the teacher to accomplish their role in development of metacognition of students efficiently.

There are some possible suggestions offered to the teachers to improve their students' metacognition (Fisher, 1998; Goos, Galbraith & Renshaw, 2002; De Jager, Jansen, & Reezigt, 2005; Larkin, 2010; Kontos & Nicholas, 2001; Paris & Winograd, 1990; Shraw, 1998; Shraw, Crippen, & Hartley, 2006; Veenman et al., 2006). For example, Shraw, Crippen and Hartley (2006) stated six ways to promote metacognition in science education. These are inquiry based learning, the role of collaborative support, strategy instruction to improve problem solving and critical thinking, strategies for helping students to construct mental models and to experience conceptual change, the use of technology and the impact of students' and teachers beliefs. Furthermore, Paris and Winograd (1990) stated four approaches for promotion of metacognition as metacognitive explanation and modeling, scaffolding instruction, cognitive coaching and cooperative learning. Hartman and Sternberg (1993) stated four ways to increase metacognition in the classroom settings as "promoting general awareness of importance of metacognition, improving knowledge of metacognition, improving regulation of cognition and fostering environments that promote metacognitive awareness" (as cited in

Hartman, 2002, p. 8; Shraw, 1998). Lombaerts, Engels and Athanasou (2007) created guidelines for teachers to design supportive learning environment for students who are less self-regulated learners in order to make students more self-regulated. These guidelines are stated as:

> structure favorable learning environments avoiding internal and environmental distractions; keeping their attention and their effort on the task being performed; organizing instruction and activities in a way they favor the use of cognitive and metacognitive strategies; providing the pupil with opportunities for self-monitoring; supplying pupils with continuous evaluating information and occasions to self-evaluate stressing the level of goal achievement; and offering corrective feedback that helps them see where they have erred and how to correct problems (Lombaerts, Engels, & Athanasou, 2007, p.31)

The possible ways for promotion of metacognition can be categorized precisely as explicit instructional methods (e.g. strategy instruction, metacognitive explanation, metacognitive questioning), implicit instructional methods (modeling, scaffolding, feedback, supportive communication and assistance), providing positive student-student interaction (e.g. tutoring, ZPD, cognitive apprenticeship, collaboration), providing think aloud process, use of technology.

Metacognitive instruction is necessary in order to be successful in cognitive tasks (Özsoy & Ataman, 2009). Reeve and Brown (1985) stated the importance of metacognitive training with problem-solving as the increase in intellectual performance of children. In metacognitive instruction, the approaches mentioned above should be used effectively since all of them have different positive contribution for students' metacognition. First of all, as an implicit instructional method, scaffolding provides learner to attain a goal with support and guidance of the teacher (Paris & Winograd, 1990). In addition, cognitive apprenticeship should be provided for the student since it helps teacher to have conversations with learner to give encouragement, metacognitive explanations and to be a model for metacognitive learning

(Paris & Winograd, 1990). Furthermore, collaboration between members of the class is an important approach for the teachers' way of promotion of metacognition (Larkin, 2010). It makes learner to be aware of their learning process (Goos, Galbraith, & Renshaw, 2002; Larkin, 2010). With this supportive relationship between students, they can obtain "the language of discussion and negotiation" (Larkin, 2010, p. 142). Shraw, Crippen and Hartley (2006) stated that collaboration provides "explicit discussion of scientific concepts and reflection that promotes metacognition and self-regulation" (p.120). Another approach is to use technology in classroom for the development of metacognition. Shraw, Crippen and Hartley (2006) stated that self-regulation can be promoted through technology that provides collaboration, feedback, scaffold and knowledge for learners. Therefore, most approaches given above can be easily done for the development of metacognition with the help of technology.

In the literature, there are certain studies that use metacognitive instruction to see whether it improves metacognition of students or not (Jacobse & Harskamp, 2009; Kramarski, Mevarech, & Arami, 2002; Mevarech,1999; Mevarech & Kramarski, 1997). A well-known metacognitive instruction is IMPROVE. IMPROVE is a comprehensive metacognitive instructional method. It includes metacognitive questioning, cooperative settings and feedback-corrective-enrichment. In metacognitive questioning, there are comprehension questions, connection questions and strategic questions. In cooperative settings; students act as a team with one high, one low and two middle achieving students. In these settings, students talk about the problem and explaining to the other, having consensus on it, accepting different perspectives and discussing best options are aimed. In feedback-corrective-enrichment part, at the end of each lesson, students take formative tests. Students who are at the level of mastery take enrichment tests, the others take corrective activities. In this enrichment-corrective part of the lesson, the teacher provides feedback to the group.

Therefore, IMPROVE includes both explicit and implicit instructional methods. In addition, it gives opportunities for teachers to create positive student-student relationship for effective metacognitive development.

All in all, the role of teachers is very important for developing metacognition and self-regulation. As Lombaerts, Engels and Athanasou (2007) emphasized, teachers must arrange learning environments where learners are encouraged to learn metacognitively. In addition, teachers must make students to believe in their capabilities so that they introduce and promote metacognition and self-regulation in their classrooms (Lombaerts, Engels, & Athanasou, 2007).

Metacognition and Mathematics

Doing mathematics has recently been explained as constructing new mathematical knowledge through problem solving (Van De Walle, Karp, & Bay-Williams, 2010). Especially word problems give opportunities for learners to see how mathematics can be used in life and in what ways they construct and apply mathematical knowledge in different contexts (Jacobse & Harsmkamp, 2009). However, mathematical problem solving is not easy without applying certain strategies (Montegue, 2008). The learners should be actively engaged in the process of problem solving through regulating their learning (Fuchs et al., 2003).

Metacognition has an important place on successful mathematical performance (Lucangeli & Cornoldi, 1997). As Desoete and Veenman (2006) stated metacognition takes place in early stages of problem solving process with accurate representations of the problem and the planning what is done to solve the problem. After solving problem, the learner evaluates and checks their calculations (Desoete, Royers, & Buysse, 2001; Desoete &

Veenman, 2006). Therefore, it can be stated that it is necessary to use cognitive sources effectively with knowing what to do and how to do and controlling the process for better mathematical competence (Lucangeli & Cornoldi, 1997).

The categories of Flavell's (1979) metacognitive knowledge, relating to person, task and strategy should be adapted with respect to necessities of mathematics learning (Garafolo & Lester, 1985). The reason is that meta-skill as metacognitive knowledge in problem solving provides learner to start the action with the knowledge of when to use, how to use and how to monitor their progress (Mayer, 1998). For example, in person component, one should be aware of her general and specific mathematical capabilities or limitations (Garafolo & Lester, 1985). When a category-task, person or strategy in metacognitive knowledge is not completely acquired, the result in problem solving can be unsuccessful because of poor metacognitive activities (Reeve & Brown, 1985). Therefore, good mathematical competence is the subject for metacognition (Desoete et al., 2001).

Factors Affecting Teachers' Practice of Self-regulation and Metacognition

The importance of metacognitive development through teachers' implications for promotion of metacognition is stated by many researchers above (Dignath-van Ewijk & van der Werf, 2012; Lombaerts et al, 2009; Lombaerts, Engels, & van Braak, 2008; Lombaerts, Engels, & Vanderfaellie, 2007). However, as Lombaerts, De Backer, Engels, van Braak and Athanasou (2009) stated examination of what teacher thinks about the practicability of self-regulation in education is limited. Lombaerts and his colleagues (2009) stated that teachers' ideas about the place of self-regulation in practice should be examined since it gives important ideas about why teachers use or not use self-regulation or metacognition in their classrooms. There are certain factors taken into account when the factors affecting teachers' design of learning environment with respect to self-regulated learning (SRL); teacher characteristics as teacher beliefs, school context characteristics and pupil characteristics (Dignath-van Ewijk & van der Werf, 2012; Lombaerts et al, 2009; Lombaerts, Engels, & van Braak, 2008; Lombaerts, Engels, & Vanderfaellie, 2007).

A factor affecting promotion of self-regulation in classrooms is stated as teacher characteristics; especially teachers' belief systems (Lombaerts et al., 2008). However, before mentioning teachers' beliefs, it is important to discuss how belief is defined in the field of education. Lombaerts and his colleagues (2009) defined "beliefs are part of a group of constructs describing the structure and content of person's thinking and providing an understanding of his/her action" (p.80). The beliefs affect how teachers behave in their teaching practices since the beliefs affect their perceptions and judgments (Lombaerts et al., 2008; Peeters, Lombaerts, De Backer, Kindekens, & Jacquet, 2013). Teachers' beliefs are stated as significant in literature because teachers' beliefs determine which improvements or development should be applied in classrooms (Hart, 2002; Minor et al., 2002 as cited in Lombaerts et al., 2008). In addition, teachers' previous teaching related experiences and educational experiences including how they conceptualize learning and teaching and theories of learning can be stated as certain teacher characteristics which affect promotion of self-regulation in their teaching practices (Lombaerts et al., 2008).

As school context characteristics, Lombaerts and his colleagues (2008) defined school as an organization that may influence teachers' promotion of SRL. Presence of sufficient teaching materials such as textbooks and educational technology, effective timetable, stable curriculum or suitable number of students for effective teaching are certain physical factors related to school context in order to improve SRL environment in classrooms (Lombaerts et al., 2008). In addition, psychological factors affecting SRL promotion are stated as collaboration between teachers and parental expectations.

Pupil characteristics are also given as an important factor affecting SRL promotion. As Lombaerts, Engels and van Braak (2008) stated the practices of teacher on SRL promotion are affected by students' motivation, social issues and to what extent the students use their cognitive, metacognitive processes and self-regulation effectively.

There are certain studies conducted in order to see the impacts of teacher characteristics, school context and pupil characteristics determinants on promotion of self-regulation. For quantitative examinations, Self-regulated Learning Teacher Belief Scale was developed and validated to measure how teacher beliefs affect introduction of self-regulation in classrooms (Lombaerts et al., 2009). The items were grouped into four as; learning context levels as pupil level, teacher level and school context level and general level. Furthermore, Self-Regulated Learning Inventory for Teachers (SRLIT) was developed and validated so as to describe teachers' claims on their practices on promotion of SRL in their classrooms. The items were grouped into SRL phases as SRL forethought, SRL performance control and SRL self-reflection. Also, Lombaerts and Engels developed and validated Self-Regulated Learning Contextual Influence Scale (SRLCI) in order to examine school and school environment characteristics as well as classroom characteristics (As cited in Lombaerts, Engels, & van Braak, 2008). Furthermore, qualitative methodology was also used while examining teachers' promotion of self-regulation (Dignath-van Ewijk & van der Werf, 2012; Lau , 2012 ;Vandevelde, Vandenbussche, & Van Keer, 2012)

Lombaerts, Engels and van Braak (2008) conducted a study to understand the effects of personal and contextual factors on SRL introduction. Therefore, the relationships between teacher characteristics, contextual factors, and the recognition of SRL were examined. The participants of this study were 172 primary school teachers. As instruments, Self-Regulated Learning Inventory for Teachers (SRLIT), Self-regulated Learning Teacher Belief Scale (SRLTB) and Self-Regulated Learning Contextual Influence Scale (SRLCI) were used. The results showed that teachers' promotion or introduction of self-regulation depends on " (a) teacher satisfaction with personal SRL insights and teacher staff, (b) teachers' beliefs about the introduction of SRL on an elementary education level, and (c) teachers' personal experiences with independent learning in their classroom practice" (p.169). Teachers' characteristics were found to be more important than contextual characteristics in SRL promotion.

Dignath-van Ewijk and van der Werf (2012) examined the relationship between teacher knowledge, teacher beliefs based on strategy instruction and constructivist approach and teacher behavior on SRL introduction. 300 primary school teachers participated in the study. The results revealed that the relationship between teachers' beliefs on SRL and on constructivist learning was found to be positive. The teachers' beliefs were found to influence teacher behavior. Furthermore, when teachers mentioned their knowledge about SRL, most of them used constructivist learning in their explanations than strategy instruction.

A qualitative study about factors affecting SRL promotion was also conducted (Vandevelde, Vandenbussche, & Van Keer, 2012). In the study, it was aimed to find out encouraging and hampering factors for SRL promotion of primary school teachers. The results indicated that collaboration with other teachers and administration; beliefs of teachers and students' willingness for contribution to their learning were encouraging teachers to stimulate SRL. In addition, the teachers reported the negative effects of perceived pressure of time and work, diversity, students' characteristics such as age, classroom characteristics such as group size, time schedule, a lack of space, lack of textbooks and media and no immediate results of SRL promotion.

Lau (2012) conducted a study about teachers' perception and implementation of SRL and factors affecting their perception and implementation of SRL. The teachers received four training workshop consisting of teaching SRL concept, its characteristics and characteristics of a SRL environment. Then the teachers were asked to select one or two modules. Then throughout the implementation of these modules which takes 18 to 36 lessons, the researcher and teachers had meetings in which they shared and discussed their experiences. In this process, the teachers were interviewed and their teaching practices were observed. However, quantitative data were collected before and after the treatment. It was found that the percentage of teachers perceiving SRL-based instruction as a necessary condition for students' academic development increased. Furthermore, teachers' experience, students' ability and motivation, time-constraints and school support were found to be important factors affecting teachers' perceptions of SRL instruction.

A study on teacher and school determinants which affect SRL introduction was also conducted (Peeters et al., 2013). The aim of this study was to find out the teacher characteristics and school context components which affect promotion of SRL. In this study, SRL promotion was taken into consideration as an educational innovation. The results of this study indicated that school-level factors affecting promotion of SRL has relatively small effect on SRL teaching practices of elementary school teachers. Another finding showed that differences in teachers' SRL promotion can be explained as a result of teachers' individual differences.

Considering the studies conducted on teachers' promotion of self-regulation, it can be seen that certain factors consisting of teacher characteristics, school context and pupil characteristics affect teachers' beliefs on SRL introduction. In addition to factors affecting SRL promotion, Ader (2009) developed a framework on factors affecting promotion of metacognition in mathematics education. In the following section, the framework and its components as factors affecting teachers' promotion of metacognition are described in detail.

The Framework for Analysing Mathematics Teaching for the Advancement of Metacognition (FAMTAM)

Ader (2009) developed a framework for analyzing mathematics teaching for the improvement of metacognition of students. The framework was constructed through an ethnographic study in which three secondary mathematics teachers' teaching practices were analyzed. The reason for developing such a framework came from "the lack of emphasis on teacher's role and teaching practices within the efforts to incorporate metacognition into mathematics classrooms" (Ader, 2013, p.7).

Related factors affecting teaching implications of mathematics teachers were discovered based on his qualitative work on mathematics teachers' promotion of students' metacognition. These factors were described as teachers' conceptualization of metacognition, teachers' perceptions of students' features and needs, distribution of mathematical authority in the classroom and external pressures perceived by teachers. Therefore, FAMTAM was believed to be a good source for "exploring the teachers' approaches to promotion of students' metacognition" (Ader, 2009, p.282).

Teachers' Conceptualization of Metacognition

Ader (2013) stated that conceptualization of complex and multifaceted phenomenon is important to investigate since the complex phenomena can be interpreted in a different perspective because of their structure. Each conceptualization may result in different teaching practices with regard to the phenomenon. For example, Self-Regulated Learning Inventory for Teachers (SRLIT) was a scale about teachers' realisations of SRL (Lombaerts, Engels,& Athanasou,2007) .Therefore, Zimmeman's cyclical model of self-regulation including the processes of forethought, performance control and self-reflection , multidimensional nature of SRL concept and characteristics of self-regulated learners were taken into consideration in the development of the scale.

In the framework developed by Ader (2009), teachers' conceptualization of metacognition was taken as a factor affecting promotion of metacognition in mathematics classrooms. It is indicated that conceptualization of metacognition influenced teachers' teaching experiences as well as practical implications affect conceptualization of metacognition. Interviews with teachers showed that teachers' conceptualization of metacognition was partly about metacognitive skills such as evaluation, planning and monitoring (Ader, 2013).

Teachers' Perceptions of Students' Features and Needs

Jaworski(1992) developed a grounded theory called "teaching triad". In this teaching triad, there were three components; sensitivity to students, management of learning and mathematical challenge. Sensitivity to students is defined as "the developing both of knowledge of students, their individual characteristics and needs, and of an approach to working with students, consistent with these needs" (Jaworski, 1992, p.8). Potari and Jaworski (2002) conducted a study based on this teaching triad framework. The category of sensitivity to students was given as how teachers introduced a task, how they responded to students, what they presented with respect to students' features and needs and how they encouraged students to contribute.

