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Enhancing Mathematics Achievement of Elementary School Students through Homework Assignments Enriched with Metacognitive Questions

Zeynep Çiğdem Özcan
Maltepe University, TURKEY
Emine Erktin
Boğaziçi University, TURKEY

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Metacognitive enrichment has become an important component of modern mathematics instruction. This study investigates the effect of homework assignments enriched with metacognitive questions on students' mathematics achievement and homework behaviors. A quasi-experimental design with pre- and post-test measures and two groups (experimental and control) was employed to investigate the effect of the enriched homework. Forty-four students, 25 boys and 19 girls, participated in the study. The students in the experimental group responded to metacognitive questions as they worked on homework that otherwise was common to both groups. First semester mathematics scores taken from students' report cards were used as a pre-test of mathematics achievement; the mean of second and third examination scores were used as a post-test. The results revealed a significant difference between the mathematics scores of students who had been given homework assignments enriched with metacognitive questions and those who had not been given such homework.

Keywords: homework assignments, metacognition, metacognitive questions, mathematics achievement

INTRODUCTION

Improving student performance in mathematics is a central goal for Turkish education. The need for better instruction is demonstrated repeatedly in the periodic assessments conducted by the Organization for Economic Cooperation and Development (OECD, 2010); the mean mathematics scores of Turkish students are consistently lower than the scores of students from all other OECD countries. As a

Correspondence: Zeynep Çiğdem Özcan,
Faculty of Education, Maltepe University, 34857, Maltepe,
İstanbul, Turkey.
E-mail: cigdemozcan@maltepe.edu.tr
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declaration of expectations, the current mathematics curriculum for all Turkish primary schools is based on the assumption that every child can learn mathematics (MEB, 2008). There is a large body of research supporting this claim, but only if every child receives the right instruction, which always seems to include a role for metacognition (Cardella-Elawar, 1992; Cardella-Elawar, 1995; Deseote, 2007; Du Toit & Kotze, 2009; Hoe, Cheong, & Yee, 2001; Hoek, Vanden, & Terwel, 1999; King, 1990; Larson at al., 1985; Özsoy & Ataman, 2009; Van der Walt & Maree, 2007; Van der Stel, Veenman, Deelen, & Haenen, 2010). Metacognition has become an essential component of modern mathematics instruction.

State of the literature

- Metacognitive strategies seem to be an effective method for teaching mathematics.
- The effect of metacognitive strategies using self-addressed questions has been the subject of several research studies.
- Metacognitive questions can be incorporated into homework assignments to avoid the problems of implementing new methods in classrooms.

Contribution of this paper to the literature

- Homework assignments enriched with metacognitive questions has an important effect on students' mathematics achievement.
- The use of homework assignments enriched with metacognitive questions is a novel approach to metacognitive training.
- Homework assignments enriched with metacognitive questions does not add to teachers work load and does not impinge on class time dedicated to mathematics instruction.

The importance of metacognition was introduced to the world of education in the 1970s, especially through the work of Flavell (1976). Although there are many current definitions of metacognition, as Desoete and Veenman (2006) have pointed out, researchers still favor Flavell's, "the knowledge and active regulation of one's own cognitive process" (1976). Metacognitive actions are common in daily life, such as the decision to use a daily calendar as a reminder of one's obligations or the choice of a particular a strategy when studying for an exam.

In the literature, metacognition is a form of self-regulated learning. Zimmerman (1986) stated that self-regulated learners can be viewed as "metacognitively, motivationally, and behaviorally active participants in their learning." Schraw and Dennison (1994) described a two-facet model of metacognition: knowledge of cognition and regulation of cognition. Dunlosky and Metcalfe (2009) identified three facets: metacognitive knowledge, metacognitive monitoring, and metacognitive control. "Metacognitive knowledge is knowledge about a kind of cognition, e.g., knowledge about how learning operates and knowledge about how to improve learning. Metacognitive monitoring is assessing the current state of a cognitive activity like judging whether you are approaching the correct solution to a problem and assessing how well you understand what you are reading. Metacognitive control is regulating some aspects of a cognitive activity like deciding to use a new strategy to solve a difficult problem or deciding to spend more time trying to remember the answer to a trivial question" (Dunlosky & Metcalfe, 2009, p. 3).

