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IMPROVING THE STUDENT'S OPINION ABOUT THE NATURE OF SCIENCE WITH THE PROCESS-BASED ACTIVITIES BY THE TEACHERS WHO GET DISTANCE EDUCATION ABOUT THE NATURE OF SCIENCE

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Abstract

The purpose of this research is to identify the effect of the activities on student's opinion about the science nature which is prepared with the explicit reflective teaching approach and integrated with 9th grade biology lesson syllabus by the teachers who gets distance education about teaching the nature of science. For that purpose, in this research, quasi experimental design with pretest and posttest control group has been used. For that purpose, in this research, quasi experimental design with pretest and posttest control group has been used. 2 teachers and 114 students in an Anatolian High School in Meram/Konya have participated in this research in the whole 2014-2015 academic year. In this project, BDHGA Form C (a survey on the ideas about nature of the science), and YYG (semi-structured interview) and Rubic are used as data collecting tools. The qualitative data of the research has been analyzed with content analysis, descriptive analysis and document review. The quantitative data has been analyzed with the SPSS 17 software using ANOVA and T-test for related samples. According to the both quantitative and qualitative data obtained from the research, the experiment class, in which the teacher educated in distant about nature of science and has taught the topic in process based way to the students, is observed to be more developed in this topic than the other class. Also it is seen that only being educated about science nature of the teachers is not adequate. However, the usage of the explicit reflective activities integrated into syllabus has contributed to the perception of the students about the nature of science topic.

Keywords: Nature of the science, biology education, explicit reflective approach, distant training

1. Introduction

Today, the development level of the societies is directly related with the science and owning the knowledge. Because of that the usage of the scientific methods and approaches with scientific data by societies in their daily life is impacting their place and respectability among the other countries directly. That is why, the democratic societies of our day needs scientific literacy individuals who appreciates the science and contribution of the science to the society, has enough knowledge about the basics of the science and the way how science works and most importantly they need the individuals who can approach critically to the discussions and facts that science brought. Performing of scientific literacy is depends on the development of the individuals' mentality on the way that they can make conscious decisions and, participate to the discussions about science and technology (OBDOP 2013).

The consideration of the science literacy with its sub-dimensions is important for presenting the causes of serving it as an aim for everybody. With this understanding, the science literacy has taken into the consideration with three sub-dimensions:

1) Nature of Science

2) Relationship between Science-Technology-Society

3) Scientific Content Knowledge (Turgut, 2007).

1.1. Nature of Science

The efforts to understanding the nature of science can be based upon the beginning of the 1900s (Lederman, 1992). But there is no common definition about the nature of science by the scientists until now. McComas and others (1998) gave the definition by saying "The nature of science is a mix of the specifics of various social sciences including science sociology, science history and science philosophy with phycology and explaining the questions such as what is science and how it works, how scientists are working as a social group and, how society lead and reacts to the scientific efforts". We can define the relationship of these disciplines with this way. Philosophy examines what science is and how it works; sociology examines whom are the scientists and how they work; Phycology examines the characters of the scientists (Can, 2005).

While there is an agreement with great scale about which approaches can be used on teaching the nature of science to the student and teachers and which approaches can be more effective, there is some different opinions about classifying them (Abd-El-Khalick and Lederman, 2000(a); Khishfe and Abd-El-Khalick 2002; Koseoglu, Tumay and Ustun, 2008). The approaches used on teaching the nature of science is divided into a two group as implicit and explicit-reflective by some researchers (Abd-El-Khalick and Lederman, 2000(b); Akindehin 1988; Bybee, 2001; Erick, 2000; Schwartz, Lederman and Crawford, 2004; Solomon and others, 1992). There are also some researchers who are adding historical approach to these two approaches and dividing the approaches used on teaching nature of science into three groups (Khishfe and Abd-El-Khalick, 2002).

One of the most important preconditions of the scientific literacy is understanding the nature of science (McComas, Clough and Almazroa, 2000). That is why "understanding the nature of science" is one of the most important aims of the science curriculums (The Ministry of Education [MEB], 2005; National Research Council [NRC], 1996; American Association for the Advancement of Science [AAAS], 1990, 1993; Collette and Chiappetta,1987; National Science Teacher Association (NSTA), 1982). Students should be able to explain the nature of science viably with today's understanding at the end of their science education.