Teachers' perceptions of students' features and needs was a component of FAMTAM since Ader (2009) observed that teachers' perceptions of students' needs and feature gave encouragement for students to use metacognition in their learning processes. Therefore, as Jaworski (1992) stated the teacher should act with respect to the features and the needs of the students for effective mathematics teaching.

Distribution of Mathematical Authority

The distribution of mathematical authority is another factor which affects teachers' promotion of metacognition in mathematics classrooms. Before defining what mathematical authority is, authority concept and authority in education should be examined. Authority word originated from "old French autorite, from Latin auctoritas, from auctor 'originator, promoter" (Oxford

Dictionaries, n.d.). In Oxford Dictionaries, there are three definitions; each includes power such that power to influence others, power to give orders and having administrative power. Amit and Fried (2005) described educational authority including Weberian authority, expert authority and shared authority.

Within authority in education, expert authority and shared authority were examined in mathematics education (Amit & Fried, 2005). Expert authority resides in where teacher provides information, guidance and instruction. Teacher has the administrative power in expert authority. Shared authority is the one with cooperative learning and non-localized authority. Shared authority is where community of practitioners of mathematics exists. Community of practitioners of mathematics consists of the ones who implement mathematical authority and are "obedient to discipline of mathematics" (Amit & Fried, 2005, p.150). From these explanations mathematics or discipline of mathematics can be taken as authority where members of mathematical communities are working on mathematics (Ader, 2013; Schoenfeld, 1992). Boaler (2002) identified the members of a community of a classroom which lacks of mathematical authority (i.e. mathematical problem solving) as not contributors in each other's mathematical learning, not doing mathematics, but as only receivers of mathematical knowledge.

Ader (2009) conceptualized metacognition as a way of practicing mathematical authority because metacognitive and problem solving processes are intertwined. In his study, the distribution of mathematical authority was explained as the way teachers encourage learners to use mathematics; they should not take the role of authority, they make students to use mathematical authority to evaluate their mathematical works (Ader, 2013).

External Pressures Perceived by Teachers

External pressures perceived by teachers were given as another factor affecting promotion of metacognition in math classroom (Ader, 2009). External pressures were stemmed not from classroom practices, but the teachers felt pressure on their teaching practices because of policies of educational system and demand or expectations of educational institutions, such as such as curriculum content, national exam, time constraint and so on (Ader, 2013). Similarly, Lombaerts and his colleagues (2008) stated that school as an organization including physical conditions such as timetable, group size, textbooks, teaching materials and collaboration with administration and with teachers and parental expectations are some of the factors affecting teachers' creation a learning environment where SRL is promoted or stimulated.

CHAPTER 3

STATEMENT OF THE PROBLEM

The Purpose of the Study

The aim of this study is to describe mathematics teachers' profiles on factors affecting promotion of metacognition through developing profiling tools. In the light of this aim, four scales were developed and validated based on the Framework for Analysing Mathematics Teaching for the Advancement of Metacognition (FAMTAM). With these scales, it is aimed not to measure actual performance of mathematics teachers on promotion of metacognition. It is aimed to explore mathematics teachers' approaches to promotion of students' metacognition with the four factors through descriptive, correlational and causal comparative research designs. Parallel to the aim of FAMTAM, it is aimed to "develop awareness of the perceptions, tensions and constraints (of mathematics teachers) on promotion of metacognition" (Ader, 2009, p.319).

The components of the framework namely, teachers' conceptualization of metacognition, teachers' perceptions of students' features and needs, distribution of mathematical authority in the classroom and external pressures perceived by teachers were determined as main factors affecting mathematics teachers' promotion of metacognition by Ader (2009). This study is significant in a way the developed scales describe a teacher profile with regard to the factors affecting metacognitive implications or promotion in their classrooms. As a result of the study, such profile identification may help researchers and policymakers to see whole picture / current situation of what affects teachers' promotion of metacognition. Therefore, they may decide what to do next and how. When the profile of teachers based on pre-determined reasons or factors are determined, teachers' metacognitive practices on mathematics teaching can be improved through eliminating negative conditions and supporting positive ones.

In the Turkish context, metacognition itself in education has been defined and investigated through many research studies. However, the study on promotion of metacognition and on supporting or hindering factors affecting promotion of metacognition was very limited. In the European context, there are certain studies that aim to explain SRL promotion with similar factors (Lombaerts et al., 2009). However, again this study differs with SRL promotion studies (Lombaerts et al., 2008; 2009) with respect to school settings, subject matter and pedagogic content knowledge.

Variables and Operational Definitions

Conceptualization of metacognition, perceptions of students' features and needs, distribution of mathematical authority, perceived external pressure, gender, age, years of experiences, educational level, teaching level and school type were the variables investigated in this study.

1. Conceptualization of metacognition variable was defined as the score on the Teachers' Conceptualization of Metacognition Scale.
2. Perceptions of students' features and needs variable was defined as the score on the Teachers' Perceptions of Students' Features and Needs Scale.
3. Distribution of mathematical authority variable was defined as the score on the Distribution of Mathematical Authority Scale.

4. Perceived external pressure variable was defined as the score on the External Pressure Perceived by Teachers Scale.

Research Questions

1- What is the teachers' profile on the factors affecting mathematics teachers' promotion of metacognition? (a)How do they conceptualize metacognition within their teaching practices?; (b) How do they perceive students' features and needs; (c) How do they distribute mathematical authority within their classrooms? ; (d) What is the level of external pressure perceived by mathematics teachers?

2- Are there significant correlations between variables of conceptualization of metacognition, perceptions of students' features and needs, distribution of mathematical authority and perceived external pressure affecting mathematics' promotion of metacognition?

3- Is there a difference according to gender invariables of conceptualization of metacognition, perceptions of students' features and needs, distribution of mathematical authority and perceived external pressure affecting mathematics teachers' promotion of metacognition?

4- Is there a difference according to age in variables of conceptualization of metacognition, perceptions of students' features and needs, distribution of mathematical authority and perceived external pressure affecting mathematics teachers' promotion of metacognition?

5- Is there a difference according to education level in variables of conceptualization of metacognition, perceptions of students' features and needs, distribution of mathematical authority and perceived external pressure affecting mathematics teachers' promotion of metacognition?

6- Is there a difference according to years of experience in variables of conceptualization of metacognition, perceptions of students' features and needs, distribution of mathematical authority and perceived external pressure affecting mathematics teachers' promotion of metacognition?

7- Is there a difference according to teaching levels in variables of conceptualization of metacognition, perceptions of students' features and needs, distribution of mathematical authority and perceived external pressure affecting mathematics teachers' promotion of metacognition?

8- Is there a difference according to school types in variables of conceptualization of metacognition, perceptions of students' features and needs, distribution of mathematical authority and perceived external pressure affecting mathematics teachers' promotion of metacognition?

CHAPTER 4

METHOD

Sample

For the description of profiles of mathematics teachers on the factors affecting promotion of metacognition, the main study was conducted with 314 middle and secondary school mathematics teachers from mainly İstanbul and Eskişehir. There were 175 female and 139 male participants. Of these, 34 participants were from private schools and 280 participants were from public schools. Of these, 161 participants were middle and 153 participants were secondary school teachers. Moreover, 116 of 163 middle and 43 of 153 secondary school mathematics teachers were graduated from faculties of education. 4 middle school mathematics teachers did not state the faculty they graduated. Remaining was graduated from faculties of science.

The sample of main study was chosen conveniently. After necessary permissions were received from İstanbul and Eskişehir District National Education Directorates, web-version of the instruments were sent over 1000 middle and secondary school mathematics teachers through e-mail for three times. Only 199 middle and secondary school mathematics teachers filled out web-version of the instruments. Then mathematics teachers who did not prefer to fill out web-version of the instruments were asked to fill out paper-version of the instruments by visiting them in their work places in İstanbul and Eskişehir. Demographic information of the main sample is given in Table 1.

Table 1

Demographic Information Table Including Participants in Main Study

		Main Study
		N (%)
Gender	Male	175 (55.7)
	Female	139 (44.3)
Age	20-29	103 (32.8)
	30-39	110 (35.0)
	40-49	62 (19.7)
	50 and above	39 (12.4)
Years of Experience	1-5	87 (27.7)
	6-10	55 (17.5)
	11-15	78 (24.8)
	16 and above	93 (29.6)
Education Level	Undergraduate	239 (76.1)
	Graduate	75 (23.9)
Teaching Level	Middle	161 (51.3)
	Secondary	153 (48.7)
School Type	Public School	280 (89.2)
	Private School	34 (10.8)
Total		314 (100)

Instruments

Within the process of development of four profiling tools, two pilot studies were conducted. Middle and secondary school mathematics teachers from public and private institutions were participated in two pilot studies. The first sample was used in order to develop the four scales. The second sample was used for assessing psychometric qualities of the instruments that were revised after the pilot study.

In the first pilot study, there were 120 middle and secondary school mathematics teachers from mainly İstanbul and Eskişehir. There were 81 female and 39 male teachers. Of these teachers, 115 were public school teachers and 5 were private school teachers. In addition, 72 of 120 mathematics teachers were teaching at a middle level and 48 of 120 mathematics teachers were teaching at a secondary level.

For the second pilot study, 62 middle and secondary school mathematics teachers participated from İstanbul. There were 35 female and 27 male participants. Of these, 9 participants were working at private institutions and 53 participants in public schools. Furthermore, 17 participants were teaching at a middle school and 45 participants were secondary school teachers. For the first and the second pilot studies, samples were chosen conveniently. Mathematics teachers working at close districts were mainly asked to fill out the instruments. Furthermore, mathematics teachers who were just graduated from universities were asked to fill out the instruments and to forward the instruments to their colleagues. Demographic information of the first and the second pilot studies is given in Table 2.

Four instruments developed by the researcher are called The Teachers' Conceptualization of Metacognition Scale, The Teachers' Perceptions of Students' Features and Needs Scale, The Distribution of Mathematical Authority Scale and The External Pressures Perceived by Teachers Scale that were used within the course of the study. Furthermore, a demographic information form was constructed and used in the study.

Table 2

Demographic Information Table Including Participants in Pilot Studies

		Pilot Study 1	Pilot Study 2
		n (%)	n (%)
Gender	Male	81 (67.5)	35 (56.5)
	Female	39 (32.5)	27 (43.5)
Age	20-29	52 (43.3)	9 (14.5)
	30-39	33 (27.5)	25 (40.3)
	40-49	27 (22.5)	23 (37.1)
	50 and above	8 (6.7)	5 (8.1)
Years of Experience	1-5	32 (26.7)	10 (16.1)
	6-10	18 (15.0)	7 (11.3)
	11-15	34 (28.3)	20 (32.3)
	16 and above	36 (30.0)	25 (40.3)
Education Level	Undergraduate	104 (86.7)	49 (79.0)
	Graduate	16 (13.3)	13 (21.0)
Teaching Level	Middle	72 (60.0)	17 (27.4)
	Secondary	48 (40.0)	45 (72.6)
School Type	Public School	115 (95.8)	53 (85.5)
	Private School	5 (4.2)	9 (14.5)
Total		120 (100)	62 (100)

In the process of test development, the Framework for Analysing Mathematics Teaching for the Advancement of Metacognition (FAMTAM) was used. The framework has four categories stated as (1) teachers' conceptualization of metacognition, (2) teachers' perceptions of students' features and needs, (3) distribution of mathematical authority in the classroom and (4) external pressures perceived by teachers (Ader, 2009). Items of the instrument were originated from FAMTAM (Ader, 2009). The factors affecting promotion of metacognition within FAMTAM were supported by related literature (key concepts: conceptualization of metacognition: Flavell, 1979; students' features and needs: Jaworski, 1992; mathematical authority: Schoenfeld, 1992; external pressures: Lombaerts et. al., 2007; 2009).

Item development process for the four scales took a semester from September 2013 to January 2014. Total number of items developed for four scales was 102. For the improvement of the scale developed, expert opinions were obtained from four university professors and one middle school mathematics teacher in a public school. The items were then revised based on the expert opinions. Certain items (e.g. from first version item 13; motivation) were eliminated from the instrument and some items (e.g. knowledge of self; knowledge of task) were added. After the expert opinions, the number of items for the instrument was reduced to 35 consisting of 13 items for The Teachers' Conceptualization of Metacognition Scale, 8 items for The Teachers' Perceptions of Students' Features and Needs Scale, 5 items for The Distribution of Mathematical Authority Scale and 9 items for The External Pressure Perceived by Teachers Scale. After the expert opinion, all items in the scale were formed as sentences. Finally, a Turkish language expert reviewed the items for correct grammatical structure and appropriate wording.

After the first pilot implementation, the number of items increased to 36 including 9 items for The Teachers' Conceptualization of Metacognition Scale, 8 items for The Teachers' Perceptions of Students' Features and Needs Scale, 10 items for The Distribution of Mathematical Authority Scale and 9 items for The External Pressure Perceived by Teachers Scale. An explanation for metacognition and its components were added to the beginning of the sheet including all four scales, because not knowing what was meant by metacognition would have created certain problems on how teachers answered The Teachers' Conceptualization of Metacognition Scale and The Teachers' Perceptions of Students' Features and Needs Scale.

After the second pilot implementation of the scales, the number of items decreased to 34 including 9 items for The Teachers' Conceptualization of Metacognition Scale, 6 items for The Teachers' Perceptions of Students' Features and Needs Scale, 10 items for The Distribution of Mathematical Authority Scale and 9 items for The External Pressure Perceived by Teachers Scale. Finally, the last version of the scales was reviewed by two Turkish language experts for accuracy and appropriateness of the language.

Table 3

The Number of Items for the Four Instruments in All Phases

Instruments	Pilot Version 1	Pilot Version 2	Last Version
The Teachers' Conceptualization of Metacognition Scale	13	9	9
The Teachers' Perceptions of Students' Features and Needs Scale	8	8	6
The Distribution of Mathematical Authority Scale	5	10	10
The External Pressure Perceived by Teachers Scale	9	9	9

Demographic Information Form

The form was developed in order to determine teachers' demographic information including gender (female or male), age (20-29, 30-39, 40-49 or 50 and above), years of experience (1-5, 6-10, 11-15 or 16 and above), teaching level (middle level or secondary level), education level (undergraduate level or graduate level) and type of schools (private school or public school).

The Teachers' Conceptualization of Metacognition Scale

The Teachers' Conceptualization of Metacognition Scale was developed for this study so as to measure how middle and secondary school mathematics teachers conceptualize metacognitive activities of students within mathematics classroom; namely to what extent their conceptualizations were parallel to those commonly accepted principles in the relevant literature. This scale aimed to determine the teachers' conceptualization of metacognition that may influence in their actions while teaching.

The scale consists of 9 items. All items within this scale were developed as five-point Likert type. Items were scored as 5 for "strongly agree", 4 for "agree", 3 for "neutral", 2 for "disagree" and 1 for "strongly disagree" indicating participants' level of agreement with the given statement. In order to get total score, the scores obtained from each item were added. As a result, an individual total score for a teacher was obtained as between minimum 9 and maximum 45. The individual total score indicated the level of fit between teachers' conceptualization of metacognition and what has been mainly documented in literature. In the following sections of the thesis, higher scores will be referred as higher conceptualizations of metacognition for conciseness.

During the development of this scale, the determination of which components of metacognition teachers conceptualize was taken into account to predict whether teachers fully conceptualized metacognition for promoting it within their classroom or not. The items were generated from relevant literature; especially metacognition definition of Flavell (1979). Metacognition can be categorized into metacognitive knowledge and metacognitive regulation components as in the model of Nelson (1986). Items of 7, 8 and 9 represented metacognitive knowledge and items 1, 2, 3, 4, 5 and 6 represents metacognitive regulation. The teachers are asked to state to what extent they agree the importance of the statements given in this scale. Sample items for this scale are “students’ planning of their thought”, “students’ evaluation of their actions” for metacognitive regulation and “having strategy knowledge for students” for metacognitive knowledge. Moreover, there were four filler items related to mathematics education to prevent blind-coding of the scale. Items 10, 11, 12 and 13 were filler items (e.g. an item about the importance of technology use of students in mathematics education).

After the development of the items of this scale, the expert opinions were obtained from five mathematics education professors. They stated whether the items were appropriate for the aim of the scale. Then an interview was conducted with a mathematics teacher working at a public school. He analyzed each item and gave feedback. According to expert opinions, this scale was revised. For the initial psychometric properties of this scale, the first pilot study was conducted with 120 middle and secondary school mathematics teachers. In order to examine initial internal consistency of the scale, statistical analysis was carried out. For The Teachers’ Conceptualization of Metacognition Scale, Cronbach’s alpha coefficient was calculated as .87. The item total correlations varied between .45 and .69.

