Available online at:
http://www.eab.org.tr/public/ijrte/3/2/kursat_yenilmez.pdf

Educational Research Association The International Journal of Research in Teacher Education
2011, 2(3): 17-28
ISSN: 1308-951X

http://www.eab.org.tr

http://ijrte.eab.org.tr

IN-SERVICE AND PRE-SERVICE MATHEMATICS TEACHERS' OPINIONS ABOUT TEACHING OF THINKING SKILLS

(Düşünme Becerilerinin Öğretimine Yönelik Matematik Öğretmenleri ve Öğretmen Adaylarının Görüşleri)

Kürşat Yenilmez

Eskişehir Osmangazi University, Turkey

Abstract

The purpose of this study was to determine differences among in-service and pre-service mathematics teachers' opinions about teaching the thinking skills in view of their demographical characteristics. The sample of the study consists of 174 teachers and teacher candidates who are randomly selected from mathematics teachers of primary and secondary schools in Eskişehir and Eskişehir Osmangazi University Faculty of Education and master degree students without thesis. Data were collected by "Teaching the Thinking Skills Questionnaire for Mathematics Teachers" with demographical information form. ANOVA and t-test were employed to analyze the data. According to the results of the study, there were some differences among the mathematics teachers' and teacher candidates' opinions about teaching the thinking skills in view of their demographical characteristics.

Keywords: thinking skills, teaching mathematics, metacognitive skills.

Öz

Bu araştırma, ilk ve ortaöğretim matematik öğretmenleri ile öğretmen adaylarının düşünme becerileri öğretimine yönelik görüşleri ile bu görüşlerin bazı demografik değişkenlere göre farklılaşıp farklılaşmadığını belirlemek amacıyla gerçekleştirilmiştir. Araştırmanın örneklemini, Eskişehir Osmangazi Üniversitesi Eğitim Fakültesi İlköğretim Matematik bölümü 4. sınıf öğrencileri, Tezsiz Yüksek Lisans Matematik bölümü öğrencileri ile Eskişehir'de görev yapan ilköğretim ve ortaöğretim matematik öğretmenleri arasından rastlantısal olarak seçilen toplam 174 öğretmen adayı ve öğretmen oluşturmuştur. Araştırmada veri toplama aracı olarak, "Matematik Öğretmenleri için Düşünme Becerileri Öğretimi Anketi" ile bir demografik bilgi formu birlikte kullanılmıştır. Verilerin analizinde t-testi ve tek yönlü varyans analizinden yararlanılmıştır. Elde edilen bulgularla öğretmen adaylarının eğitim aldıkları kurum ve düzey ile öğretmen okulu matematik öğretmenleri ve genel lise matematik öğretmenlerine göre düşünme becerilerini öğretmeye yönelik görüşlerin ne ölçüde farklılaştığı ile ilgili sonuçlara ulaşılmıştır.

Anahtar Kelimeler: düşünme becerileri, matematik öğretimi, biliş üstü beceriler.

The subject of the development of the students' thinking skills, which is one of the most important targets of the contemporary education, is still an interesting problem. Different approaches stress that along the thinking process, activities have to be related to the use of mental abilities. So, in the developing and developed countries, qualification of the education has been a major aim to implement and trigger the use of mental factors. As a consequence, due to chancing expectations of contemporary populations, expectations about education are also changed by the everyday-updated technology and science. Therefore, nowadays in Turkey, it is a calendar topic to make updates on the education, as well. Improvements on the teacher training are also surrounded by the mentioned regeneration and update studies. Because, training of the teachers who have scientific thinking skill is the first aim on the process of transferring scientific thoughts to students.

Teacher's mission in the traditional education concept is to instruct, make exams and give grades to students. However, recent researches related to teaching activities and rapid innovations in the science and technologies naturally effected and necessitate changing of the tasks conducted by teachers. This progress forced teachers to take new responsibilities (Oğuzkan, 1989). One of these new responsibilities is to make students have effective thinking skills.

The approach of the traditional teaching in our schools generally surrounded by transferring information directly, rotting (memorizing) and so the result is passive learning. In this process of teaching and learning activities, thinking and thinking skills are generally ignored. Students whose thinking skills don't grow up adequately have difficulty in mental activities and construction of the knowledge. Nowadays it has been important topic to find a treatment method which will improve individuals' thinking skills in an efficient way. Besides, with respect to thinking efficiently, it is inadequate to teach the concepts as they stand (İnan & Özgen, 2008).