Evidence that metacognition has an impact on learning mathematics is still growing. Metacognition was found to be instrumental when learners are faced with challenging tasks, regardless of their overload capacity and skill (Desoete & Vennman, 2006). Metacognitive training seems to be an effective method for teaching problem solving. Educators have studied the effect of metacognitive training in course content (Kincannon, Gleber, & Kim, 1999); cooperative learning activities (Kramarski & Mevarech, 2003), computer assisted instruction (Jacobse & Harskamp, 2009), web pages (Panaoura, Gagatsis, & Demetriou , 2009) and homework assignments (Bembenutty, 2009; Jacobse & Harskamp, 2009; Zimmerman & Kitsantas, 2005).

According to Legg and Locker (2009), metacognitive training is usually based on the principles proposed by Polya (1945), prompting the student to select and evaluate the effectiveness of various problem solving strategies. Like Polya, Schoenfeld (1992) also emphasized metacognition in the process of problem solving. Schoenfeld proposed a five-step process: surveying the problem, activating prior knowledge, making a plan, carrying out the plan, and checking the answer.

Based on Polya's (1957) and Schoenfeld's (1985) work, Mevarech and Kramarski (1997) recommended the use of self-addressed metacognitive questions to enhance students' mathematical reasoning. The method is called "IMPROVE," an acronym for the combined process of introducing new concepts, metacognitive questioning, practicing, reviewing, obtaining mastery of lower and higher cognitive processes, verification, and enrichment. According to IMPROVE, a teacher first introduces new concepts, theorems, and formulas by modeling a self-addressed questioning technique that employs four kinds of metacognitive questions: comprehension questions, connection questions, strategic questions, and reflection questions. Comprehension questions help students to articulate central ideas found in the problem. Connection questions help them to construct bridges between a given problem and problems solved in the past. Strategic questions refer to the strategies appropriate for solving a problem. Finally, reflection questions encourage the students to look backward during the solving process (e.g., "Why am I stuck?") and after a solution has been reached (e.g., "Does my solution make sense?"). Following the teacher's introduction, students practice these questions, either individually or in a cooperative group. At the end of each lesson the teacher reviews the main ideas and the use of metacognitive questions. The teacher evaluates students' progress frequently and, as needed, provides feedback followed by enrichment or remedial materials. A research study conducted by Mevarech and Fridkin (2006) to test the effectiveness of the IMPROVE method indicated that IMPROVE-taught students significantly outperformed their peers in mathematical knowledge, reasoning, and three measures of metacognition.

The effect of metacognitive strategies using self-addressed questions has been the subject of several research studies: (e.g. Küçük–Özcan; 2000; Özsoy, 2007; Özsoy & Ataman, 2009; Pilten, 2008). However, teachers are often reluctant to learn and adopt new strategies in their classrooms, perhaps because they feel overburdened by their course load or because they are dealing with classroom management problems. To help teachers see the value of metacognitive questions in this study, they have been incorporated into homework assignments, thus avoiding the problems of implementing new methods in classrooms. Students usually do their homework independently, without supervision (Ramdass & Zimmerman, 2011). They engage in metacognition if they reflect on why they do not understand a text or a problem and turn to strategies such as rereading or seeking help (Trautein & Köller, 2003 cited in Ramdass & Zimmerman, 2011). Generally, homework serves to reinforce academic knowledge and may promote self-regulated learning (Bembenutty, 2009; Zimmerman & Kitsantas, 2005; Walberg, Paschal, & Weinstein, 1985). Jacobse and Harskamp (2009) conducted a meta-analytical study of homework assignments in which they collected data from previous experimental studies. They found that students can develop self-regulatory behaviors from homework. They also concluded that teachers can help students to develop these behaviors by using homework logs. Data from the logs reveal the students' strengths and suggest ways to overcome weaknesses. Hence, homework is one way to improve self-regulation (Schmitz & Perels, 2011) and consequently to boost achievement in mathematics.

The present study investigates students' homework behaviors and the effect of homework assignments enriched with metacognitive questions. The research questions are:

i. Do homework assignments enriched with metacognitive questions increase students' mathematics scores?

ii. Do homework assignments enriched with metacognitive questions improve homework behaviors?

METHOD

Research design

While a true experimental design is highly desirable in scientific research, researchers in the field of education seldom have the chance to assign subjects into groups randomly or to adjust the composition of groups to meet design requirements (Baştürk, 2009). Hence, quasi-experimental design is often used in educational research. One advantage of quasi-experimental design is that the subjects, in many cases, will be unaware that they are participating in a research study. Since class groups are used "as is" in this study, potential influences from reactive conditions are minimized (Hsiao & Chang, 2003).

