Educational Research and Reviews Vol. 6(3), pp. 315-325, March 2011
Available online at http://www.academicjournals.org/ERR
ISSN 1990-3839 ©2011 Academic Journals

Full Length Research Paper

Do science and technology teachers and pre-service primary teachers have different thoughts about concept maps in science and technology lessons?

Yunus Karakuyu

Department of Science and Mathematics Education, Mustafa Kemal University, Hatay, Turkey.
E-mail: yunuskarakuyu@gmail.com. Tel: 90 326-2456000-5352. Fax: 90 326 2456006.

Accepted 2 February, 2011

The purpose of this study is to determine the thoughts of primary science and technology teachers, primary class teachers, pre-service primary class teachers and pre-service primary science and technology teachers' about concept maps. This scale applied the use of basic and random method on the chosen 125 4th and 5th grade primary class teachers who had science and technology courses and primary science and technology teachers from 14 primary schools in Afyonkarahisar. Also, the scale was applied to 150 2nd grade pre-service primary class teachers and 30 1st grade pre-service primary science and technology teachers in a Department of Primary Education from Mustafa Kemal University in Turkey. The general scanning model was used in this study, while t-test, one way ANOVA test, frequency and percentage values were calculated. However, analysis of the qualitative data was done by content analysis. As a result of the research findings obtained in the framework, teachers' and pre-service teachers' attitudes towards the use of concept maps is identified as positive. According to gender and class levels, which are independent variables, there are no significant differences of pre-service teachers' towards using concept maps. According to the branch and seniority, there are important significant differences of teachers' attitudes towards using concept maps. As a result of the findings from researches, some suggestions are presented.

Key words: Concept maps, science and technology, teachers' and pre-service teachers' attitudes, pre-service primary class teachers, pre-service primary science and technology teachers.

INTRODUCTION

With primary science education, students aim to learn the close and remote environment that they live in. By using scientific methods, students learn to ask questions, search, find out problems, observe, inquire, put forward hypothesis, make experiments, gather data, analyze the data and make generalizations with what they have. For science education to be effective and long-lasting, the methods and techniques should be in accordance with students' levels and should also be able to address much more senses. For this reason in science lessons, the methods and techniques which enable students participate and learn actively, are used (Akpinar, 2003).

Science lessons have great importance in the growth of people who are searching for and reaching out to information (Kaptan and Korkmaz, 2001). Particularly, in science lessons, not only methods that are used but also evaluating methods lead students to memorize and create an atmosphere where the more one memorize, the more one is successful. Concept maps are materials that make learning meaningful; as a result, they are used to help retain knowledge in long-term memory. In concept maps, knowledge is schematized, coded and presented visually, and it makes memory stronger (All et al., 2003). At students' memorization concepts, they cannot make connections between old and new information and daily events (Şahin and Oktay, 1996). The student develops

concepts in accordance with the thinking system that is based on daily life (Çepni, 2001). So that Students' have lots of alternative conceptions about topics within school science e.g. mass and weight (e.g. Moore and Harrison 2004), heat and temperature (e.g. Karakuyu et al. 2009), force and motion (e.g. Özsevgec¸ 2006), energy (e.g. Papadouris et al. 2008), mechanics (Oliva 2003), electricity and magnetism (e.g. Demirci and Çirkinoğlu 2004), sound (e.g. Eshach and Schwartz 2006) and light/light source (e.g. Çepni 2009). For this reason, in science lessons, teaching methods that can take interests of learners and help them to make connections between old and new information should be preferred. In science teaching, teaching methods should be changed and rearranged in a way that will take learners to the center to be able to create modern teaching atmosphere and make learning meaningful (Çavaş, 2005).

According to Adler (1995), the belief that concept maps make long lasting learning, help learners that have difficulty in learning and make learners perceive complex structures as a whole. Besides, researchers found out that concept maps give teachers the opportunity to observe students' knowledge about any subject and to realize which students need more help. They also help to reconcile meanings and follow the development of students from portfolio. According to Nowak and Gowin (1984) when groups of two or three children are made via concept maps, in education a very effective classroom communication can be achieved. The biggest contribution of concept maps to education studies is a valid and reliable evaluation (Atasoy, 2002).

In a study which Geban and Uzuntiryaki (1999) made about concept maps, students are divided into three groups. The first group comprised concept maps, the second group comprised simulation models and the last group is known as the control group. In the end, the success of the group in which the concept map was used was found to be higher in great deal than the group in which simulation models were used and the control group. As it can be understood from this study, the use of concept maps in lessons increased success from a positive aspect (Altin, 2002).