In lots of suggested modern education systems, for instance, in the student centered education, learners have an active role. Learning by questioning or discovering is in the forefront instead of rotting (memorizing) (Titiz, 1998). The mission of the educator is to orient the education and guide the process of construction of the knowledge, instead of lecturing one by one (Newman, 1998).

In the future, it can be said that teachers who can think and make thinking as a thinking point and transfer such ability to students will be too valid (Açıkalın, 1998).

Thinking process may be explained as reviewing mentally, visualization, investigate to conclude, comparing and using mental operations such as put account knowledge constructed before, assessing, remembering, to be interested in something and stickling and detecting details. It can also be perceived and soar to achieve new knowledge in addition to existing one. Thinking from this point needs reasoning and using information obtained. These abilities can be taught by the help of the teachers (Semerci, 1999).

Learning how thinks is to think differently. There is no matter how, but thinking will be achieved by construction of other skills. Lots of abilities, which can be placed to curriculum and guided on the teaching methods, are related to each other. For example, abilities like, evaluating and inductive thinking, comparing, interpreting, identifying related or unrelated things, detecting different hints, estimating the consequence, are related to each other. For advance thinking such as critical thinking, problem solving and creative thinking may require all the thinking skills (Özden, 1997).

Among the effective thinking modes, there exist some skills like logical thinking, reasoning, creative thinking, critical thinking, scientific thinking, detection of the thinking, thinking rapidly and having efficient thinking about the topic.

Presseisen (1985) distinguish thinking skills as "principal operations, problem solving, decision, critical and creative thinking". Besides, Özden (2000) addresses that thinking skills consist of critical thinking, problem solving, understanding what read, writing scientific thinking, creative thinking and creative problem solving skills. Furthermore Beyer (1988) deals with thinking skills in three stages. According to Beyer (1988), thinking abilities consist of (1) problem solving, decision and conceptualization skills, (2) critical thinking skills and (3) ability of data processing (as cited in Seferoğlu and Akbıyık, 2006).

Critical thinking is a skill helps to solve an issue with various mental operations or achieve principles and rules in terms of a number of abstraction and generalizations (Yaman, 2005 as cited in Bozdoğan, 2007).

Deduction is estimation about reasons of an observation. Our deduction has to be based on data. We collect data by observation and by means of it; we moreover deduct reasons about the observed events (Çınar, 2010).

During problem solving process, another thinking skill used by people is ability of scientific thinking. Scientific thinking involves logical and consistent thinking characteristics which are applied by someone to solve an issue (Stuessy, 1984).

It can be thought that mathematics is important and also has a role on teaching process of the mentioned thinking skills which are necessary to enable effective thinking. At every stage of the education on the development process of the students, mathematics is a pioneer lesson among the lessons which play important role on the scientific thinking to improve students' creativity by relations; interpreting and synthesizing. It is expected that educating modern individuals who have a good amount backlog on mathematics education, discover, detect, examine and constantly ready to learn, understand, use the new technologies and develop them; self directed, decide, take responsibilities of decisions and is good problem solver. Educating individuals who have the mentioned qualifications is possible by transferring skills devoted to construct knowledge instead of lecturing. The most important factor to construct knowledge is individuals' proficiency on "learning how to learn".

First of all, teachers who will provide students have thinking skills must have thinking skills. It will be helpful to give a chance to students establishing relations between lesson topics and thinking skills in the process of the development of the expressed skills and using thinking methods in the lessons. Teachers must provide a place of which students are more careful to stimulus. In addition to spoken and written things students should be permitted to make some treatments like understanding feelings, imagining and behaving intuitively (Başar, 1998 as cited in Semerci, 1999).

Metacognitive skills are to be aware of cognitive, affective and psychomotor characteristics. Approach of the thinking skill which targets to teach metacognitive skills are placed to curriculums. Mathematics teachers have advantages to teach metacognitive skills due to nature of the mathematics and its topics. Therefore in the related literature, mathematics teachers are accepted as the most important population about teaching of

thinking skills. As a teacher, using effective thinking skills, performing this and to be a model on the using metacognitive skills are very important. These skills are expected to train in the undergraduate schools. However it can be enabled by the experience of the teaching. In the light of the mentioned expectations, we aim to investigate in-service and pre-service mathematics teachers' opinions on the teaching of thinking skills. We think that our results will be important for the researchers and educators at university level insight of the curriculums.