In this regard, studies are made for students and teachers to have a viably scientific understanding from the preschool till the end of the secondary education at the beginning of 1960s (Lederman, Abd-El-Khalick, Bell and Schwartz, 2002). It was determined on many research that teachers' beliefs and types of understanding the nature of science is effecting their teaching experiences (Lederman, 1992; Lederman, 1999; Murcia and Schibeci, 1999; Tairab, 2001; Lin and Chen, 2002; Dass, 2005; Akcay, 2006; Oztuna Kaplan, 2006; Waters-Adams, 2006). This result shows that teachers should have the earnings at a reasonable level regarding the existing knowledge. Existing literature shows us that teachers' opinion related to the nature of science is not enough (Macaroglu, Tasar and Cataloglu, 1998; Dickinson, Abd-El Khalick and Lederman, 2000; Abd-El Khalick, 2002; Thye and Kwen, 2003; Dogan Bora, 2005; Turgut, 2005, Wahbeh, 2009; Arı, 2010).

Many scientists reported that teachers should get in-service training to overcome the deficiencies (Dogan, 2005; Can, 2008; Muslu, 2008; Onen, 2011; Koyuncu, 2011; Savas, 2011; Ozcan, 2011; Sarac, 2012). When in-service training courses organized well and needed importance given to the teaching programs of the institutions that training teachers, scientific concepts of the students will improve (Lederman and Zeidler, 1987). That is why, firstly it should be focused on the education of teachers and candidate teachers to improve the student's concept about the nature of science.

With this regard, one willing biology teacher joined to the post graduate class which is called "Nature of Science and its Teaching" handled by one universities' Post Graduate program on Science Teaching at the Education Science Institute with distance education within the scope of in-service training at the 2013-2014 academic year Spring Term.

1.2. Aim of the Research

The aim of this research is investigating the effects of the teacher who got distance education about teaching the nature of science and the events based on long-planned for improving the student's opinion about the nature of science.

1.3. Problem Sentence

On this research, this question is asked; Is there any effect of the events that based on long-planned and teacher who got distance education about teaching the nature of science to improve the student's opinion about the nature of science?

The problem sentences of the research;

1) What is the effect of the events that based on long-planned and biology teacher to improve the 9th grade student's opinion about the nature of science?

2) What is the effect of the teachers who got distance education about teaching the nature of science to improve the 9th grade student's opinion about the nature of science?

2. METHOD

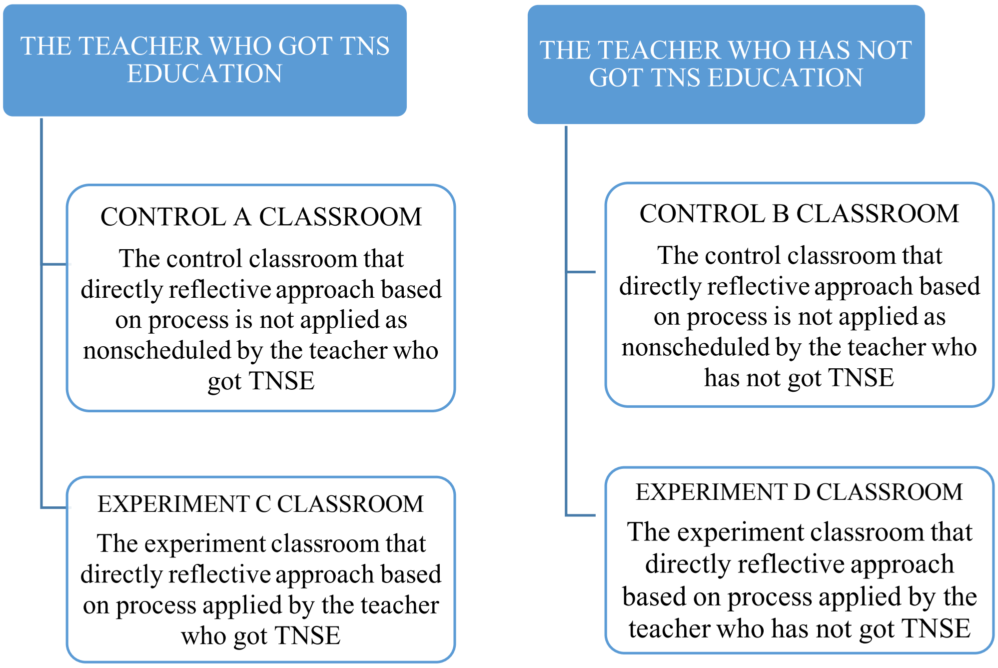
2.1 Research Model

Mixed method researches define as the qualitative and quantitative method, approach and concept that are from one study or following studies mixed by researcher (Creswell, 2003; Tashakkori and Teddlie, 1998; Johnson and Onwuegbuzie, 2004). In this study, mixed method research that enables the qualitative and quantitative method work together and "pre-test and post-test quasi-experimental design with control group" used.