Kaptan (1998) have declared that concept maps have become enormously important as learning and teaching strategy. The most important side that makes the mapping method superior from others is the presentation of the main concepts visually. Concept maps are designed as a schema which is a bridge between a person's earlier information and his new information (Nowak and Gowin, 1984). Concept maps that are prepared according to the same subject or concept can be drawn differently.

For this reason, concept maps have increased learning mostly. Concept maps are addressed to different learning styles and individual differences among students, which are student-centered, easy to learn, to teach and to use.

If students constitute 'concept maps' in their learning, they can also improve their skills about organizing the information.

Nowak and Gowin (1984) have defended that it is more effective to use 'concept maps' in education. It is easier to contact between the concepts and concept map which is drawn in the students' mind. From this aspect, 'concept maps' can be considered as one of the results of the constructivism approach. The structure of knowledge is divided into the concepts which are the smallest parts of knowledge by being separated into its subunits. Concept maps can be used as an effective means to be provided to the understanding of cognitive meaning. The knowledge is an unshakeable fact which is implied to individual responsibility. The meanings can be shared and they can become an agreement. By way of the concept maps, an advantageous communication is carried out when small groups are formed in education (Nowak and Gowin, 1984). Mc Clure et al. (1999) brought up the relations between conceptual learning and studying methods in their studies. The concept maps are used as an effective education strategy to find students' misunderstanding (Bartels, 1995). Teachers can make the curriculum transparent to students by using concept maps (Novak, 2010). The concept maps are made in order for students to make preparation concerning the subjects they have studied at school. Thanks to this, both students' evaluation will be more reliable and misunderstanding will be prevented on time (Kurhila and Satinen, 1998).

Nowak et al. (1983) have found out that the method of concept maps is a useful strategy for students to learn science subjects and it has also a positive effect on students' performance of solving problems. Wallace and Mintzes (1990) have made sure that using concept map is useful and valid in comparison to the traditional evaluation method. Roth (1994) has explained that high school students accept the concept maps as a useful means. Students also explained that the concept maps suggest a course of action to them about what they learn and why, but this is not valid for all students. Lindesay (1995) has made clear that the use of concept map provides meaningful learning and understanding of knowledge, has positive effect on students' success, motivates them and develops their self-confidence. Concept maps created by students reveal the structure of their knowledge (Novak, 2010). In a research which was made with high school students, it was explained that concept map affected, especially, the students who are unsuccessful in science course positively (Schmid and Teloro, 1990).

In the new primary science and technology curricula, it is highly recommended that concept maps should be used in science and technology education (MEB, 2005,

2006). MEB wants to use teachers and also pre-service teachers in teaching/learning scientific concepts and their relations to each other by providing concept maps (MEB, 2005, 2006). MEB claims constructivist teaching/learning theory as an instructional approach in the new primary science and technology curricula so teachers have to use concept maps in science and technology instruction, measurement and evaluation. Now, primary science and technology curricula have been using it for more than six years, but how effective concept maps are used is still uncertain. The main purpose of this study is to investigate the primary teachers' and pre-service primary teachers' attitudes towards concept maps. This study started by evaluating the information that was reached and the one that was considered by the studies on the agenda. In this study, some changeables such as gender, level of class over the students' attitudes towards concept maps and the difference of seniority over the teachers' attitudes towards concept maps have been examined.

The aim of the study

The aim of the study is to find out the attitude of pre-service primary class teachers, pre-service primary science and technology teachers in a Department of Primary, 4th and 5th grade science and technology teachers and secondary grade science and technology teachers about concept maps. With the direction of this aim, the sub research questions are thus investigated.

1. Is there any statistical difference between the average points that the pre-service primary class teachers and pre-service primary science and technology teachers take from the criterion towards concept maps attitudes?
2. Is there any statistical difference between the average points taken from the attitude measure concerning concept maps conducted between female and male of pre-service primary class teachers and pre-service primary science and technology teachers of primary education?
3. Is there any statistical difference between the average points taken from the attitude measure concerning concept maps which was conducted between teachers who attended science and technology lessons of the first and second stage of primary education?
4. Is there any statistical difference between the averages points taken from the attitude measure concerning concept maps by teachers who attended science and technology lessons on account of gender?
5. Is there any statistical difference between the averages points taken from attitude scale which is conducted between teachers who attended science and technology lessons on account of seniority concerning concept maps?
6. What are the opinions of teachers who attended science and technology courses to open ended questions of assessment device concerning concept maps?
7. What are the opinions of pre-service primary class teachers and pre-service primary science and technology teachers to open ended questions of assessment device concerning concept maps?
8. Is there any statistical difference between the average points of the pre-service primary class teachers and primary class teachers taken from the criterion towards concept maps attitudes?
9. Is there any statistical difference between the average points of the pre-service primary science and technology teachers and primary science and technology teachers taken from the criterion towards concept maps attitudes?