In the existing literature, it can be seen that some researchers focus on the determining primary and secondary school teachers' thinking skills and opinions and attitudes concerning teaching of such skills, we refer Serdar (1998), Hayran (2000), Yenilmez and Ekinci (2005), Emer (2007). The aim of the present paper is to determine differences among in-service and pre-service mathematics teachers' opinions about teaching the thinking skills in view of their demographical characteristics. Thus we pose the following research questions:

- What are in-service and pre-service mathematics teachers' opinions about ordering "Logical Thinking (LT)", "Reasoning Ability (RA)", "Creative Thinking (CT)", "Critical Thinking (CRT)", "Scientific Thinking (ST)", "Detection of the Thinking (DT)", "Rapid Thinking (RT)" and "Effective Thinking About the Topic (ERAT)" skills?
- What are the opinions of the in-service and pre-service mathematics teachers on the teaching of the thinking skills?
- Is there a significant relationship between in-service and pre-service mathematics teachers' opinions and demographic variables?

Method

In this section, research model, participants, measurement instrument and data analysis are explained.

Research Model

This work is a descriptive study. In the research exploring model is used.

Participants

The sample of the study consists of 174 teachers and teacher candidates who are randomly selected from mathematics teachers of primary and secondary schools in Eskişehir and Eskişehir Osmangazi University Faculty of Education and master degree students without thesis. With respect to gender, although there exists a homogeny distribution of pre-service teachers, the majority is constituted by master degree students without thesis (% 61.8). Besides, distribution of the in-service teachers is approximately homogenous; about a half (% 48.4) of them have 1-5 year experience. The majority of the in-service teachers' employ in the primary schools and half of the majority are graduated from education faculties.

Procedure

In the data collecting process, a survey about teaching of the thinking skills, which is developed by a project group along 1999-2000, is used. This project conducted in Boğaziçi University, Faculty of Education to

determine attitudes in pilot and experience schools concerning mathematics lessons. The survey consists of three main parts. The first part involves demographic information about in-service and pre-service teachers. In the second part there are eight thinking skills; Logical Thinking (LT), Reasoning Ability (RA), Creative Thinking (CT), Critical Thinking (CRT), Scientific Thinking (ST), Detection of the Thinking (DT), Rapid Thinking (RT) and Effective Thinking about the Topic (ERAT). It was asked to participants to order and give grades to items from 1 to 8 with respect to importance of the skills. The third part has a likert scale consists of 25 items. This part aims to determine opinions of the in-service and pre-service mathematics teachers. In the project, data of the likert scale was gathered from 80 teachers and its internal consistency was examined by the researchers. The final Cronbach's alpha coefficient was found as 0.75 (Erktin, 2004). In this work, it is observed that Cronbach's alpha is; 0.67 for in-service teachers and 0.72 for pre-service teachers.

Analysis of the Data

In order to analyze the obtained data mean, frequencies, standard deviation, independent samples t-test and analysis of variance (ANOVA) are used. To investigate sources of differences in ANOVA, Tukey multiple comparison test is used.

Findings

In this section, findings derived from data analysis are presented. They are distinguished by the parts: In-service teachers' opinions and Pre-service teachers' opinions.

In-service Teachers' Opinions With Respect to Teaching of the Thinking Skills

Frequencies of Logical Thinking (LT), Reasoning Ability (RA), Creative Thinking (CT), Critical Thinking (CRT), Scientific Thinking (ST), Detection of the Thinking (DT), Rapid Thinking (RT) and Effective Thinking about the Topic (ERAT), which are ordered by 64 mathematics teachers, are presented in Table 1.

Table 1.

Frequencies of Thinking Skills Ordered by Teachers

	1	2	3	4	5	6	7	8
LT	30	13	7	7	3	3	1	0
RA	1	3	7	3	9	8	14	19
CT	8	13	12	13	5	6	5	2
CRT	1	6	6	4	10	3	16	18
ST	6	6	4	16	7	13	9	3
DT	4	9	11	5	11	16	5	3
RT	6	5	8	9	7	8	8	13
ERAT	8	9	10	7	12	6	6	6

According to frequencies, it can be seen that logical thinking is generally marked as the first by the teachers. In addition to this, creative thinking, detection of the thinking and effective thinking about the topic are placed in the upside rows. It is observed that reasoning ability, critical thinking and rapid thinking are placed in the downside rows.