A quasi-experimental design with pre- and post-tests and two groups (experimental and control) was used in this study. Two classes at an elementary school were designated as the treatment and control groups. The students in the treatment group were given homework assignments enriched with metacognitive questions. The students in the control group were given the same assignments without the metacognitive questions. After the intervention, the mathematics performance and the homework behaviors of both groups were assessed.

Participants

The study was conducted in two seventh grade classrooms at a primary school in Istanbul. The majority of the students came from low socio-economic backgrounds. Most of their families had migrated from villages in Anatolia. Forty-four students, 25 boys and 19 girls, participated in the study, 22 in the experimental group and 22 in the control group. The experimental group had 13 boys and 9 girls. The control group had 11 boys and 11 girls. The mean age was 13.

Instruments

Mathematics homework behavior scale

To evaluate homework behaviors the Likert-type Mathematics Homework Behaviors Scale developed by Özcan and Erktin (2013) was used. Studies of homework behaviors often include a parental form (Power, Dombrowski, Watkins, Mautone, & Eagle, 2007) or a teacher form (Hong and Lee, 2006a, 2006b) in addition to a student form. This scale consists of a parent form and a student form. The student form of the scale consists of 16 items with three subscales (feelings about homework, punctuality and care in doing the assignment, and need for support). The parent form consists of 15 items with two subscales (student's willingness to complete the assignment and parents' feelings about the homework). Reliability and validity studies based on a sample of 298 students and 197 parents revealed desirable psychometric characteristics. Confirmatory factor analysis showed that the fit indices of the final model were satisfactory in both parent form ($X^2/sd = 2.39$; GFI = 0.88; AGFI = 0.85; RMSEA = 0.08; CFI = 0.92 and NFI = 0.88) and teacher form ($X^2/sd = 2.7$; GFI = 0.89; AGFI = 0.85; RMSEA = 0.07; CFI = 0.90 and NFI = 0.86). When the relationship between both forms of the scale and the mathematics scores of students was examined, it was found that both the student form ($r = 0.5$, $p<0.001$) and the parent form ($r = 0.64$, $p <0,001$) had significant correlations with achievement (Özcan & Erktin, 2013).

Mathematics achievement

In this study, since the purpose was to increase students' school achievement in mathematics, their first semester mathematics scores, taken from their report cards, were used as a pre-test of mathematics achievement. The second and third mathematics examinations, prepared by the classroom teacher and the investigators and administered in the second semester, were used as post-tests.

Procedure

One of the two classes functioned as the experimental group and the other as the control group. The two classroom groups, one serving as the control group and the other as the experimental group, were taught by the same teacher according to the prescribed mathematics curriculum. After the pre-test data related to homework behavior and mathematics achievement were recorded, both groups were assigned homework every weekend for a period of twelve weeks. The topics studied during this period were ratio and proportion, polygons, and statistics.

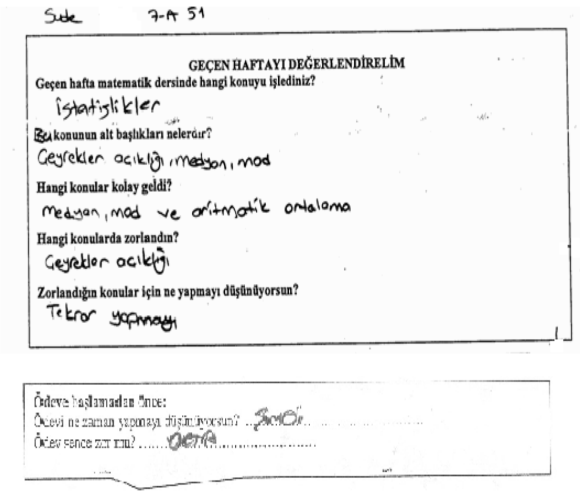
The homework assigned to the experimental group was enriched with metacognitive questions. The treatment began with an "evaluation form" on which the students had to evaluate the previous weeks' lessons by responding to the following questions:

Which main topic did you learn in your mathematics lessons last week?
What were the subtitles of this topic?
Which parts were easy?
Which parts were hard?
What do you think you should do about parts in which you had difficulty?

Then, as they started each assignment they had to answer two additional questions:

When will you start your homework?
What do you think about the difficulty of the homework assignment?