After the initial psychometric properties of this scale were analyzed, the revisions for this scale were made based on opinions of field and language experts. Filler items were eliminated from the instrument according to experts’ judgments because it was concluded that they caused a deviation from the aim of this scale. The wording of each item was changed in a way word “important” within each statement was eliminated because it states positive attitudes so it may direct mathematics’ teachers to “strongly agree” option.

For the further reliability and validity concerns, the second pilot study was conducted with 62 middle and secondary school mathematics teachers. Cronbach's alpha coefficient was found as .91. The item total correlations varied between .54 and .80.

A confirmatory factor analysis with varimax rotation was run in order to measure construct validity of the scale by limiting the number of factors as two. Two factors were found reflecting the categories of how the scale was constructed. The first factor represented metacognitive skills including the items 1, 2, 3, 4, 5 and 6. The second factor included metacognitive knowledge represented by the items 7, 8 and 9. Two observed factors fit the theoretical assumptions. Therefore, an evidence for construct validity has been found through this analysis. The factor loadings are given in Table 4.

Reliability issue was considered for both subscales also following the results of the factor analysis. The reliability coefficient of metacognitive skills related items as a subscale was found to be .87. The item total correlations varied between .62 and .78. For the second subscale representing metacognitive knowledge, the Cronbach's alpha was .91. The item total correlations of the second subscale varied between .80 and .86. See Appendix B for the final version of the scale.

Table 4

Factor Loadings of the Teachers' Conceptualization of Metacognition Scale

Item Number	FACTOR 1	FACTOR 2
4	.88	
3	.76	
1	.73	
5	.72	
6	.59	
2	.59	
7		.93
8		.87
9		.81

The Teachers' Perceptions of Students' Features and Needs Scale

The Teachers' Perceptions of Students' Features and Needs Scale was developed by the researcher in order to investigate to what extent teachers have knowledge about students' characteristics and needs with respect to metacognition and act upon it. The perceptions of teachers related to students' features and needs were investigated since they might affect teaching practices of mathematics teachers.

The scale consists of 6 items. All items within this scale were developed as five-point Likert type. Items were scored as 5 for "strongly agree", 4 for "agree", 3 for "neutral", 2 for "disagree", and, 1 for "strongly disagree". In order to obtain a total score, the scores from each item were added. As a result, an individual total score for a teacher was obtained between minimum 6 and maximum 30. The individual total score showed the level of teachers' perceptions of students' features and needs. Higher scores indicated that teachers perceived students' features and needs with respect to metacognition while adjusting a teaching environment parallel to what is mentioned in the literature. In the following sections higher scores will be referred as better perceptions of students' features and needs.

While developing this scale, teachers' perceptions of students' features and needs component of FAMTAM was taken into account. The items of this scale were developed through considering 'sensitivity to students' component of teaching triad (Jaworski, 1992) with respect to metacognition. This scale initially included 8 items. By definition of sensitivity to students, items 1,2,3,4 and 5 were developed aiming determination of teachers' knowledge of students' features and items 6, 7 and 8 were developed aiming what teachers do for meeting the needs of students in metacognitive respect. Items 5 and 8 were negative statements so they were reversely coded. After the reliability and validity analysis, the number of items was decreased to 6 through elimination of items 5 and 8. The question asked for teachers to answer this scale was that "with given explanation of metacognition and its components stated above, state to what extent you agree with the statements". Some sample items can be given as "they are observed in students with higher motivation" and "successful students can use them effectively" for teachers' knowledge of students' features and "teacher should help learner to improve metacognitive skills and knowledge by using various teaching methods (e.g. modeling, think aloud, direct teaching)" for teachers' knowledge of students' needs.

Before investigating the psychometric properties of the scale, expert opinions were obtained from five mathematics education professors. Then the same mathematics teacher documented for the previous scale assessed the items in an interview. He gave feedback on each item and the question asked for this scale. The same procedure for Conceptualization of Metacognition Scale was applied for this scale as well. According to the first pilot study, Cronbach's alpha coefficient was found as .45. The item total correlations varied between -.12 and .51 except for item 18 which had an item total correlation coefficient as .08.

The second pilot study was carried out in order to investigate further psychometric properties of the scale. Reliability coefficient of Cronbach's alpha was calculated as .69. The item total correlations varied between .03 and .63.

A confirmatory factor analysis with varimax rotation was conducted to measure construct validity of this scale. Fixed number of factors was determined as two due to the fact that first five items were developed according to "students' characteristics" and the last three items were developed with respect to "teachers' actions on students' needs". According to the factor analysis, there were two factor loadings. Items 1, 2, 3, 4, 6, 7 were on Factor 1 and items 5 and 8 were on Factor 2. The factor loadings are represented in Table 5.

Table 5

Factor Loadings of the Teachers' Perceptions of Students' Features and Needs Scale

Item Number	FACTOR	
	1	2
6	.81	
2	.76	
7	.74	
1	.68	
3	.68	
4	.65	
8		-.82
5		.78

After the psychometric properties of this scale was assessed, item 5 and item 8 were deleted because of low item total correlations (.07 and .03 respectively). Reliability of coefficient of the final form of the scale was calculated as α= .81. Furthermore, observed factor structure did not fit the theoretical structure with respect to the confirmatory factor analysis. However, after eliminating two items and the confirmatory factor analysis, expert opinions were obtained to check the accuracy of each item, coded by the mathematics teaching professors, for the aim of the construct. Experts agreed on the items that within this scale they covered important issues regarding content provided through literature on teachers' perceptions of students' features and needs. Therefore, it was an indicator of content validity for this scale. See Appendix D for the final version of the scale.

The Distribution of Mathematical Authority Scale

Third component of FAMTAM which was distribution of mathematical authority within the classroom was developed as a scale by the researcher. The aim of the scale was to show to what extent middle and secondary school mathematics teachers handled with mathematical authority within their classrooms. Therefore, within the environment where mathematical authority resides mostly in mathematics, metacognition could be promoted effectively.

Initially, there were 5 items in this scale. However, the last version of the scale consisted of 10 items based on the first pilot study results. The items of this scale were based on teachers' implications about distribution of mathematical authority. The question asked to code the items by giving explanation that the power of determining what is right or wrong should be on mathematics; such a classroom environment, state to what extent you agree or disagree the statements below. Sample items for this scale are "A learning environment should be constructed where teacher and students reason together", "Teacher should give an opportunity for students to evaluate their mathematical learning" and "Teacher should promote a learning environment where students contribute each other's learning".

All items within this scale were developed as five-point Likert type. Items were scored as 5 for "strongly agree", 4 for "agree", 3 for "neutral", 2 for "disagree", and, 1 for "strongly disagree". The scores for each item were added to get a total score. An individual total score for a teacher varied between minimum 10 and maximum 50. Higher scores on the distribution of mathematical authority showed teachers supported a learning environment where mathematical authority is exercised by students. In the following sections, higher scores on the distribution of mathematical authority will be referred to as a good distribution of mathematical authority within the classroom by mathematics teachers.

Expert opinions were also obtained for this scale from five mathematics education professors and one mathematics teacher. Items' appropriateness for the scale was assured, but small changes were made according to the feedback from experts. For the initial psychometric properties of the scale with only 5 items, the first pilot study was carried out for this scale as well. For The Distribution of Mathematical Authority Scale, Cronbach's alpha coefficient for reliability was calculated as .31. The item total correlations varied between .18 and .43. After the reliability analysis, expert opinions were received again, it was decided to increase the number of items in this scale to get more accurate data for describing middle and secondary school mathematics teachers' ideas on how mathematical authority resides in their classrooms.

The second pilot study was also carried out to measure reliability and validity of this scale. Cronbach's alpha coefficient for reliability was calculated as .65. The item total correlations varied between .20 and .55.

An exploratory factor analysis with varimax rotation was run in order to explore dimensionality of the scale with eigen value over one .There were four factor loadings observed. Items 6, 7 and 10 were loaded to factor 1 representing “teaching dimension of mathematical authority”. Items 1, 3 and 4 were loaded to factor 2 representing “classroom environment dimension of mathematical authority”. Items 2 and 5 were on factor 3 representing “teachers’ knowledge dimension of mathematical authority”. Lastly items 8 and 9 were loaded to factor 4 representing “doing mathematics dimension of mathematical authority”. The dimensions derived from the exploratory factor analysis represent the distribution of mathematical authority concept in a way that in a learning environment where mathematical authority is exercised by students, teachers should arrange teaching practices accordingly, create a positive learning environment where students do mathematics and can discuss teachers’ knowledge on mathematical concepts. Therefore, four observed factors were accepted as an evidence for construct validity of this scale since each factor was derived from the definition of where mathematical authority resides in. Factor loadings are given in Table 6.

Table 6

Factor Loadings of the Distribution of Mathematical Authority Scale

Item Number	FACTOR 1	2	3	4
7	.86			
6	.74			
10	.71			
3		.81		
1		.70		
4		.63		
5			.85	
2			.82	
8				.91
9				.76

When the reliability issue was considered for each subscale, Cronbach's alpha coefficients were .72, .66, .45 and .67 respectively. Item total correlations for the first subscale varied between .50 and .56. For the second subscale, item total correlations varied between .39 and .51. See Appendix F for the final version of the scale.

The External Pressures Perceived by Teachers Scale

As the last scale, the External Pressures Perceived by Teachers Scale was developed by the researcher. In this scale, it was aimed to determine external pressures affecting what the teachers do in classroom in general as well as metacognitive perspective. The reason was to find out which particular sources of pressures were most negatively affecting learning environments that teachers created.

There were total 9 items including factors affecting teaching practices of teachers. The items in this scale were formed through literature review (Lombaerts et al., 2008) and from FAMTAM developed by Ader (2009). The question asked for teachers is to state to what extent they agree or disagree that the listed factors affect their teaching practices. Example items are "change in curricular and teaching approach", "time pressure", "students' negative attitudes towards subject matter" and "varied expectations of parents".

All items within this scale were developed as five-point Likert type. Items were scored as 5 for "strongly agree", 4 for "agree", 3 for "neutral", 2 for "disagree", and, 1 for "strongly disagree". The scores for each item were added to get a total score. An individual total score for a teacher varied between minimum 9 and maximum 45. Higher scores on this scale indicated high level of pressure perceived by teachers. For the sake of conciseness, in the following sections, higher scores will be referred to as high pressure perceived by teachers.

According to the field and language experts' feedback on the appropriateness of the items the scale was revised, wording of certain items were changed. The first pilot implementation was conducted for this scale as well. For External Pressure Perceived by Teachers Scale, Cronbach's alpha coefficient for reliability was calculated as .76. The item total correlations varied between .27 and .54. Expert opinions were obtained again. It was decided to alter the question asked at the beginning of the scale. However, the sequence and content of items were not changed.

The second pilot study was conducted for measuring the psychometric properties of the scale. The reliability was calculated as α=.73. The item total correlations varied between .16 and .63.

An exploratory factor analysis with varimax rotation was run in order to explore the dimensions of the scale. When the exploratory factor analysis was run based on eigenvalues over one, the scale was found to consist of three factors. Each factor was consisted of items that represented same sources of perceived pressure. Items 2, 3, 4, 5 and 7 were loaded to factor 1 representing "internal sources of perceived pressure". Items 6, 8, 1 and 9 were loaded to factor 2 and 3 representing "external sources of perceived pressure". Two dimensions obtained from the exploratory factor analysis supported the construct mentioned in literature. Therefore, there is evidence for construct validity of this scale. The factor loadings are given in Table 7.

When the reliability of each subscale was considered, internal sources of perceived pressure subscale's reliability was calculated as α= .77. Item total correlations for this subscale varied between .41 and .71. For external sources of perceived pressure subscale's reliability, Cronbach's alpha was found as .41. Item total correlations varied between .08 and .31. See Appendix B for the final version of the scale.

Table 7

Factor Loadings of External Pressure Perceived by Teachers Scale

Item Number	FACTOR		
	1	2	3
4	.85		
3	.74		
5	.68		
7	.65		
2	.61		
8		.78	
6		.75	
1			.82
9			.78

Procedure

For the determination of profile of mathematics teachers on factors affecting promotion of metacognition, four scales representing four different component of FAMTAM were developed along with a demographic information form. The scales were developed in the light of relevant literature. Although it was derived from FAMTAM, each item for each scale was formed after an extensive literature review. Field and language expert opinions were obtained, and various revisions have been done in the scales. For validity and reliability of the scales, two pilot studies were conducted. After the results were received, they were discussed with field and language experts again. Finally, the last versions of the scales were formed.

Necessary permissions from İstanbul and Eskişehir Provincial Directorate for National Education were procured in order to implement The Teachers' Conceptualization of Metacognition Scale, The Teachers' Perceptions of Students' Features and Needs Scale, The Distribution of Mathematical Authority Scale and The External Pressure Perceived by Teachers Scale to middle and secondary school mathematics teachers for the main study.

In the main study, 314 middle and secondary school mathematics teachers participated. The web-version of the scales was received and filled out by 199 of them. The paper-version of the scales were received and filled out by 115 of them. Especially mathematics teachers who filled out paper version of the scales were asked to return the questionnaires to the principle of their schools. After data were collected, they were coded and entered to SPSS version 20. The responses from teachers were kept anonymous.

Statistical Analysis

Since the aim of the study is to determine mathematics teachers' profile on factors affecting their promotion of metacognition through developing profiling tools, descriptive, correlational and causal-comparative research designs were used .

For descriptive statistical analysis, means, standard deviations and possible range for four scales were calculated in order to describe the data set. Furthermore, the distribution of data for each scale was demonstrated through histograms. For correlational analysis, Pearson Product Moment correlation coefficient was carried out in order to seek answers for to what extent four variables were related to each other.

For causal comparative research design, group comparisons were done in order to observe how the profiling tools discriminated between scores of groups of teachers according to certain variables as gender, age, years of experience, education level, teaching level, school type. It was aimed to explore different aspects of the profiling tools. For this reason, firstly, normality test was also conducted. When the assumption of homogeneity of variances was satisfied, a one-way Analysis of Variance (ANOVA) was used. When the assumption of homogeneity of variances was violated, Brown-Forsythe F- ratio was used. In order to explore effect size, partial eta squared was calculated.

CHAPTER 5

RESULTS

The aim of the study is to describe mathematics teachers' profile on factors affecting their promotion of metacognition through developing profiling tools based on the framework FAMTAM. There were four different scales used to measure the variables as conceptualization of metacognition, perceptions of students' features and needs, distribution of mathematical authority and perceived external pressure.

In the light of the aim of this study, the results are presented through mainly descriptive statistical analysis. First of all, data gathered from demographic information form were presented. Secondly, the distribution of the scores obtained from each scale was presented through histograms. Then the correlation coefficients between variables were calculated. Furthermore, one-way ANOVA and Brown-Forsythe F-ratio were used to describe group differences.

Distributions of the Scores from Each Scale

This section provides description of the data through means, standard deviations and range for each variable obtained from the scales. The distribution of data for each variable is presented by histograms. The descriptive statistics are presented in Table 8.

Table 8

Descriptive Statistics

	N	Possible Range	Mean	Standard Deviation
Conceptualization of Metacognition	314	9-45	38.53	7.06
Perceptions of Students' Features and Needs	314	6-30	25.89	3.23
Distribution of Mathematical Authority	314	25-50	38.83	5.55
Perceived External Pressure	314	9-45	34.07	6.36

Research Question 1: What is the teachers' profile on the factors affecting mathematics teachers' promotion of metacognition? (a) How do mathematics teachers conceptualize metacognition within their teaching practices? (b) How do they perceive students' features and needs? (c) How do they distribute mathematical authority within their classrooms? (d) What is the level of external pressure perceived by mathematics teachers?

<u>Teachers' Conceptualization of Metacognition</u>

Conceptualization of metacognition was a variable measured by the Teachers' Conceptualization of Metacognition Scale. Higher scores in this scale showed that most teachers showed high conceptualization of metacognition. The range obtained from the scale was between 9 and 45. The mean score was 38.53. The standard deviation of the data was 7.06.