METHODOLOGY

This study whose aim is to reveal pre-service teachers' attitudes and opinions is, in general, a descriptive scanning model. The scanning model which aims to determine the case does not interfere with the existing states, but reveals realities and constitutes information. Thoughts, opinions and attitudes of people are got by the scanning method (Erözkan, 2007). For this purpose, questionnaire forms are prepared to evaluate the pre-service primary teachers' and primary teachers' concept maps attitudes. In addition to these studies, semi-structured interview forms which included only four questions, have been prepared to determine the opinions of the teachers and pre-service teachers.

Sample

The sample of the study comprised 125 4th and 5th grade primary class teachers who had science and technology courses and primary science and technology teachers from 14 different primary schools, chosen randomly in the city center of Afyonkarahisar. Also, it comprised 150 fourth-year 2nd grade pre-service primary class teachers and 30 fourth-year 1st grade pre-service primary science and technology teachers in a Department of Primary Education from Mustafa Kemal University in Hatay from Turkey. The department has seven or eight classes at each grade.

Data collection

Concept maps attitude scale is developed to assess the attitude of students and teachers. At the developing process of students' attitude measuring scale, documents were first examined. All sources such as books, newspapers, magazines, articles (published or not published) and thesis from sites on the net were taken into consideration (Kansu, 2005; MEB, 2005; Novak, 2001; Toper, 2002; YÖK, 1998). Approximately, 10 pre-service teachers were interviewed and their opinions and thoughts were also evaluated. After all notions which can be made use of when assessing pre-service teachers' attitudes had been prepared by the researcher, they were examined by 5 experts from Mustafa Kemal University and Afyon Kocatepe University. As one of the logical ways for testing the content validity of the measuring scale, the opinion of experts in their field is taken (Büyüköztürk, 2003: 162).

Pre-service teachers' attitude scale comprised personal informa-

Table 1. The Results of Independent t-test according to the departments of pre-service teachers.

Group	N	$\overline{X}$	s.d	F	Sig.
Pre-service primary class teachers	150	62.23	9.62	5.422	0.005
Pre-service primary science and technology teachers	30	75.97	8.87		

Table 2. The pre-service teachers' attitudes towards concept maps and their results according to gender.

Gender	N	$\overline{X}$	sd	df	F	Sig
Female	104	66.72	9.849	149	1.746	0 .074
Male	76	62.51	11.949			

tion in two sections. The first section comprised personal information in which free variants about school, class, gender and concept maps were asked, while the second section comprised statements which were prepared for scaling pre-service teachers' attitudes towards concept maps. Options in the scale are in the shape of a five likert scale ('strongly agree', 'agree', 'neither agree nor disagree', 'disagree' and 'strongly disagree').

For the pre-analysis studies of the pre-service teachers' attitudes scale, this scale is applied to different student groups. Applications are made in the elementary school out of the real schools. The data obtained are analyzed through the SPSS 17.0 and the substances element burdens are determined. Cronbach Alpha reliability modulus has been found in the arrangements made after the pilot application, thus the fill survey is ready for application with its latest condition by reviewing it together with a consultant staff. There is no change on the section of personal information in the fill survey, but the attitude statements are reduced to 23 items.

The second part of the fill survey comprised four questions which are semi-configured. The pre-service teachers and teachers who join the survey respond to the questions which are open-ended so as not to be affected by the questions in the attitude scale and they wanted to respond in a similar way to the likert questions.

Analysis of the data

Encoding, decoding, drawing tables and writing the data obtained by the study were made by the researchers. SPSS 17.0 programme was used in encoding the data. In order to classify the data in the survey, frequency and percentage were used, while arithmetical mean was used to show the middle point of distribution. In order to measure how much the distribution is worth in respect to average, standard deviation was used, while t-test was used to test whether or not there is difference between two groups. In order to test whether or not there is difference among three groups, one way analysis of variance (Anova) test was used, while variance analysis was used, at a 0.05 significance level, to test whether or not there was difference among more than two free groups. In other words, these criteria were used in interpreting the results. In occasions when difference is determined in a particular group, Scheffe and LSD tests are applied. Answers given to open ended questions are read one by one and the data read are split into categories. The percentage and frequency of data which are split in two categories are presented in tables.

RESULTS AND DISCUSSION

Here, the findings which are obtained through decoding related data about the main and sub-aims of the survey and the interpretations of these findings are given.

In order to determine whether or not there is a statistically meaningful difference among points' averages, the pre-service primary class teachers and pre-service primary science and technology teachers take from the scale of attitudes towards concept maps, and the independent t-test is made. The findings which are obtained with the results of the test are presented in Table 1.