Mean and standard deviation values of the likert scale which are used to determine mathematics teachers' opinions on the teaching of the thinking skills are presented in Table 2.

Table 2.

Mean and Standard Deviation Values of the Survey Items

Survey Items	Mean	S.D.
1. It is mathematics teachers' responsibility to enable students have effective thinking skills.	3,109	1,197
2. I observe that my colleagues are trying to teach thinking skills.	3,516	,976
3. Teaching of the effective thinking skills depend on students' learning capacity.	3,891	,911
4. The best way getting effective thinking skill is teaching of mathematics.	3,281	1,119
5. To be more successful in lessons, teaching effective thinking skills is necessary for students.	4,500	,563
6. Class qualification is an important factor for teaching effective thinking skills.	3,891	1,100
7. Effective thinking skill about a subject depends on an individual's background.	4,313	,814
8. Learning advance mathematics develops individual's thinking skills.	4,109	,693
9. The effect of the teacher on the development of students' thinking skill depends on teacher's proficiency on the related topic.	4,344	,781
10. Different thinking skills are necessary for the different areas.	3,797	1,042
11. An individual who learned different ways of thinking can think effective.	4,234	,904
12. People respect individuals who can think effectively.	4,516	,713
13. Individuals, who constantly criticize, prohibit the ongoing work.	4,234	,636
14. Students' deficiency on effective thinking skills depends on not to have adequate backlog.	3,375	1,000
15. To think efficiently, some general thinking skills are necessary.	3,484	1,247
16. For effective thinking, exercises and questions, which will only improve thinking skills, should be prepared.	4,172	,656
17. Materials which are used in the teaching of thinking skills should contain mathematics topics.	3,828	1,106
18. Students who have effective thinking skills are more successful on establishing piece-whole relations.	3,734	,878
19. Students who have effective thinking skills are more successful on the solving of the real world problems.	4,109	,508
20. Lesson attitude of the student is prior condition for him/her creativity and gaining effective thinking skills.	3,453	,958
21. Having inadequate background leads to ineffective thinking skills.	3,250	,992
22. Teachers' attitude on being open to new ideas leads to a class of which students can improve their thinking skills.	3,438	,957
23. Thinking skills are treated more in democratic classrooms.	4,375	,630
24. I believe that students who have thinking skills will be more successful in high school entrance tests.	4,328	,691
25. Students who have effective thinking skills determine what is needed to solve a problem by the aid of existing information.	4,328	,668

According to survey items' mean, it can be seen that teachers mostly agree on the opinions; People respect individuals who can think effectively; to be more successful in lessons, teaching effective thinking skills is necessary for students; Thinking skills are treated more in democratic classrooms and The effect of the

teacher on the development of students' thinking skill depends on teacher's proficiency on the related topic. However, it has been observed that teachers neither agree nor disagree on the items; It is mathematics teachers' responsibility to enable students have effective thinking skills; Having inadequate background leads to ineffective thinking skills and The best way getting effective thinking skill is teaching of mathematics.

Independent samples t-test is used to determine whether there exists a significant difference between teachers' opinions on the teaching of the thinking skills and employment level (elementary or secondary school). The results are presented in the Table 3.

Table 3.

t-test Results of Teachers' Opinions and Employment Level

	Employment Level	N	Mean	Std. Deviation	t	p
Item 4	Elementary School	43	3,093	1,151	2,0913	,042
	Secondary School	21	3,667	,966		
Item13	Elementary School	43	4,395	,541	-2,825	,008
	Secondary School	21	3,905	,700		
Item 19	Elementary School	43	4,186	,546	-1,978	,050
	Secondary School	21	3,952	,384		

According to Table 3, we observe that, while elementary school teachers support the opinions; Individuals, who constantly criticize, prohibit the ongoing work and Students who have effective thinking skills are more successful on the solving of the real world problems, secondary school teachers agree on "The best way getting effective thinking skill is teaching of mathematics".

One-way analysis of variance (ANOVA) is used to investigate significant difference between teachers' opinions on the teaching of the thinking skills and teaching experience. The difference analyzed by the help of the multiple comparisons; Tukey test and results are given in the Table 4.