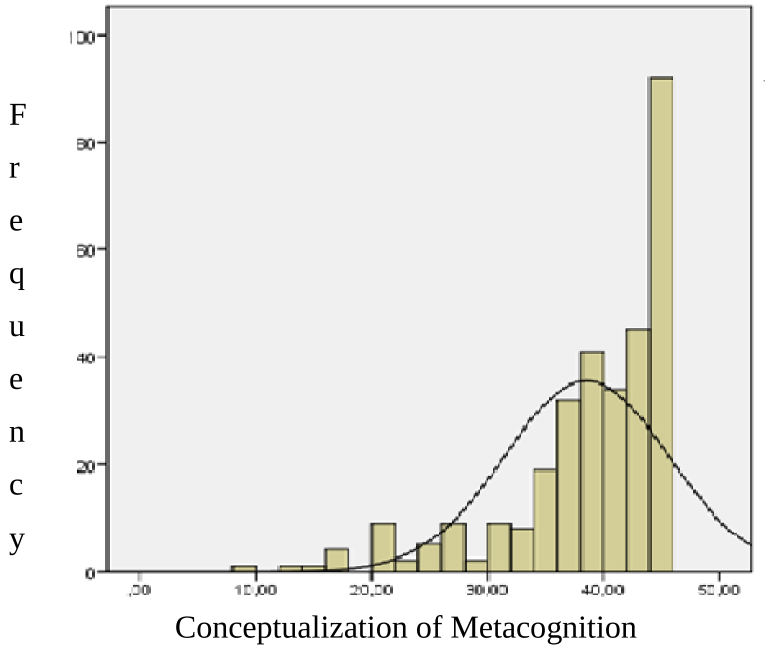

Fig. 1: Histogram of teachers' conceptualization of metacognition

The distribution of frequencies of scores from the Teachers' Conceptualization of Metacognition Scale showed that there was a negatively skewed distribution (Figure 1). This showed that most teachers in the sample demonstrated high conceptualization of metacognition. In addition, to explain the data set more specifically, the frequencies of score intervals are stated in Table 9.

Table 9

Frequencies of Score Intervals for the Teachers' Conceptualization of Metacognition Scale

Score Interval	N	%
9-20	11	3.5
21-33	40	12.7
34-45	263	83.8

For this scale, 3.5 % of participants had scores between 9 and 20, showing a low conceptualization of metacognition. 12.7 % of participants who had scores between 21-33 indicated moderate conceptualization of metacognition. Furthermore, 83.8 % of participants who received scores between 34-45 had high conceptualization of metacognition.

In addition to teachers' overall conceptualization of metacognition scores, scores for each item are presented in Table 10 in order to get detailed information on especially which components of metacognition were mainly conceptualized by the teachers.

Table 10

Descriptive Statistics of Scores for Items on the Teachers' Conceptualization of Metacognition Scale

Item Number	N	Mean	Standard Deviation
1	314	4.26	0.98
2	314	4.18	1.01
3	314	4.36	0.86
4	314	4.36	0.89
5	314	4.38	0.94
6	314	4.39	0.91
7	314	4.20	0.97
8	314	4.12	1.05
9	314	4.29	0.98

The mean and standard deviation of each item supported high conceptualization of metacognition as shown in Figure 1. Each item representing metacognition definition in literature was agreed on by most participants. When items' means were examined, it can be seen that there was no item received lower score than 4.

Teachers' Perceptions of Students' Features and Needs

Perceptions of students' features and needs was another variable operationalized by the Teachers' Perceptions of Students' Features and Needs Scale. Higher scores on this scale showed that middle and secondary school mathematics teachers had better perceptions of students' features and needs. The range obtained from the scale was between 6 and 30. The mean score was 25.89 with a standard deviation of 3.23.

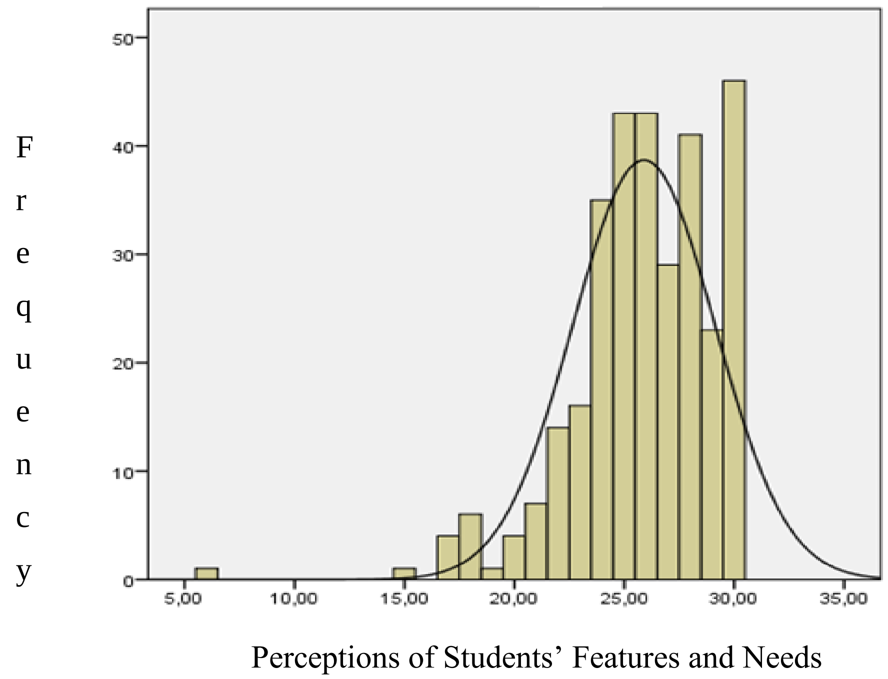

Fig. 2:Histogram of teachers' perceptions of students' features and needs

The distribution of scores from the Teachers' Perceptions of Students' Features and Needs Scale indicated a slightly negatively skewed distribution. Therefore, most middle and secondary school mathematics teachers had good perceptions on students' features and needs and acting upon accordingly. To explain the distribution of data more clearly, a frequency table was formed with respect to specific interval scores obtained from this scale in Table 11.

Table 11

Frequencies of Score Intervals for the Teachers' Perceptions of Students' Features and Needs Scale

Score Interval	N	%
6-13	1	0.3
14-22	37	11.8
23-30	276	87.9

For this scale, only 1 participant who received s score between 6-13 indicated low perceptions of students' features and needs. 11.8 % of participants who received between 14-22 indicated moderately perceived students' features and needs. In addition, students' features and needs on metacognition were recognized by most participants as well.

For further description of data, mean and standard deviations of each item on the Teachers' Perceptions of Students' Features and Needs Scale are presented in Table 12. Each item's mean showed that most participants stated they agreed or strongly agreed on each item that supported the distribution of total scores received from this scale. Therefore, most teachers seemed to be aware of metacognitive characteristics of students and acting upon with this respect.

Table 12

Descriptive Statistics of Scores for Items on the Teachers' Perceptions of Students' Features and Needs Scale

Item Number	N	Mean	Standard Deviation
1	314	4.14	0.91
2	314	4.32	0.78
3	314	4.44	0.75
4	314	4.28	0.83
5	314	4.30	0.81
6	314	4.40	0.73

Distribution of Mathematical Authority

The distribution of mathematical authority was a variable measured by the Distribution of Mathematical Authority Scale. Higher scores from this scale showed an appropriate distribution of mathematical authority within the classroom. The range of scores obtained from this scale was between 25 and 50. The mean score was 38.83 with the standard deviation of 5.55. The mode and median were both 39.

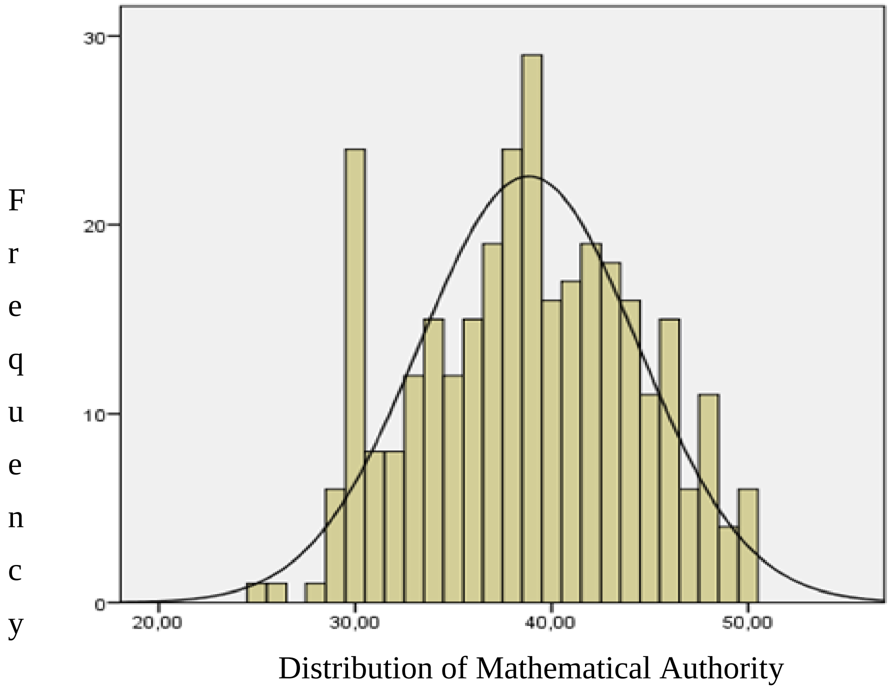

Fig. 3: Histogram of distribution of mathematical authority

The distribution of scores from the Distribution of Mathematical Authority Scale indicated that there was a normal distribution. The data were distributed normally between scores 25 and 50. For further description of data, frequencies of interval scores are given in Table 13.

Table 13

Frequencies of Score Intervals for the Distribution of Mathematical Authority Scale

Score Interval	N	%
10-22	0	0
23-37	122	38.9
38-50	192	61.1

No participant obtained between 10 and 22 scores from this scale. Mathematical authority was moderately and well distributed with 38.9 and 61.1 of teachers respectively.

To give detailed information on each statement on the scale, the mean and standard deviations for items of this scale are given in Table 14. However, it has to be emphasized that items 2, 5, 6, 7 and 10 were negative statements and they were reversely coded.

Table 14

Descriptive Statistics of Scores for Items on the Distribution of Mathematical Authority Scale

Item Number	N	Mean	Standard Deviation
1	314	4.49	0.73
2	314	2.90	1.42
3	314	4.03	1.03
4	314	4.43	0.81
5	314	3.09	1.42
6	314	4.03	1.27
7	314	3.81	1.30
8	314	3.58	1.21
9	314	4.40	0.79
10	314	4.07	1.22

The means of items 1, 3, 4, 6, 7, 9 and 10 indicated that most teachers agreed on these statements. However, the means of items 2, 5 and 8 were moderate so most teachers were neutral or indifferent to the statements: “Item 2: Teachers should not hesitate to express their lack of knowledge (statement reversed)”, “Item 5: It should be allowed to question teachers’ knowledge in mathematics classroom (statement reversed)” and “Item 8: Students should be directed to do mathematics by using problem solving strategies and methods by not in the need of mathematics teachers”. The results indicated that most teachers were neutral on the subject of students' questioning of teachers' knowledge and on a learning environment where teachers are passive, but students were active while doing mathematics.

External Pressure Perceived by Teachers

Perceived external pressure variable was operationalized with the External Pressure Perceived by Teachers Scale. In this scale, higher scores indicated high level of pressure perceived by teachers on their teaching practices. The scores obtained from this scale ranged from 9 to 45. The mean score was 34.07 with a standard deviation of 6.36. The median and mode were 34 and 36 respectively.

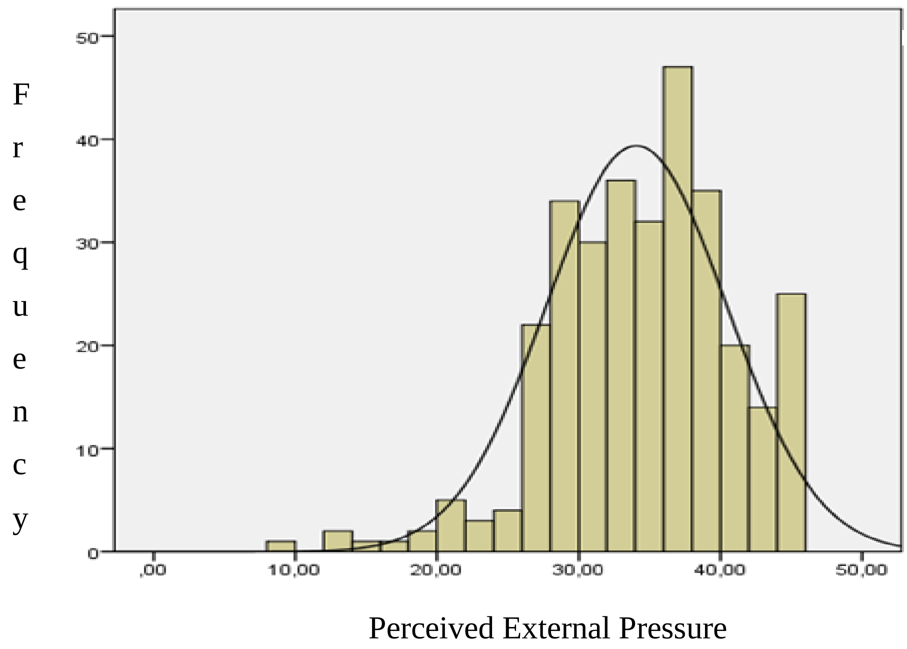

Fig. 4: Histogram of perceived external pressure

The histogram given in Figure 4 showed that the distribution of scores on the External Pressure Perceived by Teachers Scale was slightly negative skewed. This distribution mainly indicated that most participants perceived high external pressures. To explain the data set more meaningfully, both distribution of total scores on this scale on interval score bases and mean and standard deviation of each item on this scale are stated in Table 15 and Table 16 respectively.

Table 15

Frequencies of Score Intervals for the External Pressure Perceived by Teachers Scale

Score Interval	N	%
9-20	11	3.5
21-33	130	41.4
34-45	173	55.1

Table 15 indicated that 55.1 % of teachers had scores between 34-45 showing perception of high levels of external pressure. On the contrary, a relatively low percentage of teachers, 3.5 %, perceived low levels of external pressure. The rest of the participants perceived moderate levels of external pressure.

Descriptive statistics of items on this scale indicated that contents of most items i.e. issues in items 1, 2, 3, 4, 5, 6 and 9 were perceived as sources of pressure. However, most teachers indicated that moderate pressure they perceived from items 7 as “Lack of necessary sources for effective teaching” and 8 “The expectations of administration from the teachers besides to their teaching role”.

Table 16

Descriptive Statistics of Scores for Items on the External Pressure Perceived by Teachers Scale

Item Number	N	Mean	Standard Deviation
1	314	3.94	0.99
2	314	4.22	1.01
3	314	3.84	1.19
4	314	4.07	1.04
5	314	3.81	1.29
6	314	3.73	1.20
7	314	3.38	1.34
8	314	3.37	1.33
9	314	3.72	1.17

Correlation Analysis

Research Question 2: Are there significant correlations between variables of conceptualization of metacognition, perceptions of students' features and needs, mathematical authority and perceived external pressure affecting mathematics' promotion of metacognition?

In this section, the relationships between variables which can be stated as factors affecting mathematics teachers' promotion of metacognition were investigated. The correlations were used to examine to what extent two variables were related to each other. Therefore, Pearson Product Moment correlation coefficient was conducted as shown in Table 17.

Table 17

Correlation Analyses

	Conceptualization of Metacognition	Perceptions of Students' Features and Needs	Mathematical Authority	Perceived External Pressure
Conceptualization of Metacognition	1	.43**	.16**	.20**
Perceptions of Students' Features and needs		1	.21**	.23**
Distribution of Mathematical Authority			1	-.07
Perceived External Pressure				1

** Correlation is significant at the 0.01 level (2-tailed).

With the correlation analyses, the relationships between variables were revealed. First of all, when the results were examined, it was seen that there was a significant relationship between conceptualization of metacognition variable and distribution of mathematical authority variable. Although there was a significant relationship between these variables, the correlation coefficient was relatively low. Therefore, it was weak positive relationship, $r = .16$, $p < .01$. It was same with the relationship between conceptualization of metacognition variable and perceived external pressure variable, $r = .20$, $p < .01$. Perceptions of students' features and needs variable was significantly, but weakly correlated with distribution of mathematical authority variable, $r = .21$, $p < .01$. Furthermore, same situation can be observed in the relationship between perceptions of students' features and needs variable and perceived external pressure variable, $r = .23$, $p < .01$. Only non-significant correlation was found between distribution of mathematical authority variable and perceived external pressure variable.