It has been determined that the departments of pre-service teachers on attitudes towards the concept maps according to the results of t-test have a significant difference in pre-service primary science and technology teachers' favour ($p<0.05$). The mean of pre-service primary science and technology teachers' attitudes towards the concept maps ($\overline{X}$ =75.97) is higher than the mean of pre-service primary class teachers' attitudes towards the concept maps ($\overline{X}$ = 62.23).

The findings are presented in Table 2, using an independent t-test in order to determine whether or not a significant difference is statistically between the mean of the scores and their attitudes scale, in relation to their concept map depending on the gender of the pre-service teachers.

It has been determined that the average of the female pre-service teachers is higher than the average of the male pre-service teachers. The pre-service teachers' gender on attitudes towards the concept maps according to the results of t-test does not create a statistically significant difference ($p>0.05$).

Independent t-test has been conducted in order to determine whether or not a significant difference is found statistically between the teachers who have science and

Table 3. The results of the independent t-test according to the branch of teachers.

Group	N	$\overline{X}$	s.d	F	Sig.
Elementary class teachers	104	68.14	9.96	1.26	0.66
Science and technology teachers	21	66.07	11.03		

Table 4. The results of the independent t-test according to the gender of teachers.

Gender	N	$\overline{X}$	s.d.	F	Sig.
Male	55	66.21	9.46	1.26	0.24
Female	70	64.87	9.79		

Table 5. The results of ANOVA according to teachers' seniority and attitudes towards concept maps.

Seniority	N	$\overline{X}$	s.d.	F	Sig.
0 to 5 years	18	65.21	14.46	1.05	0.35
5 to 10 years	20	70.87	6.79		
More than 10 years	87	68.05	9.63		
Total	125	68	10.00		
Source	**df**	**Sum of squares**	**Mean square**	**F**	**Sig.**
Between groups	2	209.81	84.90		
Within groups	122	12721.26	79.94	1.05	0.35
Total	124	12430.69			

technology lessons at the first stage in primary school and those who have it at the second stage in primary school about their scale scores in terms of their attitudes towards the concept maps. As such, the findings of the independent t-test are presented in Table 3.

It has been determined that the teachers' branches on attitudes towards the concept maps according to the results of t-test do not have a significant difference on the study (p>0.05).

Independent t-test has been conducted in order to determine whether or not there is a significant difference between the gender of teachers who have science and technology lessons at the first stage and those who have it at the second stage in primary school about their scale scores in terms of their attitudes towards the concept maps. The findings, obtained by one-way analysis of variance, are presented in Table 4.

Although the mean of male teachers' attitudes towards the concept maps ($\overline{X}$=66.21) is higher than that of female teachers ($\overline{X}$ = 64.87), it has been determined that the teachers' genders on attitudes towards the concept maps according to the results of the t-test do not have a significant difference (p> 0.05).

Independent t-test has been conducted in order to determine whether or not there is a significant difference between the seniority of teachers who have science and technology lessons at the first and second stages in primary school about their scale scores in terms of their attitudes towards the concept maps. Thus, the findings of the test obtained by one-way analysis of variance are presented in Table 5.

It has been determined that the teachers' scores of attitudes towards the concept maps depending on the teachers' seniority according to the results of one-way variance analysis of the test do not have a significant difference (p> 0.05).

For indentifying the opinion of teachers and pre-service teachers attending and taking science and technology courses, about the use of concept maps, they were directed to 4 open head questions and data were analyzed by using frequency and percentage.

Table 6. The distribution of pre-service teachers and teachers' response to the question: In which steps of subject do you prefer using concept maps?"

Pre-service teachers' answers		**f**	**%**
1	Before starting the subject	30	16.6
2	When summarizing the subject	40	22.2
3	At the beginning part of the subject	36	20
4	When repeating the subject	46	25.6
5	When studying the subject	28	15.6
Total		180	100
Teachers' answers		**f**	**%**
1	Before starting the subject	20	16.3
2	When summarizing the subject	28	22.7
3	At the beginning part of the subject	26	21.2
4	When repeating the subject	32	26
5	When studying the subject	17	13.8
Total		123	100

Table 7. The distribution of the pre-service teachers and teachers' response to the question: "What are the difficulties one may encounter when conducting the method of concept maps in science and technology courses?"