Table 4.

Tukey Test Results of Teachers' Opinions and Teaching Experience

	Source	df	Sum of	Mean of	F	p	Difference
Item 15	Between Groups	2	11,152	5,576	3,917	,025	1-5 years>greater than 10 years
	Within Groups	61	86,833	1,423			
	Total	63	97,984				

According to Table 4, teachers who have 1-5 year experience support; to think efficiently, some general thinking skills are necessary opinion more than the teachers who have 10 year teaching experience.

One-way analysis of variance (ANOVA) and multiple comparisons test are used to determine whether there exists a significant difference between teachers' opinions and graduation school type. The results are presented in the Table 5.

Table 5.

Tukey Test Results of Teachers' Opinions and Graduation School type

	Source	df	Sum of S	Mean of S	F	p	Difference
Item 4	Between Groups	2	18,229	9,115	9,158	<,001	EF>FS
	Within Groups	61	60,708	,995			
	Total	63	78,938				EF>D
Item 9	Between Groups	2	4,260	2,130	3,802	,028	EF>FS
	Within Groups	61	34,177	,560			
	Total	63	38,438				

According to Table 5, teachers who graduated from educational faculty support the item; the best way getting effective thinking skill is teaching of mathematics and the effect of the teacher on the development of students' thinking skill depends on teacher's proficiency on the related topic opinions more than teachers who graduated from other schools.

Pre-service Teachers' Opinions With Respect to Teaching of the Thinking Skills

Frequencies of Logical Thinking (LT), Reasoning Ability (RA), Creative Thinking (CT), Critical Thinking (CRT), Scientific Thinking (ST), Detection of the Thinking (DT), Rapid Thinking (RT) and Effective Thinking about the Topic (ERAT), which are ordered by 110 pre-service mathematics teachers, are presented in Table 6.

Table 6.

Frequencies of Thinking Skills Ordered by Pre-service Teachers

	1	2	3	4	5	6	7	8
LT	29	27	16	14	10	9	1	4
RA	2	2	6	11	11	18	32	28
CT	30	18	18	13	12	13	5	1
CRT	4	10	17	12	10	17	18	22
ST	12	9	19	18	17	18	8	9
DT	15	14	7	18	21	13	11	11
RT	8	12	12	10	13	15	20	20
ERAT	9	17	14	13	16	10	16	15

According to frequencies, it can be said that pre-service mathematics teachers generally put the creative and logical thinking to upside rows. Besides, scientific thinking and effective thinking about the topic are in the upside rows, as well. However, reasoning ability and thinking rapidly skills are in the downside rows.

Mean and standard deviation values of likert scale, which are used to investigate pre-service teachers' opinions on the teaching of thinking skills, are presented in table 7.

Table 7.

Mean and Standard Deviation Values of the Survey Items

Survey Items	Mean	S.D.
1. It is mathematics teachers' responsibility to enable students have effective thinking skills.	3,973	,829
2. I observe that my colleagues are trying to teach thinking skills.	2,973	,962
3. Teaching of the effective thinking skills depend on students' learning capacity.	3,582	1,061
4. The best way getting effective thinking skill is teaching of mathematics.	3,964	,928
5. To be more successful in lessons, teaching effective thinking skills is necessary for students.	4,727	,487
6. Class qualification is an important factor for teaching effective thinking skills.	4,109	,932
7. Effective thinking skill about a subject depends on an individual's background.	4,527	,631
8. Learning advance mathematics develops individual's thinking skills.	3,973	,840
9. The effect of the teacher on the development of students' thinking skill depends on teacher's proficiency on the related topic.	4,282	,803
10. Different thinking skills are necessary for the different areas.	3,800	1,116
11. An individual who learned different ways of thinking can think effective.	4,236	,753
12. People respect individuals who can think effectively.	4,564	,684
13. Individuals, who constantly criticize, prohibit the ongoing work.	4,455	,659
14. Students' deficiency on effective thinking skills depends on not to have adequate backlog.	3,355	1,001
15. To think efficiently, some general thinking skills are necessary.	3,727	,938
16. For effective thinking, exercises and questions, which will only improve thinking skills, should be prepared.	4,291	,708
17. Materials which are used in the teaching of thinking skills should contain mathematics topics.	3,436	1,146
18. Students who have effective thinking skills are more successful on establishing piece-whole relations.	3,573	,903
19. Students who have effective thinking skills are more successful on the solving of the real world problems.	4,127	,622
20. Lesson attitude of the student is prior condition for him/her creativity and gaining effective thinking skills.	3,582	,913
21. Having inadequate background leads to ineffective thinking skills.	3,555	1,063
22. Teachers' attitude on being open to new ideas leads to a class of which students can improve their thinking skills.	3,782	,871
23. Thinking skills are treated more in democratic classrooms.	4,409	,547
24. I believe that students who have thinking skills will be more successful in high school entrance tests.	4,382	,635
25. Students who have effective thinking skills determine what is needed to solve a problem by the aid of existing information.	4,218	,882