Thus the students were prompted to think about the topics they found difficult. Then, they had to decide when they were going to do the homework and determine the difficulty of the task. A sample student response is shown in Figure 1.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GEÇEN HAFTAYI DEĞERLENDİRELİM

Geçen hafta matematik dersinde hangi konuyu işlediniz?
İstatistikler

Bu konunun alt başlıkları nelerdir?
Çeyrekler açıklığı, medyan, mod

Hangi konular kolay geldi?
Medyan, mod ve aritmatik ortalama

Hangi konularda zorlandın?
Çeyrekler açıklığı

Zorlandığın konular için ne yapmayı düşünüyorsun?
Tekrar yapmayı

Ödeve başlamadan önce:
Ödevi ne zaman yapmayı düşünüyorsun? ...Şimdi...
Ödev sence zor mu? ......Orta......

EVALUATION OF PREVIOUS WEEK
Which main topic did you learn in your mathematics lessons last week? *Statistics* What were the subtitles of this topic? *Interquartile range, median and mode* Which parts were easy? *Median, mode and mean* Which parts were hard? *Interquartile range* What do you think you should do about parts in which you had difficulty? *Drill and practice*
Before starting to homework When do you think to start to do homework? *Now* Is the homework hard? *Yes*

Figure 1. One student's response to "Evaluation of the Previous Week," with translation
Note: Students responses are given in italic form

The enriched homework assignments continued with the teacher's questions about topics covered during the preceding week. The experimental groups' homework had metacognitive questions similar to those used by IMPROVE (Mevarech and Kramarski, 1997). The students were asked to mark the problems that they could not solve or had difficulty solving. [If they were able to solve a problem, they were not directed to self-directed metacognitive questions about it. Metacognitive questions seem to have no significant effect for students who already possess relevant knowledge (Camahalan, 2006; Efklides, Kiorpelidou, & Kiosseoglou, 2006; Kapa, 2001)]. Then they were asked to try solving the difficult problems again, using these metacognitive questions as a scaffold:

> Which topic is this problem related to?
> Are there any problems that resemble this one in your notebook or text book?
> If there are similar problems, what are the similarities?
> What are the differences? What do you need to know to solve this problem?

A sample student response is shown in Figure 2.

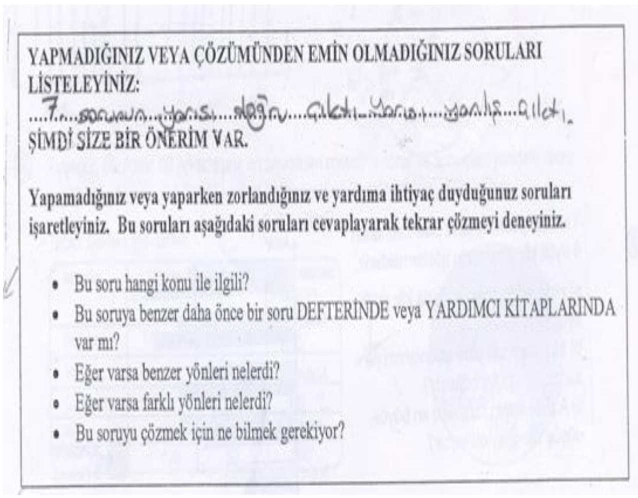
To conclude the homework, the students evaluated the homework process by answering the questions:

> When did you do your homework?
> How much time did it take to finish your homework?
> Was the homework assignment difficult?
> How many problems could you solve?
> How many problems could you not solve?

At the beginning of the following week the students would find correct answers to the homework problems on the classroom bulletin board. They recorded the number of problems they had answered correctly, the number answered incorrectly, and the number they did not complete. They concluded by writing a plan for making corrections. A sample student response is shown in Figure 3.

No metacognitive questions were given to students in the control group. The only questions they were asked to address were the content questions that were part of the homework assigned to both groups.

The data collected from the homework and the metacognitive questions were analyzed descriptively using mean scores and standard deviations. An analysis of covariance (ANCOVA), which has higher power than other techniques such as a t-test or ANOVA (Huitema, 2007), was used to test the null hypotheses at the 0.05 level of significance.


YAPMADIĞINIZ VEYA ÇÖZÜMÜNDEN EMİN OLMADIĞINIZ SORULARI LİSTELEYİNİZ:
....7....sorunun....yarısı....doğru....çıktı...yarısı....yanlış....çıktı.
ŞİMDİ SİZE BİR ÖNERİM VAR.