Pre-service teachers' answers		**f**	**%**
1	Difficulty when drawing concept maps	39	22.8
2	There is no difficulty	72	42.1
3	Inability to understand concept maps	31	18.1
4	Inability to draw concept maps about complex subject	29	17
Total		171	100
	Teachers' answers	f	%
1	Complexity of concept maps.	20	16.3
2	Reading and interpretation of concept maps.	11	9.1
3	Not understanding concept maps.	28	23.2
4	Some subjects are not appropriate for concept maps.	22	18
5	Connection failure between terms.	15	12.2
6	Basic subject not taken into consideration and lack of abstract thoughts.	16	13.1
7	When passing description, they may be meaninglessness.	10	8.1
Total		122	100

As it can be seen in Table 6, the majority of the pre-service teachers prefer using concept maps when repeating the subject (f=46); also, the majority of them prefer using concept maps when summarizing the subject (f=40). This situation shows that a large number of pre-service teachers believe that using concept maps after studying the subject may be much more beneficial.

The majority of teachers prefer using concept maps when repeating the subject; also, the majority of them prefer it when summarizing the subject (f=28). Additionally, the teachers mentioned that the subject should be given as an introductory information at the beginning part of the subject (f=26).

As it is seen in Table 7, a large part of the pre-service teachers (f = 72) indicate that they have not faced any problem with concept maps when applied in science and technology lessons, but some of the pre-service teachers (f = 39) point out that it is very difficult to draw concept maps, while the other group (f = 31) states that they can not understand concept maps.

A large part of the teachers (f = 28) state that some of the concept maps are not understood, while the other

Table 8. The distribution of the pre-service teachers and teachers' response to the question: "What are your suggestions about the problems that are faced with the method of mapping in science and technology lessons?"

	Pre-service teachers' answers	**f**	**%**
1	Mapping methods should be taught in courses.	35	19.6
2	Concept maps should include much more explanation.	33	18.5
3	Concept maps should be made to be more comprehensible.	26	14.6
4	Concept maps should be made as a working group.	42	23.6
5	No problem.	22	12.4
6	Do not have a suggestion	20	11.3
Total		178	100
	Teachers' answers	**f**	**%**
1	In confusing concept maps, it is necessary that the word which will be written should be limited and organized.	13	10.4
2	Progress should be made from easy to difficult; sometimes, it is difficult to find the most correct word.	20	16
3	In the topics that are hard to be understood, more than one concept map can be prepared.	31	24.8
4	Seminars should be given about concept maps.	38	30.4
5	There should be more places for concept maps in course books.	23	18.4
Total		125	100

part (f = 22) points out that some subjects are not suitable for using concept maps. However, teachers also (f =20) complain of the complicated concept maps.

As it is seen in Table 8, a large part of the pre-service teachers (f = 42) indicate that concept maps should be made as a group working in science and technology lessons, and the other big part (f = 35) state that concept maps should be taught in lessons. Moreover, some pre-service teachers (f = 33) state that concept maps should include much more explanation. A part of the pre-service teachers (f = 26) indicate that concept maps should be made to be more comprehensible and that they have difficulty in drawing concept maps in science and technology lessons, while some opine that they have no suggestion to the problems faced in science and technology lessons.

As a solution to these problems encountered in concept maps method in science and technology lessons, a large part of the teachers (f = 38) suggest that seminars should be given about concept maps, while the other part (f = 31) suggest that the topics which are hard to be understood, can be prepared with more than one concept map. Teachers (f = 23) also pointed out that there should be more place for concept maps in course books.

As it is seen in Table 9, most of the pre-service teachers (f=38) pointed out the subject being given in summary without extending it as the benefit of the concept maps used in science and technology lessons. Some of them (f=29) say that they listen to the lesson carefully and some (f=29) say they remember the subject easily.

Most of the teachers (f=25) indicated that they can easily build up connection between the main concepts which are to be learnt through the subject, while quite a number of them (f=16) indicated that the abstract can be learnt more easily by transforming them to concrete. Moreover, teachers (f=14) indicated that with the use of concept maps, they develop their social intercourse and collaboration, and also, it helps them fill their lack of knowledge and understanding of the subject through a game like process. Similarly, the teachers indicated that (f=13) brain storming and understanding helped the students have a permanent retention of their knowledge.

It is noticed that most of the pre-service teachers (f=120) think that they achieve enough information, and also most of the teachers (f=98) think that sufficient information was given to the pre-service teachers as it is seen in Table 10 for the question: "Have you received/ take enough information in drawing concept maps?"

Independent t-test has been conducted in order to determine whether or not there is a statistically meaningful difference between the average points of pre-service primary class teachers and primary class teachers taken from the criterion towards concept maps attitudes in Table 11.

In the study, a meaningful difference is found among the scores ($p< 0.05$) in the primary class teachers' favor. The mean of primary class teachers is higher than that of the pre-service primary class teachers taken from the concept maps attitude questionnaire.

Independent t-test has been conducted in order to determine whether or not there is a statistically meaningful difference in the pre-service primary science and technology teachers and primary science and

Table 9. Distribution of the pre-service teachers and teachers' response to the question: "What do you think about the benefits of concept maps used in science and technology lessons?"