According to survey items' mean, it can be said that pre-service mathematics teachers mostly agree on the opinions; to be more successful in lessons, teaching effective thinking skills is necessary for students; people respect individuals who can think effectively and effective thinking skill about a subject depends on an individual's background. Additionally, it has been observed that pre-service teachers neither or disagree on the opinions "*I observe that my colleagues are trying to teach thinking skills*", "*Students' deficiency on effective thinking skills depends on not to have adequate backlog*" and "*Materials which are used in the teaching of thinking skills should contain mathematics topics*".

Independent samples t-test is used to investigate whether there exists a significant difference between pre-service teachers' opinions on the teaching of the thinking skills and graduation school type. The results are presented in Table 8.

Table 8.

t-test Results of Pre-Teachers' Opinions and Employment Level

	Graduation School Type	N	Mean	Std. Deviation	t	p
	Educational Faculty Master Without Thesis			,550	-3,132	,002
				,890		
	Educational Faculty Master Without Thesis			,833	-2,251	,027
				,919		
	Educational Faculty Master Without Thesis			1,057	-3,065	,003
				,384		

According to Table 8, pre-service primary mathematics teachers support the opinions, "The effect of the teacher on the development of students' thinking skill depends on teacher's proficiency on the related topic", "Students who have effective thinking skills are more successful on the solving of the real world problems" and "Having inadequate background leads to ineffective thinking skills" more than pre-service teachers who are master of science students without thesis.

Discussion and Conclusion

According to in-service and pre-service primary mathematics teachers, the most important skill is "logical thinking", and the least important is "critical thinking". Some processes such as theorem and proof, that is its nature, mathematics is a special lesson which yields exact conclusions. The mentioned results are not questioned and accepted without a further thinking. But, in the social sciences concepts may be discussed and treated. So, it can be said that logical thinking skill may be thought as mathematics ability and ordered in the upside rows due to working sample which consists of in-service and pre-service primary mathematics teachers. Emer (2007) explained that teachers ordered logical thinking and creative thinking skills in the upside rows and

critical thinking, reasoning ability, thinking rapidly and detection of thinking skills are in downside rows. Moreover, in another work, Yenilmez and Ekinci (2005) observed that teachers' responses on the thinking skills were; logical and creative thinking skills were in the upside rows and thinking rapidly skill was in the downside row.

Science of mathematics is generally accepted as a research area which cannot be criticized. Mathematics' rules are exact and cannot be changed. System of the critical thinking does not aim to change and judge rules of mathematics. But this system is able to know that 3x3=9 is not an invariant; it is valid for the number base 10 or greater. However, the conclusion expressed above is different in the basis 2,4 or 8 (Kökdemir, 2003).

Both in-service and pre-service teachers attended to this research agree on the teaching of thinking skills to students to get more success in the lessons. However, in the work, it has been addressed that they are mostly ambivalent on the opinions; "It is mathematics teachers' responsibility to enable students have effective thinking skills" and "The best way getting effective thinking skill is teaching of mathematics". In the light of this result, it can be said that in-service and pre-service teachers are abstaining on taking responsibility of the teaching of thinking skills. In addition to this, secondary school mathematics teachers support the opinion "The best way getting effective thinking skill is teaching of mathematics" more than elementary mathematics teachers do. As a matter of the fact that, Emer (2007) also indicated that teachers do not strongly support the opinions "It is mathematics teachers' responsibility to enable students have effective thinking skills", "The best way getting effective thinking skill is teaching of mathematics" and "Materials which are used in the teaching of thinking skills should contain mathematics topics".