Yapamadığınız veya yaparken zorlandığınız ve yardıma ihtiyaç duyduğunuz soruları işaretleyiniz. Bu soruları aşağıdaki soruları cevaplayarak tekrar çözmeyi deneyiniz.

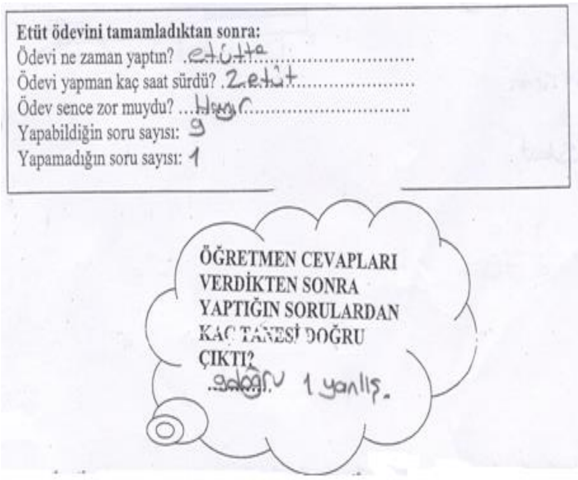
- Bu soru hangi konu ile ilgili?
- Bu soruya benzer daha önce bir soru DEFTERİNDE veya YARDIMCI KİTAPLARINDA var mı?
- Eğer varsa benzer yönleri nelerdi?
- Eğer varsa farklı yönleri nelerdi?
- Bu soruyu çözmek için ne bilmek gerekiyor?

Mark the problems that they could not solve or had difficulty in solving. Try to solve these problems again, using the following questions as a scaffold.

Half of the seventh question is wrong and the other half is right.

- Which topic is this problem related to?
- Are there any problems that resemble this one in your NOTEBOOK or TEXT BOOK?
- If there are similar problems, what are the similarities?
- What are the differences?
- What do you need to know to solve this problem?

Figure 2. One student's response to metacognitive questions, with translation
Note: Students responses are given in italic form



After completing the homework:
When did you do homework? *At study time*
How much time did it take to finish your homework? *1 hour*
Was the homework assignment difficult? *No*
How many problems could you solve? *9*
How many problems could you not solve? *1*

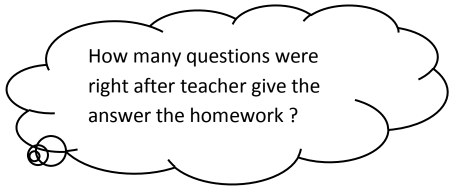


Figure 3. One student's response to the homework evaluation, with translation
Note: Students responses are given in italic form

Table 1. Means and standard deviation of the control group and the experimental group on pre- and post-test measures of mathematics

		N	M	SD
Experimental Group	Pretest of mathematics scores	21	42.38	19.79
	Posttest of mathematics scores	21	48.00	18.14
Control Group	Pretest of mathematics scores	21	48.48	25.48
	Posttest of mathematics scores	21	51.71	23.27

Table 2. ANCOVA with dependent variable post-test mathematics scores, fixed factor pre-test mathematics scores

	Type III Sum of squares	Df	Mean square	F	Partial Eta-Squared
Model	17257.28	2	8628.64	1122.33***	.98
Pre-test of mathematics	17112.42	1	17112.42	2225.63***	.98
Group	33.87	1	33.87	4.41*	.10
Error	299.86	3	7.69		
Total	17557.14	41			

**p<0,05, ***p<0,001*

RESULTS

Pre-assessment of homework behaviors and mathematics scores showed that the two groups were not significantly different prior to the intervention. There were no significant differences between their mean mathematics achievement scores (t = 0.87; p >0.05) or between their homework behaviors scores on the parent form (t = 1.28; p >0.05) and student form: (t = 0.39; p >0.05).

Pre-and post-assessments of mathematics achievement addressed the first research question: “Do homework assignments enriched with metacognitive questions increase students’ mathematics scores?” Mean scores and standard deviations are presented in Table 1.

To assess the effect of the intervention, ANCOVA was used to control for the pre-test of mathematics achievement (see Table 2). Post-test mathematics scores corrected according to pre-test scores were $\bar{X}$ = 50.76 for the experimental group and $\bar{X}$ = 48.95 for the control group.