The relationship between conceptualization of metacognition variable and perceptions of students' features and needs variable was found as significant, but there was moderate correlation between them, $r = .43$, $p < .01$. The result indicated that when the teachers had high conceptualization of metacognition, then they better perceived students' features and needs based on metacognition.

Group Comparisons

In this section, results for various group comparisons on variables based on factors affecting mathematics teachers' promotion of metacognition are presented. In this respect, the comparisons according to teachers' gender, teachers' age-group, teachers' education-level, teachers' years of experiences, the school type and teaching level on four variables conceptualization of metacognition variable, perceptions of students' features and needs variable, distribution of mathematical authority variable and perceived external pressure variable were investigated through one-way ANOVA.

Research Question 3: Is there a difference according to gender in variables of conceptualization of metacognition, perceptions of students' features and needs, distribution of mathematical authority and perceived external pressure affecting mathematics teachers' promotion of metacognition?

In order to examine gender differences on each variable, one-way ANOVA was conducted. The mean and standard deviation for gender variable are given in Table 18. The ANOVA results are presented in Table 19 and Table 20.

Table 18

Gender-Based Distribution of Measures of Variables Affecting Mathematics Teachers' Promotion of Metacognition

Variable	Gender	N	Mean	Standard Deviation
Conceptualization of Metacognition	Female	175	39.56	6.31
	Male	139	37.24	7.73
Perceptions of Students' Features and needs	Female	175	26.18	2.98
	Male	139	25.52	3.51
Distribution of Mathematical Authority	Female	175	39.38	5.50
	Male	139	38.14	5.55
Perceived External Pressure	Female	175	35.39	5.97
	Male	139	32.40	6.47

Table 19

Robust Test of Equality of Means for Gender Differences on Conceptualization of Metacognition Variable

Variable		Statistics	df1	df2	*p*
Conceptualization of Metacognition	Brown-Forsythe	8.24	1	263.96	.00

Furthermore, in conceptualization of metacognition variable, the assumption of homogeneity of variance was violated, so, the Brown-Forsythe F-ratio was reported. There were significant gender differences on conceptualization of metacognition, F (1, 263.96) = 8.24, p= .00, partial $\eta^2 = 0.03$. The conceptualization of metacognition scores of female participants (M=39.56, SD=6.31) were significantly higher than male participants' scores on the same variable (M=37.24, SD= 7.73).

Table 20

ANOVA Results for Teachers' Gender Differences on Variables Affecting Mathematics Teachers' Promotion of Metacognition

Variable	Source	SS	Df	MS	*F*	*p*
Perceptions of Students Features and needs	Between Groups	33.51	1	33.51	3.22	.07
	Within Groups	3246.81	312	10.46		
	Total	3280.32	313			
Distribution of Mathematical Authority	Between Groups	117.82	1	117.82	3.86	.05
	Within Groups	9516.23	312	30.50		
	Total	9634.05	313			
Perceived External Pressure	Between Groups	693.22	1	693.22	18.05	.00
	Within Groups	11981.23	312	38.40		
	Total	12674.46	313			

SS= sum of squares, df= degree of freedom, MS= mean of squares

No significant gender differences were found in perceptions of students' features and needs variable. However, male and female mathematics teachers showed significant differences on distribution of mathematical authority variable F (1, 312) = 8.86, p = .05, partial $\eta^2 = 0.01$. Female participants (M=39.38, SD= 5.50) showed better distribution of mathematical authority than male participants (M= 38.14, SD=5.54). Moreover, there were significant gender differences on perceived external pressures F (1, 312) = 18.052, p=. 00, partial $\eta^2 = 0.05$. Female participants (M= 35.39, SD= 5.96) perceived higher external pressure than male participants (M=32.40, SD= 6.47). Even if there was a significant difference between female and male participants on each variable, the effect sizes of gender on each variable were very small.

Research Question 4: Is there a difference according to age in variables of conceptualization of metacognition, perceptions of students' features and needs, distribution of mathematical authority and perceived external pressure affecting mathematics teachers' promotion of metacognition?

In order to search answers for age-group differences on each scale, one-way ANOVA was run. Teachers' age was grouped into four categories. The teachers were not asked their specific age, but they were expected to select most appropriate category for them among age intervals of 20-29, 30-39, 40-49 and 50 and above. The mean and standard deviations for age group on each scale are given in Table 21. Furthermore The ANOVA results are given in Table 22.

Table 21

Age-Based Distribution of Measures of Variables Affecting Mathematics Teachers' Promotion of Metacognition

Variable	Age Group	N	Mean	Standard Deviation
Conceptualization of Metacognition	20-29	103	39.00	6.85
	30-39	110	38.79	6.98
	40-49	62	39.05	6.26
	50 and above	39	35.77	8.54
Perceptions of Students' Features and needs	20-29	103	25.52	3.39
	30-39	110	26.13	3.34
	40-49	62	25.81	2.84
	50 and above	39	26.33	3.14
Distribution of Mathematical Authority	20-29	103	40.99	4.95
	30-39	110	39.05	5.47
	40-49	62	37.32	5.70
	50 and above	39	34.90	4.15
Perceived External Pressure	20-29	103	34.80	6.18
	30-39	110	33.52	6.37
	40-49	62	34.52	5.70
	50 and above	39	33.00	7.66

A one-way ANOVA was calculated on participants' scores on each variable with respect to their age groups. There was no significant difference according to age groups in conceptualization of metacognition variable, perceptions of students' features and needs variable and perceived external pressure variable.

Table 22

ANOVA Results for Teachers' Age Group Differences on Variables Affecting Mathematics Teachers' Promotion of Metacognition

Variable	Source	SS	df	MS	F	p
Conceptualization of Metacognition	Between Groups	344.15	3	114.71	2.33	.07
	Within Groups	15257.97	310	49.22		
	Total	15602.11	313			
Perceptions of students' Features and needs	Between Groups	28.08	3	9.36	.89	.45
	Within Groups	3252.25	310	10.49		
	Total	3280.32	313			
Distribution of Mathematical Authority	Between Groups	1230.25	3	410.08	15.13	.00
	Within Groups	8403.80	310	27.11		
	Total	9634.05	313			
Perceived External Pressure	Between Groups	144.79	3	48.26	1.19	.31
	Within Groups	12529.67	310	40.42		
	Total	12674.46	313			

SS= sum of squares, df= degree of freedom, MS= mean of squares

There were significant age differences found in distribution of mathematical authority variable, F(3,310)=15.127, p=.00, partial $\eta^2 = 0.13$. Post hoc comparisons using Tukey HSD test revealed that significant differences between participants in age group 20-29 and with the other three groups as participants in 30-39 age group, p=.04, d= 0.37, 40-49 age group, p=.00, d=0.68 and 50 and above age group, and p= .00, d= 1.15 respectively. The mean score for participants in age group 20-29 (M=40.99, SD= 4.95) on distribution of mathematical authority variable was significantly higher than participants in age group 30-39 (M= 39.05, SD= 5.47), participants in age group 40-49 (M=37.32, SD= 5.70) and participants in age group 50 and above (M=34.90, SD= 4.15). Furthermore, there was also significant difference between participants belonging to age group 30-39 (M= 39.05, SD= 5.47) and participants belong to age group 50 and above (M=34.90, SD= 4.15), p=.00, d=0.71, on distribution of mathematical authority variable in favor of participants in age group 30-39. However, the effect size of age on distribution of mathematical authority was low even if there are significant differences between certain age groups. The results indicated that younger teachers supported a learning environment where authority resides in mostly in mathematics.

Research Question 5: Is there a difference according to education level in variables of conceptualization of metacognition, perceptions of students' features and needs, distribution of mathematical authority and perceived external pressure affecting mathematics teachers' promotion of metacognition?

Related to this question, participants' educational level differences on each variable are presented in this section. The mathematics teachers were asked to select which level of university degree they completed; undergraduate or graduate. Therefore, a one-way ANOVA was conducted for group comparisons. The mean and standard deviations for education level variable are presented in Table 23. The ANOVA results are shown in Table 24, Table 25 and Table 26.

Table 23

Education Level-Based Distribution of Measures of Variables Affecting Mathematics Teachers' Promotion of Metacognition

Variable	Education Level	N	Mean	Standard Deviation
Conceptualization of Metacognition	Undergraduate	239	38.15	7.31
	Graduate	75	39.75	6.08
Perceptions of Students' Features and needs	Undergraduate	239	25.76	3.32
	Graduate	75	26.31	2.93
Distribution of Mathematical Authority	Undergraduate	239	38.34	5.59
	Graduate	75	40.40	5.13
Perceived External Pressure	Undergraduate	239	34.55	6.57
	Graduate	75	32.53	5.40

Table 24

Robust Test of Equality of Means for Educational Level Differences on Conceptualization of Metacognition Variable

Variables		Statistic	df1	df2	P
Conceptualization of Metacognition	Brown-Forsythe	3.53	1	146.83	.06

First of all, in conceptualization of metacognition variable and perceived external pressure variable, the assumption of homogeneity of variance was violated; therefore, the Brown

Forsythe F-ratio was reported. There was no significant effect of the education level on conceptualization of metacognition variable.

Table 25

ANOVA Results for Teachers' Education Level Differences on Variables Affecting Mathematics Teachers' Promotion of Metacognition

Variable	Sources	SS	df	MS	F	P
Perceptions of Students' Features and needs	Between Groups	16.97	1	16.97	1.62	.20
	Within Groups	3263.35	312	10.46		
	Total	3280.32	313			
Distribution of Mathematical Authority	Between Groups	242.51	1	242.51	8.07	.00
	Within Groups	9391.55	312	30.10		
	Total	9634.05	313			

SS= sum of squares, df= degree of freedom, MS= mean of squares

There was no significant education level difference found in perceptions of students' features and needs variable. A significant difference according to education level was found in distribution of mathematical authority variable, $F(1,312) = 8.06$, $p=.00$, partial $\eta^2 = 0.03$. Participants who attended to graduate studies ($M=40.40$, $SD=5.13$) distributed mathematical authority better than participants who graduated only from undergraduate studies ($M= 38.33$, $SD= 5.59$). However, the effect size of education level on distribution of mathematical authority variable was very low.

There were significant differences on perceived external pressure according to education level, F (1, 148.78) = 1.76, p =.01, partial $\eta^2 = 0.02$. External pressures perceived by participants who graduated only from undergraduate studies (M=34.55, SD= 6.57) were higher than the ones who attended to graduate studies (M=32.53, SD= 5.40). Although significant difference according to education level was found in perceived external pressure variable, the effect size was very low.

Table 26

Robust Test of Equality of Means for Educational Level Differences on Perceived External Pressure Variable

Variables		Statistic	Df1	df2	P
Perceived External Pressure	Brown-Forsythe	7.16	1	148.78	.01

Research Question 6: Is there a difference according to years of experience in variables of conceptualization of metacognition, perceptions of students' features and needs, distribution of mathematical authority and perceived external pressure affecting mathematics teachers' promotion of metacognition?

In order to see the differences on scores on each variable with respect to years of experiences of mathematics teachers, a one-way ANOVA was conducted. Specific age of teachers was not received, but the teachers were assigned to pick the appropriate years of experience interval for them for this section. The intervals of the years of experience are 1-5, 6-10, 11-15 and 15 and above. The mean and standard deviations for years of experience variable are presented in Table 27. The results are presented in Table 28, Table 29 and Table 30.

Table 27

Experience-Based Distribution of Measures of Variables Affecting Mathematics Teachers' Promotion of Metacognition

Variable	Years of Experience	N	Mean	Standard Deviation
Conceptualization of Metacognition	1-5	87	38.31	7.33
	6-10	55	39.02	5.85
	11-15	78	38.91	6.99
	16 and above	93	38.11	7.60
Perceptions of Students' Features and Needs	1-5	87	25.18	3.67
	6-10	55	26.27	2.99
	11-15	78	25.86	3.23
	16 and above	93	26.31	2.85
Distribution of Mathematical Authority	1-5	87	40.73	5.32
	6-10	55	38.96	4.84
	11-15	78	38.59	6.35
	16 and above	93	37.18	4.94
Perceived External Pressure	1-5	87	34.95	5.53
	6-10	55	33.02	7.10
	11-15	78	34.22	6.25
	16 and above	93	33.75	6.74

ANOVA results showed that there was no significant effect of teachers' years of experiences on teachers' conceptualization of metacognition, on their perceptions of students' features and needs and on perceived external pressure.

Table 28

ANOVA Results for the Differences between Teachers' Years of Experiences on Variables Affecting Mathematics Teachers' Promotion of Metacognition

Variable	Source	SS	df	MS	*F*	*p*
Conceptualization of Metacognition	Between Groups	45.17	3	15.06	0.30	.83
	Within Groups	15544.90	309	50.31		
	Total	15590.07	312			
Perceptions of Students Features and needs	Between Groups	68.01	3	22.67	2.19	.09
	Within Groups	3195.37	309	10.34		
	Total	3263.39	312			

SS= sum of squares, df= degree of freedom, MS= mean of squares

Table 29

Robust Test of Equality of Means for Years of Experiences Differences on Distribution of Mathematical Authority Variable

Variable		Statistic	df1	df2	*p*
Distribution of Mathematical Authority	Brown-Forsythe	6.57	3	282.90	.00

The assumption of homogeneity of variances was violated on distribution of mathematical authority variable. Therefore, the Brown-Forsythe F-ratio was reported. There was a significant effect of teachers' years of experience on distribution of mathematical authority within the classroom F (3, 282.90) = 6.57, p=.00, partial $\eta^2 = 0.06$. Since homogeneity of variances could not be assumed, Games-Howell post hoc tests were used. The test results showed that only a significant difference was found between participants who had 1-5 years of experience, and participants who had 16 and above of experience, p=.00, d = 0.69. Therefore, it could be stated that teachers who had 1-5 years of experience (M=40.73, SD=5.32) distributed mathematical authority better than teacher who had 16 and above of experience (M=37.18, SD = 4.94). Although significant difference according to years of experiences was found on distribution of mathematical authority, the effect size of years of experience on this variable was found as very low.

Table 30

ANOVA Results for the Differences between Teachers' Years of Experiences on Perceived External Pressure Variable

Variable	Source	SS	df	MS	*F*	*p*
Perceived External Pressure	Between Groups	139.90	3	46.63	1.15	.33
	Within Groups	12533.40	309	40.56		
	Total	12673.31	312			

SS= sum of squares, df= degree of freedom, MS= mean of squares

Research Question 7: Is there a difference according to teaching levels in variables of conceptualization of metacognition, perceptions of students' features and needs, distribution of mathematical authority and perceived external pressure affecting mathematics teachers' promotion of metacognition?

For this question, it was investigated whether middle school mathematics teachers and secondary school teachers differed from each other on four variables affecting their promotion of metacognition or not. The mean and standard deviation for teaching level variable are presented in Table 31. Therefore, a one-way ANOVA was conducted. The results are presented in Table 32, Table 33 and Table 34.

Table 31

Teaching Level-Based Distribution of Measures of Variables Affecting Mathematics Teachers' Promotion of Metacognition

Variable	Teaching Level	N	Mean	Standard Deviation
Conceptualization of Metacognition	middle school	161	39.92	6.35
	secondary school	153	37.07	7.48
Perceptions of Students' Features and Needs	middle school	161	26.24	3.27
	secondary school	153	25.53	3.17
Distribution of Mathematical Authority	middle school	161	39.76	5.71
	secondary school	153	37.86	5.22
Perceived External Pressure	middle school	161	34.80	6.98
	secondary school	153	33.30	5.56

Table 32

Robust Test of Equality of Means for Teaching Level Differences on Conceptualization of Metacognition Variable

Variables		Statistic	df1	df2	p
Conceptualization of Metacognition	Brown-Forsythe	13.21	1	298.46	.00

For conceptualization of metacognition variable and perceived external pressure variable, the Brown-Forsythe F-ratio was used since the assumption of homogeneity of variance was broken showed in Table 32 and Table 34. It was found that there was significant effect of teaching levels of mathematics teachers on conceptualization of metacognition variable, F (1,298.464) = 13.209, p= .00, partial $\eta^2 = 0.04$ and on perceived external pressure, F (1, 302.829) = 4.46, p= .04, partial $\eta^2 = 0.01$. First of all, middle school mathematics teachers (M=39.92, SD=6.35) showed higher conceptualization of metacognition than secondary school mathematics teachers (M=37.07, SD=5.22). Furthermore, perceived external pressure was higher for middle school mathematics teachers (M=34.80, SD=6.98) than secondary school mathematics teachers (M=33.30, SD=5.56). Low effect sizes of teaching level were also found on conceptualization of metacognition and perceived external pressure variables.