Pre-service teachers' answers		**f**	**%**
1	It helps us to remember more easily.	29	16.4
2	It helps us to understand better.	25	14.1
3	It enables us to concentrate on the lesson and to comprehend the subject matters in a better way	19	10.7
4	It is repetitive and summative	22	12.4
5	It has importance in understanding and reviewing the subject	15	8.6
6	It enables us listen to the lesson carefully	29	16.4
7	The subject matter is given in summary	38	21.4
Total		177	100
Pre-service teachers' answers		**f**	**%**
1	The subjects are fixed in the minds of students in a more planned and permanent way.	10	8
2	It is beneficial for understanding and brain-storming	13	11
3	The main concepts that are to be learnt during the lesson and the relationship between them are given	25	20
4	It enables the students comprehend the subject through a game like process	14	11
5	It helps the students have a permanent retention of the information	13	11
6	Abstract concepts are transformed into concrete concepts, thus they are learnt more easily	16	13
7	It motivates the students by arousing interest	8	7
8	It enables the students to build up connection between events by making conclusions and generalizations	10	8
9	The use of concept map helps us fill our lack of knowledge and develop our social relationships and collaboration	14	11
Total		123	100

Table 10. The distribution of the pre-service teachers and teachers' response to the question: "Did you give/take enough information to be able to draw concept maps in the science and technology lesson?"

Pre-service teachers' answers		**f**	**%**
1	Yes, enough information was taken	120	66.7
2	No, enough information was not taken	60	33.3
Total		180	100
Teachers' answers		**f**	**%**
1	Yes, enough information was given	98	78.4
2	No, enough information was not given	27	21.6
Total		125	100

technology teachers taken from the criterion towards concept maps attitudes in Table 12.

In the study, the mean of primary science and technology teachers is higher than the mean of pre-service primary science and technology teachers taken from the concept maps attitude questionnaire, and it is found that there is no statistically meaningful difference among the scores ($p > 0.05$).

RESULTS, DISCUSSION AND SUGGESTIONS

This research aims to assess the attitudes of pre-service teachers and teachers towards concept maps. The answers that pre-service teachers and teachers gave for the attitude scale show that they have a positive attitude towards concept maps. Teachers and pre-service teachers believe that concept mapping process is beneficial for them.

Pre-service teachers have a positive attitude towards concept maps. This indicates that teaching with the use of concept map method is more effective than teaching with the use of traditional methods (Wallece and Mintzes, 1990; Aykanat, 2005; Güneş et al., 2005; Öner and Arslan, 2005; Candan et al., 2006; Gürbüz, 2006). It can be said that female pre-service teachers have more

Table 11. t- test results of the thoughts of pre-service primary class teachers and primary class teachers towards concept maps.

Statue	N	$\overline{X}$	sd	df	F	sig
Pre-service primary teachers	150	41.79	14.34	252	17.50	0.00
Primary class teachers	104	61.03	14.61			

Table 12. t- test results of the thoughts of pre-service primary science and technology teachers and primary science and technology teachers towards concept maps.

Statue	N	$\overline{X}$	sd	df	F	sig
Pre-service primary science and technology teachers	30	61.79	9.14			
Primary science and technology teachers	21	65.03	9.67	49	21.35	0.08

positive attitudes than male pre-service teachers. However, it is understood in both groups that there is no big difference in attitudes towards concept maps. Attitudes of pre-service teachers change significantly according to the level of the classes. The usage of concept maps does not change as the kinds of department of pre-service teachers attitudes towards concept maps do.

Statistically, questionnaires of teachers using concept maps attitudes do not have meaningful difference depending on classes which they have taught. Primary class teachers who taught science and technology in classes four and five are more effective than the primary science and technology teachers' attitudes towards concept maps.

Although the mean of male teachers' attitudes towards concept maps is higher than that of female teachers, there is no statistically significant difference between the teachers' genders and attitudes towards the concept maps. Male teachers have more positive attitudes than female teachers.

Attitude surveys of teachers' concept maps do not change significantly based on working years, in that the averages of the teachers whose professional seniority is for 6 to 10 years are more positive than teachers who have served more than 10 years. As such, teachers who are at the first years in their teaching career have been determined. Therefore, there is no significant difference between teachers' seniority and the attitudes of concept maps.

There is a statistically meaningful difference between the pre-service primary class teachers and primary class teachers taken from the criterion towards concept maps attitudes. In addition to this, there is no statistically meaningful difference between the pre-service primary science and technology teachers and primary science and technology teachers taken from the criterion towards concept maps attitudes. Concept maps create significantly changes according to teachers' and pre-service teachers' status. This indication can be determined as there is a significant relationship between the attitudes towards concept maps and status.