Apart from the large main effect of the pre-test, the intervention had a significant main effect on mathematics performance ($F(1,3) = 4.41$, $p < 0.05$). Mathematics scores of students in the experimental group, those given homework enriched with metacognitive questions, were higher than the scores of students in the control group. Partial eta-squared values, independent of pre-test scores from different groups (experimental and control), explain 11% of the variance in the mathematics scores.

A comparison of post-test homework behavior scores (parent form) of the experimental and control groups addressed the second set of research questions: "Do homework assignments enriched with metacognitive questions improve homework behaviors?" and "How do homework behaviors differ in experimental and control groups?"

First the means of pre- and post-test homework behavior scores and standard deviations were calculated. Table 3 shows the results for both groups.

ANCOVA was used to assess the effect of the intervention, controlling for pre-test scores (parent form) for homework behaviors (see Table 4). Post-test homework behaviors scores (parent form), corrected according to pre-test scores, were $\overline{X}$ = 44.23 for the experimental group and $\overline{X}$ = 43.70 for the control group.

ANCOVA results showed that when the effect of the pre-test was controlled the intervention had no significant main effect on the students' homework behaviors scores (parent form) ($F(1,17) = 0.03$, $p > 0.05$). The homework behaviors scores (parent form) of students in the experimental group were not significantly different from those of students in the control group. Partial eta-squared values, independent of pre-test scores from different groups (experimental and control) did not explain the variability in the mathematics scores.

In addition to homework behaviors scores from the parent form, scores from the student form were also compared. First the means of pre- and post-test homework behavior scores and standard deviations were calculated. Table 5 shows the results for both groups.

Table 3. Means and standard deviations for pre- and post-test measures of mathematics homework behaviors (parent form)

		N	M	SD
Experimental group	Pre-test of mathematics homework behaviors scores (parent from)	15	38.47	9.72
	Post-test of mathematics homework behaviors scores (parent from)	15	42.60	12.22
Control group	Pre-test of mathematics homework behaviors scores (parent from)	5	44.40	5.64
	Post-test of mathematics homework behaviors scores (parent from)	5	48.60	6.50

Table 4. ANCOVA with dependent variable post-test homework behaviors scores, fixed factor pre-test homework behavior scores (parent form)

	Type III Sum of squares	Df	Mean square	F	Partial Eta-Squared
Model	1889.91	2	944.96	31.88***	.79
Pre-test of homework behaviors (parent form)	1754.91	1	1754.91	59.21***	.77
Group	.97	1	.97	.03**	.00
Error	503.89	17	29.64		
Total	2393.80	19			

****p<0.001, **p>0.05*

Table 5. Means and standard deviations for pre- and post-test measures of mathematics homework behaviors (student form)

		N	M	SD
Experimental group	Pre-test of mathematics homework behaviors scores (student from)	19	52.00	10.24
	Post-test of mathematics homework behaviors scores (student from)	19	55.37	8.47
Control group	Pre-test of mathematics homework behaviors scores (student from)	14	53.43	10.55
	Post-test of mathematics homework behaviors scores (student from)	14	53.22	9.50

Table 6. ANCOVA with dependent variable post-test homework behaviors scores, fixed factor pre-test homework behaviors scores (student form)

	Type III Sum of squares	*Df*	Mean square	F	Partial Eta-Squared
Model	1398.07	2	699.04	18.99***	.56
Pre-test of homework behaviors (student form)	1360.67	1	1360.67	36.97***	.55
Group	75.44	1	75.42	2.05**	.06
Error	1104.11	30	36.80		
Total	2502.18	32			

****p<0.001, **p>0.05*

ANCOVA was used to assess the effect of the intervention, controlling for the homework behaviors pre-test scores (student from) (see Table 6). Post-test homework behaviors scores (student form), corrected according to pre-test scores, were $\overline{X}$ = 55.76 for the experimental group and $\overline{X}$ = 52.69 for the control group.

ANCOVA results showed that, when the effect of the pre-test was controlled, the intervention had no significant main effect on students' homework behaviors scores (student form) ($F(1,30) = 2.05$, $p > 0.05$). The homework behaviors scores (student form) of students in the experimental group were not significantly different from those of students in the control group. Partial eta-squared values, independent of pre-test scores from different groups (experimental and control), explain 6 % of the variance in the mathematics scores.