ANOVA results indicated that middle school mathematics teachers and secondary school mathematics teachers differed from each other on their perceptions of students' features and needs variable, F (1,312) = 3.771, p=.05, partial $\eta^2 = 0.01$. Middle school mathematics teachers (M=26.24, SD=3.27) perceived students' features and needs better than secondary school mathematics teachers (M=25.53, SD=3.18). Furthermore, a significant difference according to teaching levels was observed in distribution of mathematical authority variable, $F(1,312) = 9.46$, $p=.00$, partial $\eta^2 = 0.03$. Mean scores of middle school mathematics teachers' distribution of mathematical authority (M=39.76, SD= 5.71) were better than mean scores of secondary school mathematics teachers' distribution of mathematical authority (M= 37.86, SD=5.22). Although the significant differences between teaching levels on perceived students' features and needs variable and distribution of mathematical authority variable were found, the effect sizes of teaching level on these variables were calculated as very low.

Table 33

ANOVA Results for Teachers' Teaching Level Differences on Variables Affecting Mathematics Teachers' Promotion of Metacognition

Variable	Sources	SS	df	MS	F	p
Perceptions of Students' Features and Needs	Between Groups	39.17	1	39.17	3.77	.05
	Within Groups	3241.15	312	10.39		
	Total	3280.32	313			
Distribution of Mathematical Authority	Between Groups	283.66	1	283.66	9.46	.00
	Within Groups	9350.39	312	29.97		
	Total	9634.05	313			

SS= sum of squares, df= degree of freedom, MS= mean of squares

Table 34

Robust Test of Equality of Means for Teaching Level Differences on Perceived External Pressure Variable

Variables		Statistic	df1	df2	p
Perceived External Pressure	Brown-Forsythe	4.46	1	302.83	.04

Research Question 8: Is there a difference according to school types in variables of conceptualization of metacognition, perceptions of students' features and needs, distribution of mathematical authority and perceived external pressure affecting mathematics teachers' promotion of metacognition?

In this section, teachers working at public school and teachers working at private school are compared in terms of the variables of teachers' conceptualization of metacognition, their perceptions of students' features and needs, distribution of mathematical authority and perceived external pressure. A one-way ANOVA was conducted to examine the differences between school types, as private or public, teachers working at. Mean and standard deviation values are shown in Table 35. The results are given in Table 36 and 37.

Table 35

School-Based Distribution of Measures of Variables Affecting Mathematics Teachers' Promotion of Metacognition

Variable	School Type	N	Mean	Standard Deviation
Conceptualization of Metacognition	Private	34	40.70	4.30
	Public	280	38.27	7.29
Perceptions of Students' Features and needs	Private	34	26.68	2.37
	Public	280	25.80	3.32
Distribution of Mathematical Authority	Private	34	39.23	4.61
	Public	280	38.78	5.66
Perceived External Pressure	Private	34	31.62	6.68
	Public	280	34.37	6.27

Table 36

Robust Test of Equality of Means for School Type Differences on Conceptualization of Metacognition Variable

Variable		Statistic	df1	df2	p
Conceptualization of Metacognition	Brown-Forsythe	8.09	1	59.22	.01

The assumption of homogeneity of variances was violated on conceptualization of metacognition variable. Therefore, the Brown-Forsythe F-ratio was reported given in Table 36. There was a significant effect of school type on conceptualization of metacognition variable, F (1, 59.22) = .01, partial $\eta^2 = 0.01$. Mathematics teachers working at a private school (M= 40.70, SD= 4.30) had higher conceptualization of metacognition than mathematics teachers working at a public school (M=38.27, SD= 7.29). However, the effect size of school type on conceptualization of metacognition variable was very low.

The results of one-way ANOVA indicated that there were no significant difference between mathematics teachers working at a public school and mathematics teachers working at a private school on perceptions of students' features and needs and on distribution of mathematical authority. However, mathematics teachers working at different types of school significantly differed from each other on perceived external pressure variable, F (1,312) = 5.75, p= .02, partial $\eta^2 = 0.02$. Public school mathematics teachers (M=34.37, SD= 6.27) perceived more external pressure than private school mathematics teachers (M=31.62, SD= 6.68). Calculated effect sizes of school types on perceived external pressure variable were very low although there was a significant difference between public school teachers and private school teachers on perceived external pressure variable.

Table 37

ANOVA Results for the Differences between School Types on Variables Affecting Mathematics Teachers' Promotion of Metacognition

Variable	Source	SS	df	MS	*F*	*p*
Perceptions of Students' Features and needs	Between Groups	23.48	1	23.48	2.25	.13
	Within Groups	3256.84	312	10.44		
	Total	3280.32	313			
Distribution of Mathematical Authority	Between Groups	6.23	1	6.23	.20	.65
	Within Groups	9627.83	312	30.86		
	Total	9634.05	313			
Perceived External Pressure	Between Groups	229.32	1	229.32	5.75	.02
	Within Groups	12445.14	312	39.89		
	Total	12674.46	313			

SS= sum of squares, df= degree of freedom, MS= mean of squares

CHAPTER 6

DISCUSSION AND CONCLUSION

In the light of the aim of the study, describing profiles of mathematics teachers regarding factors affecting promotion of students' metacognition was done in order to raise awareness on mathematics teachers' approaches to promotion of metacognition. The rationale for this study was to contribute towards filling the gaps in scientific knowledge on psychological and sociological factors affecting teachers' promotion of metacognition as an educational innovation through development of profiling tools. Although there are a limited number of studies on promotion of metacognition and self-regulation, the literature on supporting and hindering factors of promotion of metacognition and self-regulation is even scarcer. Promotion of metacognition is a rather new issue in literature so supportive or hampering factors are studied by a few researchers (Dignath-van Ewijk & van der Werf, 2012; Lau, 2013; Lombaerts, Engels, & van Braak, 2009; Vandevelde, Vandenbusshe, & Van Keer, 2012). Therefore, it was aimed to explore mathematics teachers' approaches towards promotion of metacognition by stating their current thoughts on these factors.

For this study, four instruments as the profiling tools were developed and validated. The data were gathered from 314 middle and secondary school mathematics teachers. The results indicated that most mathematics teachers' current thoughts on three factors namely as teachers' conceptualization of metacognition, teachers' perceptions of students' features and needs, the distribution of mathematical authority were positive. However, most mathematics teachers felt external pressures on their teaching practices. The results indicated that although most teachers have positive approaches towards promotion of metacognition, external pressure they perceived might have a negative influence on promotion of metacognition as an educational innovation. The negative factors create pressure or stress on teachers so especially teachers hesitating integrating educational changes in their classrooms may have problems with adjusting their learning environment for example with respect to promotion of metacognition (Lombaerts, Engels, & Van Braak, 2009; Pelletier, Seguin-Levesque, & Legault, 2002).

Teachers' Conceptualization of Metacognition

Teachers' profile on conceptualization of metacognition variable was described through descriptive statistics. Most participants were found to conceptualize metacognition as multiphase phenomena which include those commonly accepted principles in the relevant literature. This means most teachers stated they agreed on the importance of each component of students' metacognition within their teaching practices. It shows that teachers' beliefs about the presence of metacognition in their teaching are positive. Although the positive results might be a result of social desirability, it is important to keep in mind that the teachers are aware of the importance of metacognition in mathematics classrooms. The awareness of teachers might lead them to introduce and promote metacognitive activities within their teaching practices (Lombaerts et al., 2009). Furthermore, Dignath-van Ewijk and van der Werf (2012) stated that primary school teachers have positive attitudes towards creating and supporting constructivist and SRL environments. They supported the findings with observations and confirmed that the teachers with positive attitudes created a learning environment where SRL was promoted. However, teacher awareness or teacher belief about metacognition is a necessary, but not a sufficient condition. The reason is that there is a literature on belief systems of teachers which indicate that beliefs are not always reflected in teacher behavior (Chen, 2008; Raymond, 1997). The multi-case study of Raymond (1997) indicated that when teachers gain more experience on teaching, their beliefs on teaching mathematics nontraditionally turned into traditional mathematics teaching in their practices. As an example, classroom management concerns of a teacher shadowed the teacher's beliefs on mathematics teaching and learning negatively. Therefore, from this finding, it can be stated that better teachers' conceptualization of metacognition parallel to those in the literature reflecting the details and sophistication might influence teachers' promotion of metacognition positively when hampering factors were diminished or eliminated.

Teachers' conceptualization of metacognition was investigated through group comparisons as well to describe the sample on this variable. The results indicated that there were significant gender differences on this variable in favor of female teachers. Middle school mathematics teachers got higher points in conceptualization of metacognition variable than secondary school mathematics teachers. The higher points in conceptualization of metacognition variable showed that middle school mathematics teachers conceptualized metacognition emphasizing more importance of its components than secondary school mathematics teachers. Furthermore, a significant difference was also found between teachers working at different school types on conceptualization of metacognition in favor of mathematics teachers working at private school. It could be a result of their differences in educational experiences or working conditions since in a previously conducted study teachers working at private institutions stated having a good working condition, positive relationship with colleagues, the opportunity of reflection on their teaching and reaching their teaching goals (Karaköse & Kocabaş, 2006). Furthermore, the differences between teachers working at different school types might be a result of the fact that secondary school mathematics teachers are mostly graduates of faculties of science (111 out of 153), not of faculties of education (42 out of 153). Therefore, the differences could be explained by the educational experiences and background of teachers since it might direct teachers' beliefs on adapting educational innovations such as metacognition (Peeters et al., 2013).

Teachers' Perceptions of Students' Features and Needs

Teachers' perceptions of students' features and needs was explored through descriptive statistics. It was found that most participants perceived students' features and needs in terms of metacognition. They mostly stated they were aware of metacognitive characteristics of students and acting upon it. In order to promote metacognition and self-regulation, learning environments should be arranged accordingly (Lombaerts et al, 2007). However, there are certain factors in which teachers' stimulation of metacognition or self-regulation might be affected by pupil characteristics and teachers' teaching skills (Lombaerts, Engels, & van Braak, 2009). They stated that it is important to integrate students' cognitive and metacognitive characteristics in designing learning environments. As Vandevelde, Vandebussche and Van Keer (2012) stated, teachers who give priority to students' characteristics in terms of their developmental milestones, their way of knowledge construction, and participation of the learning process, are the ones taking "learning needs and experiences of students as starting point" (p.1563). According to the findings of this study, it could be stated that the participants might have positive approaches on introducing metacognition in their classroom considering students' metacognitive features and needs. In perceptions of students' features and needs variable, only significant difference was found according to teaching level in favor of middle school level. The reason for the result might be the nurturing, parent-like nature of primary education (Louis, Marks, & Kruse, 1996). As they stated, the concerns in high school shift to a more academic plane.

The Distribution of Mathematical Authority within Classroom

The distribution of mathematical authority is another factor defined as affecting mathematics teachers' promotion of metacognition. Results showed the majority of participants stated good distribution of mathematical authority in which mathematics teachers guide learners to use mathematical concepts and procedures in order to reach conclusions through creating an environment where learners share their knowledge and discuss their mathematical thinking, where they become communities of practices (Schoenfeld, 1992). As Schoenfeld (1992) stated, teachers' knowledge and skills are very important to create such a learning environment. The results might be interpreted such that most participants might provide learners with a learning environment where mathematical activities, processes or problems can be interpreted and conceptualized through multiple viewpoints and where learners share and discuss their mathematical ideas through taking responsibility of their learning (Wilson & Lloyd, 2000). Lombaerts and his colleagues (2007) stated that such collaborative learning environment should be beneficial for stimulating SRL. As Lau (2013) also stated for SRL environment or promoting metacognition, teachers should give students control of their learning gradually.

When group comparisons were investigated on distribution of mathematical authority variable, there are remarkable results found. As Amid and Fried (2005) pointed out when authority in classroom is discussed, most people imagine the teacher as "the head of a classroom" (p.145). However, they also stated that there are authorities of parents, textbooks, administrators or students. Mathematical authority also belongs to the web of authorities in a classroom. However, mathematical authority in the classroom might exist within a classroom when teacher authority as expert authority is eliminated (Amid & Fried, 2005). Therefore, mathematical authority is rather a new concept that provides a student-centered learning environment for teachers and learners (Wilson & Llyod, 2000). With educational and organizational change, it is important to investigate age, career stage, generational identity of teachers that might give an idea about the effectiveness of the changes through educators with various backgrounds (Hargreaves ,2005).

The group comparison results on distribution of mathematical authority variable indicated that the teachers who had 1-5 years of experience distributed mathematical authority better than the teachers who had 16 and above years of experience. Ghaith and Yaghi (1997) reached the same conclusion that the relationship between experience and attitudes towards integrating educational innovations into teaching practices was negative. Furthermore, Hargreaves (2005) also described teachers in their early career as more enthusiastic, optimistic and adaptive and in their later career as resistant to the changes in education.

A significant difference was found between age groups on distribution of mathematical authority as well. Younger teachers supported a classroom environment where mathematical authority is used by students better than older teachers. Younger teachers provide learner with a mathematical discourse where they can discuss mathematical ideas, they become a mathematical community. On the contrary to this finding, Mendoza (2004) stated that there was no significant difference according to age between teachers on their teaching styles consisting of expert and formal authority (Cluster 1), personal model, expert and formal authority (Cluster 2), facilitator, personal model and expert (Cluster 3) and facilitator, delegator and expert (Cluster 4). Both younger and older teachers chose cluster 1 and cluster 2 described more as a teacher-centered learning environment (Grasha, 1994).

However, the findings of this study were consistent with the difference according to teachers' level of experience on distribution of mathematical authority. Younger teachers as generally less experienced ones that had 1-5 years of experience supported students' exercises of mathematical authority better than older ones as generally experienced ones that had 16 and above years of experience.

Difference between teachers' approaches to distribution of mathematical authority according to gender was also found significant in this study. Female teachers got higher scores on distribution of mathematical authority variable than male teachers. This means that female teachers help learners to be active participants while teaching mathematics. Grasha's (1994) study on teaching styles of university teachers also supported this finding in a way that female teachers' scores on expert and formal authority were lower and on facilitator and delegator were higher than male teachers. Mendoza (2004) also confirmed that male teachers had more teacher-centered teaching styles and female teachers had more student-centered teaching styles which are desirable in a learning environment where mathematical authority is promoted.

The results of this study also indicated there was a difference between teachers' approaches to distribution of mathematical authority according to teaching levels. Middle school mathematics teachers have more positive approaches to a classroom environment where mathematical authority is well-distributed than secondary school mathematics teachers. Üredi (2006) found a significant difference between first and second level primary school teachers' teaching styles. First level primary school teachers chose student-centered teaching as Cluster 4 consisting of facilitator, delegator and expert teaching styles. He stated such differences might be a result of developmental characteristics and needs of first level primary school students. Therefore, the difference between middle and secondary mathematics teachers' role in distribution of mathematical authority might be explained with the differences between middle and secondary school students' characteristics and needs as mentioned before.

Significant difference between teachers' approaches to distribution of mathematical authority according to education level differences was also found. Mathematics teachers with a master's degree had a more positive approach to distribute mathematical authority than mathematics teachers with bachelor degree. However, Üredi's (2006) study indicated that there was no significant difference according to education level of middle school teachers on their teaching styles. Especially, teachers who graduated with a bachelor degree and with master's degree less inclined to adopt a teacher-centered teaching style. As mentioned before, such a significant difference might be a result of the difference between teachers' educational backgrounds since mathematical authority is an educational innovation in which student-centered activities such as investigation of mathematics and discussion of mathematics are fostered (Wilson & Lloyd, 2000).

External Pressure Perceived by Teachers

External pressure is highly perceived by most teachers in the sample. Especially change in curriculum, timing, content, and students' attitudes towards mathematics, classroom size, parental expectations and achievement test were found to be important factors affecting teaching practices such as promotion of metacognition. Vandevelde, Vandebussche and Van Keer (2012) also found similar factors affecting teachers' stimulation of self-regulation. They stated that reluctance to change, traditions, teachers' social and cultural background, lack of time and an overloaded curriculum and parental expectations were hindering factors. As Lombaerts, Engel and van Braak (2009) stated, school context characteristics consisting of classroom size, curriculum, parental expectations, expectations from principal and timing creates occupational stress or pressure on teachers. They stated that school context factors affect the stimulation of self-regulation or metacognition negatively.