Teachers and pre-service teachers use concept maps during the review of the subject or while summing it up. Most of the pre-service teachers indicate that they do not face any problem in using concept map method in science and technology lesson, while some indicate that they have difficulty in understanding and drawing concept maps. Teachers point out that some subjects are not suitable for concept maps and some are complicated. Pre-service teachers advise that concept maps should be taught during the lesson and they should be made to be more comprehensible. Furthermore, teachers indicate that seminars about concept maps should be conducted with more than one concept map in difficult subjects and more concept maps should be used in students' books. Pre-service teachers say that they remember what they learn more easily when they use concept maps, as concept maps summarize the subject without protracting the lesson; moreover, they listen to the teacher more effectively. In researches that are made in different fields, concept maps have been used to be able to understand concepts, which are complex to understand more easily and have also been used to be able to evaluate science education in an effective way (Throwbridge and Wandersee, 1994). Teachers say that they can show the fundamental conceptions and the connections between them very easily, and they can teach by concreting abstract things more easily. They indicate that social relationships and collaboration between the teachers develop and this helps them to lessen their lack of knowledge. Besides, teachers believe that what they

teach by concept maps is more permanent because this method creates a game-like atmosphere. Pre-service teachers indicate that they get enough knowledge to draw concept maps, while teachers indicate that they give enough knowledge to draw concept maps. Both pre-service teachers and teachers indicate that concept maps make it easier for them to remember the subject in science and technology lesson.

REFERENCES

Adler S (1995). Helping Teachers Build Complex Conceptual Frameworks. In Ron Hoz & Moshe Silberstein (Eds.) Partnerships Sch. Instit. Higher Educ. Teach. Dev., 85-100. Israeli Ben Gurion University of the Negev Press.

Akpınar E (2003). Science Education Strategy of Energy Related Invention: Living for the Matter and Energy Unit. Master's Thesis, D.E.Ü. Institute of Education Sciences.

Altın K (2002). "Computer Use in Teaching Science: Application Examples", Naval Academy, Tuzla, Istanbul.

All JA, Huycke IL, Fisher JM (2003). Instructional Tools for Nursing Education: Concept Maps, Nursing Educ. Perspectives, 24(6): 311-317.

Atasoy B (2002). "Science Learning and Teaching", London.

Aykanat F, Doğru M, Kalender S (2005). Computer Assisted Instruction on Student Achievement Effects of Concept Mapping Method of Science, Gazi University, Kastamonu Educ. J. ,13: 2391-400.

Barertholz H, Tamir P (1992). A comprehensive use of concept mapping in design instruction and assessment. Res. Sci. Technol. Educ., 10: 39-52.

Baykul,Y (1999). Statistical Methods and Applications. Memorial Publications.

Büyüköztürk, S (2004). Handbook of Data Analysis 4 Edition, London: Pegem Publishing.

Candan A, Turkmen L, Cardak O (2006). The Effects of Concept Mapping on Primary School Students' Understanding of the Concepts of Force and Motion, J. Turkish Sci. Educ., 3(1): 28- 29.

Çavaş B (2005). Primary Science Education with Information and Communications Technology Integrated Learning Environment on Students' Achievement and Attitude Effects. Doctoral Thesis, D.E.Ü. Inst. Educ. Sci.

Çeken R (2010). Before and after 2005 are taken by Primary School Students in Science and Technology Programs Applied Attitudes Towards Education, Ziya Gokalp Education Faculty at Dicle University J., 14(38): 48-38.

Çepni S, Ayvacı HŞ, Keleş E (2001). Introduction to Schools and High School Science Tests Asked Questions A Comparison of Bloom Taxonomy. Sci. Educ. Symposium. 7:8. Maltepe University, s.144-150, Istanbul.

Çepni S (2009) Effects of computer supported instructional material (CSIM) in removing students misconceptions about concepts: ‘‘Light, light source and seeing’. Energy Educ. Sci. Technol. Part B Soc. Educ. Stus. 1: 51–83

Çoban B (2007). Concept Maps as a Teaching Technique course, the use of athletics. Journal of Social Sciences, Firat University Firat University J. Soc. Sci., 17(1): 161-171, Elazig.

Çoruhlu TŞ, Nas SE, Çepni S (2009). Using Alternative Assessment Techniques in Science and Technology Teachers' Problems Encountered: The Case of Trabzon, Centenary University J. Educ., 6(I): 122-141, http://efdergi.yyu.edu.tr.

Demirci N, Çirkinoğlu A (2004). Determining students’ preconceptions/misconceptions in electricity and magnetism concepts. J. Turkish. Sci. Educ., 1(2): 116–138.