While teachers who have less experience defend the opinion "To think efficiently, some general thinking skills are necessary", especially teachers graduated from educational faculty think that "The best way getting effective thinking skill is teaching of mathematics". This fact may be caused by young teachers' idealist attitude to teaching of mathematics and thinking skills and contemporary approaches.

Pre-service elementary mathematics teachers agree on the opinion "The effect of the teacher on the development of students' thinking skill depends on teacher's proficiency on the related topic" and "Students' deficiency on effective thinking skills depends on not to have adequate backlog". Besides, both pre-service elementary and secondary school teachers commonly agree not only on the opinion necessity of the teaching of thinking skills but also this teaching should be in the mathematics classrooms.

The most preferred items in the survey are about effective thinking. In-service and pre-service mathematics teachers think that the principal aim of the mathematics is to make students have effective thinking skill. Thus, it can be said that teachers think that teaching of mathematics is an effective way to enable students have thinking skills.

As a consequence, the training process is really important to enable students have thinking skills. In this process, teacher's role should not be ignored. Mathematics is an effective lesson in both making students has thinking skills and further activities. Therefore it should be point out to enable mathematics teachers thinking skills and proficiency on these skills. To assist this suggestion, some special seminars about the expressed results and thinking skills may be given to working school teachers and educators in universities.

Due to limited and restricted works related to scientific thinking skills, some further studies dealing with teaching of thinking and determining relations with the other variables may be proposed as a future work.

References

Açıkalın, A. (1998). Before 40 years, after 40 years (Turkish). *Milli Eğitim Dergisi, 137*, 17-19.

Bozdoğan, A. (2007). *The effects of worksheets on the logical thinking abilities on the education of science lessons*. Unpublished MA thesis, Çukurova University, Adana.

Çınar, İ. (2010). *Scientific attitudes and behaviors.* Retrieved March 22, 2010, from http://www.pdrciyiz.biz/bilimsel-tutum-davranislar-t1712.html

Emer, A. (2007). Primary school teachers' opinions about teaching thinking skill (A case of Izmir). Unpublished MA thesis, Eskişehir Osmangazi University, Eskişehir.

Erktin, E. (2004). *Survey development project for mathematics teachers* (Turkish). G. Yıldıran (Ed.). *A First, A Hope.* Istanbul: Boğaziçi University Pub., 88-102.

Hayran, İ. (2000). *Elementary school teachers' opinions on thinking skill and its operations*. Unpublished MA thesis, Afyon Kocatepe University, Afyonkarahisar.

İnan, C., & Özgen, K. (2008). Evaluation of mathematics teacher candidates' views towards efficiency in teaching thinking skills to students during the teaching training. *Electronic Journal of Social Sciences, 7(25)*, 39-54.

Kökdemir, D. (2003). *Critical thinking and education of science* (Turkish). *Pivolka, 2(4)*, 3-5.

Newman, J.H. (1998). Reapprochment among undergraduate psychology, science, mathematics, engineering, and technology education. *American Psychologist, 53(9)*, 1032-1043.

Oğuzkan, A.F. (1989). *Education in elementary schools* (Turkish). Ankara: Emel Pub.

Özden,Y. (1997). *Learning and teaching* (Turkish). Ankara: Pegem A Pub.

Seferoğlu, S.S., & Akbıyık, C. (2006). Teaching critical thinking. *Hacettepe University Journal of Education, 30*, 193-200.

Semerci, N. (1999). The function of a teacher: Developing of thinking. *Fırat University Journal of Social Sciences, 9(1)*, 209-216.

Serdar, B. (1998). Secondary school teachers' attitudes and opinions towards enabling students have scientific thinking, Unpublished MA thesis, Afyon Kocatepe University, Afyonkarahisar.

Stuessy, C. (1984). Correlates of scientific reasoning in adolescents: experience, locus of control, age, field, dependence-independence, rigity/flexibility, IQ and gender. Columbus, OH: Unpublished PhD thesis, The Ohio State University, ED 244 834.

Titiz**,** M.T. (1998). *Education without memorizing: "A guide"* (Turkish). Ankara: Beyaz Pub.

Yenilmez, K., & Ekinci, A. (2005). Attitudes of mathematics and primary school teachers about teaching of thinking skills and effect of graduate education on these skills (Sample of Eskişehir). *II. Graduate Education Symposium*, Marmara University, Institute of Educational Sciences, 26 – 28 September 2005, Istanbul.