When group comparisons were taken into account in terms of perceived external pressure, on the contrary to literature (Karaköse & Kocabaş, 2006), public school mathematics teachers perceived higher external pressure than private school teachers in this study. Karaköse and Kocabaş (2006) stated that private school teachers feel more pressure because of high expectations from them. In this study, it was found that female teachers perceived more external pressure than male teachers in parallel to occupational stress study of Antaniou, Polychroni and Vlachakis (2006). Their study indicated that female teachers perceived more occupational stress than male teachers when their workload, their students' progress and their interaction with students were considered. Furthermore, this study indicated middle and secondary school mathematics teachers also differed with respect to perceived external pressure in favor of middle school mathematics teachers. Chan, Chen and Chong (2010) also pointed out that middle school teachers perceived higher stress than secondary school teachers when the sources of stress were workload, time pressure, educational reforms, classroom management and students' learning progress. The reason for this result could be given as the characteristics of age-group taught and primary learning environment (Kokkinos, 2007).

Results showed that there were significant relationships between factors affecting promotion of metacognition. For example, conceptualization of metacognition had a significant moderate correlation with perceptions of students' features and needs and low but significant correlation with mathematical authority and perceived external pressure. Furthermore, perceptions of students' features and needs were significantly correlated with perceived external pressure and mathematical authority as well. The results were parallel to Ader's findings (2009). He stated that the psychological and sociological factors within FAMTAM are intertwined with each other. This inference was confirmed with correlation analysis once more.

Ader (2009) especially stated that teachers' perceptions of students' features and needs and teachers' conceptualization of metacognition could not be separable at some point since without conceptualizing metacognition, teachers could not act according to students' features and needs based on metacognitive characteristics. In this study, with the Teachers' Conceptualization of Metacognition Scale, it is aimed that teachers determine the place of metacognitive activities of children in their teaching practices and students' learning. Furthermore, the aim of the Teachers' Perceptions of Students' Features and Needs Scale was to examine what teachers know and do about metacognition of students in their classrooms. While developing both scales, it was considered that both variables are related since teachers' knowledge about students' metacognition and their needs with respect to the development of metacognition is highly dependent upon what teachers attach importance to the components of metacognition. Therefore, the moderate correlation between the variables of conceptualization of metacognition and perceptions of students' features and needs makes sense with the findings of Ader's study.

Limitations and Suggestions

One limitation of this study is the use of self-report instruments as the single data source. Group comparisons for factors affecting promotion of metacognition are significant, but effect sizes of the group comparisons were relatively small. The small amount of explained variances is a limitation for explaining the factors affecting promotion of metacognition (Lombaerts, Engels, & van Braak, 2009; Peeters et al., 2012). As the study of Dignath-van Ewijk and Van der Werf (2012) performed in their study, it would be informative to describe such data in-detail through using qualitative methods. For the further studies, it would be better to describe the profiles of mathematics teachers with a larger sample size in order to improve the generalizability of findings derived from the profiling tools.

Four factors on FAMTAM were derived from qualitative work with the observation of three mathematics teachers working in England. It can be another limitation because there are cultural differences between the context of the teachers that FAMTAM was developed with and the context of the mathematics teachers of whom FAMTAM was used to describe the approaches. However, such cultural differences contribute to FAMTAM since this study indicated what the current place of Turkish mathematics teachers is in the factors affecting promotion of metacognition. For further research on profiling, it might be helpful for researchers to decide what to do next and what should be done for teachers while studying promotion of metacognition.

The data were collected through two different means: Web-version and paper-version of the instruments. The reason is that firstly web-version was decided on so teachers could reach the link easily. However, it was realized that most teachers who responded through web-version of the instrument were younger ones so it was decided to use paper-version of instruments to reach a variety of teachers who had different demographic information. Therefore, paper-version of the instrument was used. For further research, it would be better to collect data from same version of the instruments for possible negative effects.

Another limitation of this study might be depending on the extent to which mathematics teachers' own metacognition affected the data collected through the scales on factors affecting promotion of metacognition. While self-report instruments are filled out, it is necessary to use metacognitive skills to reflect and to question one's own thinking. The profiling tools consist of statements on teachers' teaching practices. For further research, researchers could examine the relationship between teacher metacognition and the self-report instruments on factors affecting promotion of metacognition.

The study showed that mathematics teachers have already had positive approaches towards promotion of metacognition with respect to conceptualization of metacognition variable, perceptions of students' features and needs variables and distribution of mathematical authority variable. However, perceived external pressure might have negative influence on their teaching practices. As a possible next major step in research on teachers' promotion of metacognition, investigation of the extent to which these variables affect promotion of metacognition can be suggested. Therefore, teachers' promotion of metacognition can be modelled using the factors affecting promotion of metacognition.

Profiling tools developed in this study can be used for designing in-service training. An intervention for mathematics teachers can be done based on the results of the study. In addition, developed profiling tools might be used in an intervention for mathematics teachers for helping them to create a learning environment where positive factors were supported and negative factors were eliminated. An intervention on dealing with factors affecting promotion of metacognition for one specific mathematics teacher can be also done through determination of the teacher's profile on factors affecting promotion of metacognition using these tools. Therefore, for the further research it would be better to design in-service training for mathematics teachers through benefiting from FAMTAM and profiling tools derived from FAMTAM.

The results of this study might inform researchers about where to start enabling teachers to promote students' metacognition. However, it should be considered that the positive picture appearing in this study might be resulting from teachers' ideas on how they are supposed to think. Therefore, in addition to the self-report instruments, qualitative methodology should also be used. Furthermore, the differences between teachers working at middle and secondary schools should be investigated in detail. Although significant differences on conceptualization of metacognition, perceptions of students' features and needs and perceived external pressure were found in favor of middle school mathematics teachers in comparison with secondary school mathematics teachers, why such differences occur need to be further investigated. For this reason, qualitative methods such as classroom observations and in-depth interviews can be used. Teachers' promotion of metacognition in mathematics classrooms in different levels can be explained in detail with the factors affecting promotion of metacognition. In addition to elaboration of four factors affecting promotion of metacognition, with such qualitative methods, different factors affecting promotion of metacognition might be observed and relationships can be drawn with the existing factors.

APPENDICES

Appendix A

Demographic Information Sheet

KATILIMCI BİLGİ FORMU

1- Cinsiyet

Kadın ☐ Erkek ☐

2- Aşağıdaki yaş gruplarından size uygun olanı işaretleyiniz.

20-29 ☐ 30- 39☐ 40-49 ☐ 50 ve üstü☐

3- Öğrenim durumunuz aşağıdakilerden hangisidir?

Lisans ☐ Yüksek Lisans ☐ Doktora ☐

4- Mezun olduğunuz <u>okul ve bölümü</u> lütfen belirtiniz.

………

5- Aşağıdaki mesleki kıdem gruplarından size uygun olanı işaretleyiniz.

1-5 ☐ 6-10 ☐ 11-15☐ 16 ve üstü ☐

6- Çalıştığınız kurum türünü işaretleyiniz.
Devlet ☐ Özel☐

7- Eğitim verdiğiniz seviyeyi belirtiniz.
İlkokul ☐ Ortaokul ☐ Ortaöğretim ☐

8- Eğitim verdiğiniz <u>okulun adını</u> belirtiniz.

………

9- Kaçıncı sınıflara eğitim vermekte olduğunuzu belirtiniz.

……….

Appendix B

The Teachers' Conceptualization of Metacognition Scale

AÇIKLAMA

Üst biliş (metacognition) genel olarak düşünme hakkında düşünme şeklinde açıklanan bir kavramdır. "Üst biliş, kişinin kendi bilişsel süreçleri hakkındaki bilgisi ve bu bilgiyi bilişsel süreçlerini denetlemek için kullanmasıdır" (Karakelle ve Saraç, 2010). Üst bilişsel bilgi, bilişsel süreçlerimizi nasıl gerçekleştireceğimize dair bir bilgi türüdür. Üst bilişsel bilgiler kişinin kendi özellikleri hakkındaki bilgisi, farklı bilişsel görevlerin bilgisi ve bu görevleri gerçekleştirme adına kullanılacak olan strateji bilgisi olarak tanımlanır. Üst bilişsel beceriler ise yöntemsel bilgilerdir. Üst bilişsel becerilerin kullanılması kişinin öğrenme süreçlerinin düzenlenmesi ve kontrol etmesi için gereklidir. Kontrol etme, planlama, kendini değerlendirme ve kendini gözlemleme, üst bilişsel beceriler için birer örnektir. Üst biliş ve onu oluşturan kavramlar öğretim pratiklerimizde yer alan kavramlardır. Bu araştırmada matematik sınıflarında üst bilişin teşvik edilmesini etkileyen faktörleri belirlemek hedeflenmiştir.

1 numarayı işaretlemeniz hiç katılmadığınızı, 2 numarayı işaretlemeniz katılmadığınızı, 3 numarayı işaretlemeniz ne katıldığınızı ne de katılmadığınızı (nötr olduğunuzu), 4 numarayı işaretlemeniz katıldığınızı ve 5 numarayı işaretlemeniz kesinlikle katıldığınızı göstermektedir.

Aşağıdaki ifadelerin ne derece önemli olduğuna katılma durumunuzu belirtiniz.	**1 Hiç Katılmıyorum**	**2**	**3**	**4**	**5 Kesinlikle Katılıyorum**
1-Öğrencilerin kendi düşüncelerini planlaması					
2- Öğrencilerin matematik ile uğraşırken kendini gözlemlemesi					
3-Öğrencilerin gerekirse kendi yaptıklarını tekrar düzenlemesi					
4-Öğrencilerin kendi yaptıklarını değerlendirmesi					
5-Öğrencilerin gerekli bilgiyi seçip kullanabilmesi					
6-Öğrencilerin kendi yaptıklarını kontrol etmesi					
7-Öğrencilerin matematikteki uygulamalar hakkında bilgi sahibi olması					
8-Öğrencilerin strateji bilgisine sahip olması					
9-Öğrencilerin kendi bilişsel özelliklerini bilmesi					

Appendix C

Psychometric Properties of The Teachers' Conceptualization of Metacognition Scale

Table C1. Means and Standard Deviations of the Items in The Teachers' Conceptualization of Metacognition Scale

Item Number	Mean	Standard Deviation	N
1	4.53	0.72	62
2	4.55	0.62	62
3	4.55	0.69	62
4	4.65	0.55	62
5	4.55	0.74	62
6	4.69	0.62	62
7	4.45	0.86	62
8	4.48	0.80	62
9	4.52	0.78	62

Table C2. Item-total Correlations of the Items in The Teachers' Conceptualization of Metacognition Scale

Item Number	Corrected Item-Total Correlation
1	.73
2	.61
3	.80
4	.54
5	.60
6	.66
7	.62
8	.80
9	.80

Appendix D

The Teachers' Perceptions of Students' Features and Needs Scale

AÇIKLAMA

Üst biliş (metacognition) genel olarak düşünme hakkında düşünme şeklinde açıklanan bir kavramdır. "Üst biliş, kişinin kendi bilişsel süreçleri hakkındaki bilgisi ve bu bilgiyi bilişsel süreçlerini denetlemek için kullanmasıdır" (Karakelle ve Saraç, 2010). Üst bilişsel bilgi, bilişsel süreçlerimizi nasıl gerçekleştireceğimize dair bir bilgi türüdür. Üst bilişsel bilgiler kişinin kendi özellikleri hakkındaki bilgisi, farklı bilişsel görevlerin bilgisi ve bu görevleri gerçekleştirme adına kullanılacak olan strateji bilgisi olarak tanımlanır. Üst bilişsel beceriler ise yöntemsel bilgilerdir. Üst bilişsel becerilerin kullanılması kişinin öğrenme süreçlerinin düzenlenmesi ve kontrol etmesi için gereklidir. Kontrol etme, planlama, kendini değerlendirme ve kendini gözlemleme, üst bilişsel beceriler için birer örnektir. Üst biliş ve onu oluşturan kavramlar öğretim pratiklerimizde yer alan kavramlardır. Bu araştırmada matematik sınıflarında üst bilişin teşvik edilmesini etkileyen faktörleri belirlemek hedeflenmiştir.

1 numarayı işaretlemeniz hiç katılmadığınızı, 2 numarayı işaretlemeniz katılmadığınızı, 3 numarayı işaretlemeniz ne katıldığınızı ne de katılmadığınızı (nötr olduğunuzu), 4 numarayı işaretlemeniz katıldığınızı ve 5 numarayı işaretlemeniz kesinlikle katıldığınızı göstermektedir.

Anketin başında verilen bilgi ve beceriler hakkındaki ifadelere ne kadar katıldığınızı belirtiniz.	**1-Hiç Katılmıyorum**	**2**	**3**	**4**	**5-Kesinlikle katılıyorum**
1-Gelişimsel süreç içinde gerçekleşir, yaş büyüdükçe onlar da gelişir.					
2-Okul öncesi dönemden itibaren eğitimin yardımıyla gelişir.					
3- Motivasyonu yüksek öğrencilerde daha çok görülmektedir.					
4-Başarılı çocuklar etkin bir şekilde kullanmaktadır.					
5- Öğretmen, problem çözme sürecinde başarılı olamayan öğrencilere bu bilgi ve becerileri kullanıp yönlendirmeler yapmalıdır.					
6-Çeşitli öğretim yöntemleri (model olma, sesli düşünme, direkt anlatma gibi) kullanarak öğrencilerin bu bilgi ve becerilerinin geliştirilmesi sağlanmalıdır.					

Appendix E

Psychometric Properties of The Teachers' Perceptions of Students' Features and Needs Scale

Table E1. Means and Standard Deviations of the Items in the Conceptualization of Metacognition Scale

Item Number	Mean	Standard Deviation	N
1	4.21	0.83	62
2	4.32	0.74	62
3	4.42	0.71	62
4	4.19	0.88	62
5	4.32	0.72	62
6	4.48	0.67	62

Table E2. Item-total Correlations of the Items in The Teachers' Perceptions of Students' Features and Needs Scale

Item Number	Corrected Item-Total Correlation
1	.53
2	.60
3	.52
4	.48
6	.63
7	.58

Appendix F

The Distribution of Mathematical Authority Scale

1 numarayı işaretlemeniz hiç katılmadığınızı, 2 numarayı işaretlemeniz katılmadığınızı, 3 numarayı işaretlemeniz ne katıldığınızı ne de katılmadığınızı (nötr olduğunuzu), 4 numarayı işaretlemeniz katıldığınızı ve 5 numarayı işaretlemeniz kesinlikle katıldığınızı göstermektedir.

Matematik sınıfında yapılanların doğru ya da yanlış olduğunu belirleme gücü matematikte olmalıdır. Böyle bir sınıf ortamı için aşağıdaki ifadelere ne kadar katıldığınızı lütfen belirtiniz.	**1-Hiç katılmıyoru m**	**2**	**3**	**4**	**5- Kesinlikle Katılıyoru m**
1-Öğretmen ve öğrencilerin birlikte sorguladıkları bir sınıf ortamı oluşturulmalıdır.					
2- Öğretmen bilmediğini göstermemelidir					
3-Öğrencilerin matematiksel süreçleri kendilerinin yönetebildiği bir sınıf ortamı oluşturulmalıdır.					
4-Öğrencilerin birbirlerinin öğrenmelerine katkı sağlayabilecekleri bir sınıf ortamı teşvik edilmelidir.					
5- Matematik sınıfında öğretmenin matematik bilgisinin sorgulanmasına izin verilmemelidir.					
6-Öğretmen matematiği sınıfta öğrencilere sadece bilgi aktararak gerçekleştirmelidir					
7-Matematik sınıfında öğrenmenin gerçekleşmesinin tek yolu öğretmenin bilgiyi öğrenciye aktarmasıdır.					
8- Öğrencilerin problem çözme strateji ve yöntemlerini kullanarak öğretmene ihtiyaç duymadan matematik yapabilmeleri sağlanmalıdır.					
9- Öğrencilerin matematiksel süreçleri değerlendirmelerine fırsat verilmelidir.					
10-Sınıfta matematik uygulamaları sadece öğretmen tarafından yapılmalıdır.					

Appendix G

Psychometric Properties of The Distribution of Mathematical Authority Scale

Table G1. Means and Standard Deviations of the Items in The Distribution of Mathematical Authority Scale

Item Number	Mean	Standard Deviation	N
1	4.48	0,70	62
2	3.47	1.35	62
3	3.87	0.91	62
4	4.45	0.80	62
5	3.60	1.36	62
6	4.50	0.76	62
7	4.16	1.03	62
8	3.56	1.14	62
9	4.37	0.68	62
10	4.32	1.07	62

Table G2. Item-total Correlations of the Items in The Distribution of Mathematical Authority Scale

Item Number	Corrected Item-Total Correlation
1	.43
2	32
3	.20
4	.50
5	.15
6	.55
7	.25
8	.20
9	.35
10	.50

Appendix H

The External Pressure Perceived by Teachers Scale

1 numarayı işaretlemeniz hiç katılmadığınızı, 2 numarayı işaretlemeniz katılmadığınızı, 3 numarayı işaretlemeniz ne katıldığınızı ne de katılmadığınızı (nötr olduğunuzu), 4 numarayı işaretlemeniz katıldığınızı ve 5 numarayı işaretlemeniz kesinlikle katıldığınızı göstermektedir.