Erözkan A (2007). Sci. Res. Methods, London: BA Publishing.

Eshach H, Schwartz JL (2006) Sound stuff? Naive materialism in middle-school students’ conceptions of sound. Int. J. Sci. Educ. 28: 733–764.

Geban Ö, Uzuntiryaki E (1999). "Concept Mapping and affinity with the Mole Concept Teaching Method", III. National Sci. Educ. Symposium, Karadeniz Technical University, Trabzon.

Güneş HM, Çelikler D, Güneş T (2005). Using Concept Mapping Techniques for Better Understanding the nervous system, Ondokuz Mayis University Educ. J., 20: 70-76.

Gürbüz R (2006). Concept Maps in Teaching the Topic of Probability, J. Educ. Technol., 3(2): 133-151

Kansu N (2005). Multiple intelligences and learning. n.kansu @ sympatico.ca.

Kaptan F (1998). Method Using Concept Mapping in Science Teaching, HacettepeUniversity Faculty Educ. J., 14: 95-99

Kaptan F, Korkmaz H (2001). Science Teaching in Primary Education. Ministry of Education Teachers' Handbook, Module 7 London: Department of State Printing House Books.

Karakuyu Y, Uzunkavak M, Tortop HS, Bezir NÇ, Ozek N (2009). Identification of Misconceptions about Heat and Temperature at High School Students in Sandıklı Region, Afyon Kocatepe University J. Sci., 8(1): 149-162.

Lindesay M (1995). Can concept mapping be used to promote meaningful learning in nurse education?, J. Adv. Nursing, 21(6): 1175–1179.

McClure RJ, Sonak B, Suen KH. (1999). Concept Map Assesment of Classroom Learning, J. Res. Sci. Teach., 36(4): 475- 492.

MEB (2005). Teaching Elementary Science and Technology Program, Draft Edition. London: Department of State Printing House Books.

Ministry of Education (2005). Science and technology education program, elementary school 4th-5th. class. Ankara, Turkey.

Ministry of Education (2006). Science and technology education program, primary 6,7,8. class. Ankara, Turkey.

Moore T, Harrison A (2004). Floating and sinking: everyday science in middle school. Retrieved 20 Jan 2008 from http://www.aare.edu.au/04pap/moo04323.pdf.

Novak J, Gowin D, Johansen G (1983). The use of concept mapping and knowledge vee mapping with junior high school science students. Sci. Educ., 67: 625 - 645.

Novak JD, Gowin DB (1984). Learning How to Learn. Cambridge, England: Cambridge University Press.

Novak JD (2001). The theory underlying concept maps and how to construct them. URL: http://cmap.coginst.uwf. edu/info/

Novak JD (2010). Learning, creating, and using knowledge: Concept maps as facilitative tools in schools and corporations. 2nd Ed. New York: Routledge.

Oliva MJ (2003). The structural coherence of students’ conceptions in mechanics and conceptual change. Int J Sci.Educ., 25(5):539–561.

Öner F, Arslan M (2005). Primary 6 Classroom Teaching Learning with Concept Maps in Science Teaching Unit, The Effect of Electricity, The Turkish Online J. Educ. Technol.-TOJET, October, 4(19).

Özsevgec¸ T (2006). Determining effectiveness of student guiding material based on the 5E model in ‘‘force and motion’’ unit. J Turkish Sci Educ., 3:121–134.

Papadouris, N., Constantinou, P. C., Kyratsi, T. (2008). Students’ Use of the Energy Model to Account for Changes in Physical Systems J. Res. Sci. Teach., 45(4): 444–469.

Roth M (1994). Student Views Of Collaborative Concept Mapping An Emancipatory Research Project, Sci. Educ., 78: 1- 34.

Schmid RF, Telara G (1990). Concept mapping as an instructional strategy for high school biology. J. Educ. Res., 84(2): 78-85.

Şahin F, Oktay A (1996). Conceptual Change Related to Primary cell respiration, Marmara University, Faculty of Educ. Sci. J., 8: 227-236.

Toper Ö (2002). But how do we learn? http://www.enocta.com/tr/kaynaklar_makale_detay.asp?url=192

Trowbridge JE, Wandersee JH (1994). Identifying a critical juncture in the learning in a college course on evolution. J. Res. Sci. Teach., 31(5): 459-473.

Utku N (2010). Elementary Science and Technology course, the use of concept maps. Master's thesis, BATTERY, Institute of Science.
Wallace JD, Mintzes JJ (1990). The Concept Map as a Research Tool: Exploring Conceptual Change in Biology. J. Res. Sci. Teach., 27: 1033 – 1052.
YÖK (1998). Elementary Science Teaching. National Education Development Project Publication, Ankara.