DISCUSSION

This study examined the effect of homework assignments enriched with metacognitive questions on mathematics achievement, as expressed by the research question "Do homework assignments enriched with metacognitive questions increase students' mathematics scores?". The results reveal a significant difference between the mathematics scores of students who were given homework assignments enriched with metacognitive questions and those who were not given such homework. This result is consistent with the results of earlier investigations showing that achievement in mathematics can be raised through instruction enriched with metacognitive activity (Jacobse & Harskamp, 2009; Kapa, 2002; Özsoy & Ataman, 2009; Panaoura, Gagatsis, & Demetriou, 2009).

A review of the literature suggests that attempts to improve mathematics achievement via metacognitive training has taken two directions: decontextualized metacognitive training and embedded metacognitive training. For example, Camahalan (2006) designed and implemented the Mathematics Self-Regulated Learning Program over a period of six weeks, for a total of 30 sessions. The results revealed significant improvement in mathematics achievement and mathematics self-regulated learning among students in the experimental group. However, because of the time constraints in schools and the need to move through the mathematics curriculum, most mathematics educators have preferred to embed metacognitive training in course content (Kincannon, Gleber, & Kim, 1999), through cooperative learning (Kramarski & Mevarech, 2003), computer assisted instruction (Jacobse & Harskamp, 2009), web pages (Panaoura, Gagatsis, & Demetriou , 2009), and homework (Bembenutty, 2009; Jacobse & Harskamp, 2009; Zimmerman & Kitsantas, 2005). All of these studies succeeded in raising students' mathematics achievement. The use of homework assignments enriched with metacognitive questions is a novel approach to metacognitive training that is likely to appeal to teachers because it does not add to their work load and does not impinge on class time dedicated to mathematics instruction.

Some previous research studies have shown that homework contributes to students' overall achievement. (Hill, Spencer, Alston, & Fitzgerald, 1986; Kitsantas, Cheema, & Ware, 2011). On the other hand research supported by the Organization of Economic Cooperation and Development (2004) found that students in Finland and Japan are assigned less homework than students in the United States yet out-perform the American students on standardized mathematics assessments. The students in this study are expected to learn the skills and concepts prescribed by the Turkish National Ministry of Education (MEB, 2008), but some do not have the wherewithal to do their homework correctly. While providing metacognitive training, these embedded questions help students to complete their homework and thus to raise their mathematics achievement.

The questions require students to do a certain amount of self-evaluation and revision. In this context, self-evaluation has had a positive effect on achievement. In other investigations recorded in the literature, Schunk and Ertmer (2000) found that self-evaluation contributed to improved achievement, whereas Labuhn, Zimmerman, and Hasselhorn (2010) found that self-evaluation activities had no effect on calibration or accuracy in mathematics.

Investigation of the research question "Do homework assignments enriched with metacognitive questions improve homework behaviors?" led to the conclusion that there was no significant difference between the homework behavior scores of students who had been given homework assignments enriched with metacognitive questions and those who had not been given such homework. In this study, the teacher did not give the students feedback about homework; the students evaluated their own homework. In Xu's study (2011) both student self-evaluation and teacher feedback were positively related to homework behavior and homework completion. In the present study, more teacher feedback might have effected a change in the students' homework habits. Nevertheless, the parents of students in the experimental group and the teacher of both groups reported that students in the experimental group were consistently eager to do the homework assignments. These informal reports suggest that this approach to metacognitive training can make homework more enjoyable. The study lasted for twelve weeks; perhaps a longer duration would produce higher scores in assessments of homework behaviors.

As Hattie and Timperly (2007) discovered, feedback from another person can influence learning outcomes. In this study, the teacher did not check students' answers and write feedback on their papers; the only feedback provided was an answer key for the problems assigned. The students checked their own answers and were expected to make a plan for correcting their incorrect answers, by getting help from a friend or a teacher, for example. As Labuhn, Zimmerman, and Hasselhorn (2010) pointed out, feedback positively influences self-regulatory processes in which metacognition has an important part. They found that students who received feedback were more accurate in their self-evaluative judgments than students who did not receive feedback (Labuhn et al., 2010).

To improve subsequent research, the following suggestions are offered. Interviews with students and teachers would elicit more data. The effect of homework assignments enriched with metacognitive questions might be enhanced if the duration of the study were lengthened and if the participating teachers evaluated their students' homework and gave constructive feedback.

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