Aşağıda verilen faktörlerin öğretim pratiklerinizi ne kadar etkilediğine katılma durumunuzu belirtiniz.	**1-Hiç katılmıyorum**	**2**	**3**	**4**	**5-Kesinlikle Katılıyorum**
1-Müfredat ve öğretim yaklaşımları değişimi					
2-Konuları yetiştirmek için zamanın kısıtlı olması					
3-İçeriğin çocukların seviyesine ağır gelmesi					
4-Öğrencilerin derse karşı negatif olmaları					
5-Sınıf mevcudunun çok olması					
6-Velilerin beklentilerinin farklı farklı olması					
7-Okulda bunun için yeterli kaynak olmaması					
8-Okul idaresinin öğretmen rolü dışındaki beklentileri					
9-Genel başarı sınavları					

Appendix I

Psychometric Properties of The Distribution of Mathematical Authority Scale

Table I1. Means and Standard Deviations of the Items in The External Pressure Perceived by Teachers Scale

Item Number	Mean	Standard Deviation	N
1	4.29	.73	62
2	4.29	.91	62
3	3.84	1.15	62
4	3.82	1.24	62
5	3.71	1.32	62
6	3.50	1.20	62
7	3.21	1.31	62
8	3.08	1.28	62
9	3.68	1.10	62

Table I2. Item-total Correlations of the Items in The External Pressure Perceived by Teachers Scale

Item Number	Corrected Item-Total Correlation
1	.17
2	.42
3	.50
4	.63
5	.53
6	.39
7	.49
8	.32
9	.16

BIBLIOGRAPHY

Ader, E. (2009). An ethnographic study of mathematics teachers' promotıon of metacognition from a constructivist perspective. Unpublished Dissertations. University of Nottingham: England.

Ader, E. (2013). A framework for understanding teachers' promotion of students' metacognition. *International Journal for Mathematics Teaching & Learning.* Retrieved August 5, 2014 from http://www.cimt.plymouth.ac.uk/journal/ader.pdf

Amit, M., & Fried, M. N. (2005). Authority and authority relations in mathematics education: A view from an 8th grade classroom. *Educational Studies in Mathematics*, *58*(2), 145-168.

Antoniou, A. S., Polychroni, F., & Vlachakis, A. N. (2006). Gender and age differences in occupational stress and professional burnout between primary and high-school teachers in Greece. *Journal of Managerial Psychology*, *21*(7), 682-690.

Azevedo, R. (2009). Theoretical, conceptual, methodological, and instructional issues in research on metacognition and self-regulated learning: A discussion. *Metacognition and Learning*, *4*(1), 87-95.

Boaler, J. (2002). Learning from teaching: Exploring the relationship between reform curriculum and equity. *Journal for research in mathematics education*, 239-258.

Bråten, I. (1991). Vygotsky as precursor to metacognitive theory: II. Vygotsky as metacognitivist. *Scandinavian Journal of Educational Research*, *35*(4), 305-320.

Chen, C. H. (2008). Why do teachers not practice what they believe regarding technology integration?. *The Journal of Educational Research*, *102*(1), 65-75.

Cleary, T. J., & Chen, P. P. (2009). Self-regulation, motivation, and math achievement in middle school: Variations across grade level and math context. *Journal of School Psychology, 47,* 291-314.

Cleary, T. J., & Zimmerman, B. J. (2004). Self-regulation empowerment program: A school-based program to enhance self-regulated and self-motivated cycles of student learning. *Psychology in the Schools, 41*(5), 537-550.

Dean, D., & Kuhn, D. (2003). *Metacognition and Critical Thinking.* ERIC #ED477930.

de Jager, B., Jansen, M., & Reezigt, G. (2005). The development of metacognition in primary school learning environments. *School effectiveness and school improvement*, *16*(2), 179-196.

Desoete, A. (2007). Evaluating and improving the mathematics teaching-learning process through metacognition. *Electronic Journal of Research in Educational Psychology*, *5*(3), 705-730.

Desoete, A., Roeyers, H., & Buysse, A.(2001). Metacognition and mathematical problem solving in grade 3. *Journal of Learning Disabilities, 34*(5), 435-449

Desoete, A., & Veenman, M. (2006). Metacognition in Mathematics: Critical issues in nature, theory, assessment and treatment. In A. Desoete & M. Veenman (Eds.), *Metacognition in mathematics education* (pp. 1–10). New York, NY: Nova Science Publishers

DeVellis, R. F. (2003). *Scale development: Theory and applications* (2nd ed.). Thousand Oaks, CA: Sage.

Dignath-van Ewijk, C., & van der Werf, G. (2012). What Teachers Think about Self-Regulated Learning: Investigating Teacher Beliefs and Teacher Behavior of Enhancing Students' Self-Regulation. *Education Research International, 2012,* 1-10.

Dinsmore, D. L., Alexander, P. A., & Loughlin, S. M. (2008). Focusing the conceptual lens on metacognition, self-regulation, and self-regulated learning. *Educational Psychology Review*, *20*(4), 391-409.

Efklides, A. (2001). Metacognitive experiences in problem solving; cognition, affect, and self-regulation. In A. Efklides, J. Kuhl, & R. Sorrentino (Eds.), *Trends and prospects in motivation research* (pp. 297-323).Dordrecht, The Netherlands: Kluwer.

Efklides, A. (2008). Metacognition: Defining its facets and levels of functioning in relation to self-regulation and co-regulation. *European Psychologist*, *13*(4), 277.

Efklides, A. (2009). The role of metacognitive experiences in the learning process. *Psicothema*, *21*(1).

Fisher, R. (1998). *Teaching thinking.* London: Cassell.

Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive–developmental inquiry. A*merican psychologist*, *34* (10), 906-911.

Fox, E., & Riconscente, M. (2008). Metacognition and self-regulation in James, Piaget, and Vygotsky. *Educational Psychology Review*, *20*(4), 373-389.

Fuchs, L. S., Fuchs, D., Prentice, K., Burch, M., Hamlett, C. L., Owen, R., & Schroeter, K. (2003). Enhancing third-grade students' mathematical problem solving with self-regulated learning strategies. *Journal of Educational Psychology, 95*(2), 306-315.

Garofalo, J., & Lester, F. K. (1985). Metacognition, cognitive monitoring, and mathematical performance. *Journal for Research in Mathematics Education, 16,* 163-176.

Ghaith, G., & Yaghi, H. (1997). Relationships among experience, teacher efficacy, and attitudes toward the implementation of instructional innovation.*Teaching and Teacher Education*, *13*(4), 451-458.

Goos, M., Galbraith, P., & Renshaw, P. (2002). Socially mediated metacognition: Creating collaborative zones of proximal development in small group problem solving. *Educational Studies in Mathematics*, *49*(2), 193-223.

Grasha, A. F. (1994). A matter of style: The teacher as expert, formal authority, personal model, facilitator, and delegator. *College teaching*, *42*(4), 142-149.

Hacker, D. J. (1998). Definitions and empirical foundations. In D. J. Hacker, J. Dunlosky and A. C. Graesser (Eds.). *Metacognition in educational theory and practice* (pp. 1-25). Mahwah, N. J.: Erlbaum Associates.

Hargreaves, A. (2005). Educational change takes ages: Life, career and generational factors in teachers' emotional responses to educational change.*Teaching and teacher education*, *21*(8), 967-983.

Hart, L. C. (2002). Preservice teachers' beliefs and practice after participating in an integrated content/methods course. *School Science and Mathematics,102*(1), 4-14.

Hartman, H. J. (2001). *Metacognition in learning and instruction: Theory, research and practice.* Dordrecht, The Netherlands: Kluwer Academic.

Hartman, H. (2002). Developing students' metacognitive knowledge and skills. In H. Hartman (ed.). *Metacognition in learning and instruction: Theory, research and practice* (pp. 33–68). Dordrecht, The Netherlands: Kluwer Academic.

Jacobse, A. E., & Harskamp,E. G. (2009). Student-controlled metacognitive training for solving word problems in primary school mathematics. *Educational Research and Evaluation: An International Journal on Theory and Practice, 15*(5), 447-463.

Jacobse, A. E., & Harskamp, E. G. (2012). Towards efficient measurement of metacognition in mathematical problem solving. *Metacognition and Learning*,*7*(2), 133-149.

Jaworski, B. (1992). Mathematics teaching: What is it?. *For the Learning of Mathematics*, *12*(1), 8-14.

Karaköse, T., & Kocabaş, İ. (2013). Özel ve devlet okullarında öğretmenlerin beklentilerinin iş doyumu ve motivasyon üzerine etkileri. *Eğitimde Kuram ve Uygulama*, *2*(1), 3-14.

Kokkinos, C. M. (2000). Job stressors, personality and burnout in primary school teachers. *British Journal of Educational Psychology, 77*, 229-243.

Kontos, S., &Nicholas, J. G. (2001). Independent problem solving in the development of metacognirion. *The Journal of Genetic Psychology*, *147*(4), 481-495.

Kramarski, B., Mevarech, Z. R., & Arami, M. (2002). The effects of metacognitive instruction on solving mathematical authentic tasks. *Educational studies in mathematics*, *49*(2), 225-250.

Ku, K. Y., & Ho, I. T. (2010). Metacognitive strategies that enhance critical thinking. *Metacognition and Learning*, *5*(3), 251-267.

Larkin, S. (2010). *Metacognition in young children*. Abingdon, Oxon: Routledge.

Lau, K. L. (2012). Instructional practices and self-regulated learning in Chinese language classes. *Educational Psychology*, *32*(4), 427-450.

Lombaerts, K., De Backer, F., Engels, N., van Braak, J., & Athanasou, J. (2009). Development of the self-regulated learning teacher belief scale. *European Journal of Psychology of Education*, *24*(1), 79-96.

Lombaerts, K., Engels, N., & Athanasou, J. (2007). Development and validation of the self-regulated learning inventory for teachers. *Perspectives in Education*, *25*(4), 29-47.

Lombaerts, K., Engels, N., & Vanderfaeillie, J. (2007). Exploring teachers' actions to promote self-regulated learning practices in primary school. *The Australian Educational and Developmental Psychologist*, *24*, 4–24.

Lombaerts, K., Engels, N., & van Braak, J. (2009). Determinants of teachers' recognitions of self-regulated learning practices in elementary education. *The Journal of Educational Research*, *102*(3), 163-174.

Louis, K. S., & Marks, H. M. (1998). Does professional community affect the classroom? Teachers' work and student experiences in restructuring schools.*American journal of education*, *106*, 532-575.

Lucangeli, D., & Cornoldi, C. (1997). Mathematics and metacognition: What is the nature of the relationship?. *Mathematical cognition*, *3*(2), 121-139.

Mevarech, Z. R. (1999). Effects of metacognitive training embedded in cooperative settings on mathematical problem solving. *The Journal of Educational Research*, *92*(4), 195-205.

Mevarech, Z. R., & Kramarski, B. (1997). IMPROVE: A multidimensional method for teaching mathematics in heterogeneous classrooms. *American Educational Research Journal*, *34*(2), 365-394.

Mayer, R. E.(1998). Cognitive, metacognitive, and motivational aspects of problem solving. *International Science, 26,* 49-63.

Montague, M. (2008). Self-regulation strategies to improve mathematical problem solving for students with learning disabilities. *Learning Disability Quarterly,31*(1), 37- 45.

Nelson, T. O. (1996). Consciousness and metacognition. *American psychologist, 51*(2), 102-116.

Authority (n.d.). *In Oxford Dictionaries Online,* Retrieved August 4, 2014, from http://www.oxforddictionaries.com/definition/english/authority

Özsoy, G., & Ataman, A. (2009). The effect of metacognitive strategy training on mathematical problem solving achievement. *International Electronic Journal of Elementary Education, 1*(2), 68-82.

Paris, S. G., & Winograd, P. (1990). How metacognition can promote academic learning and instruction. *Dimensions of thinking and cognitive instruction*, *1*, 15-51.

Peeters, J., Lombaerts, K., De Backer, F., Kindekens, A., Jacquet, W. (2013). *Impact of teacher and school determinants on self-regulated learning practices in elementary education.* Paper presented at the AERA 2013 Annual Meeting, San Francisco.

Pelletier, L. G., Séguin-Lévesque, C., & Legault, L. (2002). Pressure from above and pressure from below as determinants of teachers' motivation and teaching behaviors. *Journal of Educational Psychology*, *94*(1), 186-196.

Perels, F., Gürtler, T., & Schmitz, B. (2005). Training of self-regulatory and problem-solving competence. *Learning and Instruction*, *15*, 123-139.

Potari, D., & Jaworski, B. (2002). Tackling complexity in mathematics teaching development: Using the teaching triad as a tool for reflection and analysis.*Journal of Mathematics Teacher Education*, *5*(4), 351-380.

Raymond, A. M. (1997). Inconsistency between a beginning elementary school teacher's mathematics beliefs and teaching practice. *Journal for Research in Mathematics Education*, *28*(5), 550-576.

Reeve, R. V., & Brown, A. L. (1985). Metacognition reconsidered: Implications for intervention research. *Journal of Abnormal Child Psychology, 13*(3), 343-356.

Schoenfeld, A. H. (1992). Learning to think mathematically: Problem solving, metacognition, and sense making in mathematics. In D. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 334-370). New York: Macmillan.

Schraw, G. (1998). Promoting general metacognitive awareness. *Instructional Science*, *26*(1-2), 113-125.

Schraw, G., Crippen, K. J., & Hartley, K. (2006). Promoting self-regulation in science education: Metacognition as part of a broader perspective on learning. *Research in Science Education*, *36*(1-2), 111-139.

Üredi, L. (2006). *İlköğretim I. ve II. kademe öğretmenlerinin öğretim stili tercihlerine göre öğretmenlik mesleğine ilişkin algılarının incelenmesi*. (Unpublished doctoral dissertation). Marmara Üniversitesi Eğitim Bilimleri Enstitüsü, İstanbul

Vandevelde, S., Vandenbussche, L., & Van Keer, H. (2012). Stimulating self-regulated learning in primary education: Encouraging versus hampering factors for teachers. *Procedia-Social and Behavioral Sciences*, *69*, 1562-1571.

Van De Walle, J. A., Karp, K. S. & Bay-Williams, J. M. (2010). *Elementary and middle school mathematics: Teaching developmentally* (7th ed). Boston: Allyn and Bacon/Pearson Education.

Veenman, M. V. J., & Spaans, M. A. (2005). Relation between intellectual and metacognitive skills: Age and task differences. *Learning and individual differences*, *15*(2), 159-176.

Veenman, M. V. J., Van Hout-Wolters, B. H. A. M., & Afflerbach, P. (2006). Metacognition and learning: conceptual and methodological considerations. *Metacognition Learning, 1,* 3-14.

Veenman, M. V. J., Wilhelm, P., & Beishuizen, J. J. (2004). The relation between intellectual and metacognitive skills from a developmental perspective. *Learning and Instruction, 14,* 89-109.

Whitebread, D., Coltman, P., Pino Pasternak, D., Sangster, C., Grau, V., Pingham, S., Almeqdad, Q., & Demetriou, D. (2009). The development of two observational tools for assessing metacognition and self-regulated learning in young children. *Metacognition and Learning, 4,* 63-85.

Wilson, M. S., & Lloyd, G. M. (2000). Sharing mathematical authority with students: the challenge for high school teachers. *Journal of Curriculum and Supervision, 15*(2), 146-169.

Zimmerman, B. J. (1990). Self-regulated learning and academic achievement: An overview. *Educational Psychologist*, *25*(1), 3-17

Zimmerman, B. J. (2000). Attaining self-regulation: A social cognitive perspective. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), Handbook of self-regulation. San Diego: CA: Academic Press.

Zimmerman, B. J., & Moylan, A. R. (2009). Self-regulation: Where metacognition and motivation intersect. In D. J. Hacker, J. Dunlosky, & A.C. Graesser (Eds.), *Handbook of metacognition in education* (pp. 299-315). New York, NY: Routledge.