2.2. Study Group

The study group of this research forms with the 9th grade students from 4 different classrooms in an Anatolian High School at the Center county of Konya (Meram) (n=114). Availability sampling method is used for picking the study group. In this method researcher study with a group that easy to reach and close (Yildirim and Simsek 2011). Two volunteer biology teacher has chosen that teaches these classrooms. One of the teachers had distance education about Teaching the Nature of Science (TNS) and the other one is not. On teaching the nature of science to the classrooms on the study group, the activities from the MEB's textbook for 9th grade students have applied to one group and the planned activities that prepared with directly reflective approach based on process has applied to the other group.

Table 1. *The study groups in the research*



2.3. Data Collection Tools

The data collection tools applied to the teachers and students who are in the study groups on this research is forms with the Views of Nature of Science Questionnaire (VNOS-C) improved by the Lederman (2002), semi-structured interviews (SSI) and Staggered Scoring Key (Ozcan, 2013).

The Staggered Scoring Key (SSK) developed by Ozcan (2013) has used on the research to watch and evaluate the changes and improvements on the teachers and students' opinion about the nature of science. While the intraclass correlation coefficient values of the VNOS-C and SSK was between 0.72 and 0.88, the Cronbach's Alpha Reliability Coefficient is between 0.92 and 0.97.

2.4. Data Analysis and Interpretation

As this research has mixed research method that the qualitative and quantitative methods used together, the data analysis is characterized by this situation (Buyukozturk, 2007). The qualitative and quantitative data analyze process gathered from research are shown at the Table 2.

Table 2. *Data analyze process*

Data Analyze Tools	Type	Data Analyze Methods
VNOS-C Pre-test and Post-test (Student)	Qualitative	Content Analyze
SSK(Student Surveys)	Quantitative	T test for Related Samples and
SSI	Qualitative	Content Analyze

As "Views of Nature of Science Questionnaire – Form C" that used for identify the students' opinion about the nature of science in this research generally using for qualitative researches, the data gathered from this scale has been resolved with content analyze and quantitative analyze methods (T test, ANOVA, Tukey). For analysis SPSS 17 package program has been used.

3. RESULTS

3.1. The Results Gathered from the Comparison of the Pre-Tests of the Research Groups

The VNOS-C survey has applied to the groups before the research. The scores that groups are gain about the nature of science from the answers has been compared with the Anova Test on the Table 3.

Table 3. *The Pre-test results of the groups related to the Nature of Science Element*

ANOVA						
		Sum of Squares	df	Mean Square	F	p
Changeability (pre-test)	Between Groups	12,699	3	4,233	,995	,398
	Within Groups	467,871	110	4,253		
	Total	480,570	113			
Experimentalism (pre-test)	Between Groups	3,994	3	1,331	,328	,805
	Within Groups	445,971	110	4,054		
	Total	449,965	113			
Observation and Inference (pre-test)	Between Groups	6,660	3	2,220	,813	,489
	Within Groups	300,497	110	2,732		
	Total	307,158	113			
Theory and Law (pre-test)	Between Groups	,282	3	,094	1,915	,131
	Within Groups	5,402	110	,049		
	Total	5,684	113			
Theory Loaded (pre-test)	Between Groups	5,258	3	1,753	,860	,464
	Within Groups	224,269	110	2,039		
	Total	229,526	113			
Imagination and Creativity (pre-test)	Between Groups	91,204	3	30,401	3,656	,105
	Within Groups	914,655	110	8,315		
	Total	1005,860	113			
Social and Cultural Effect (pre-test)	Between Groups	13,953	3	4,651	2,010	,117
	Within Groups	254,564	110	2,314		
	Total	268,518	113			

As it is seen on Table 3, there is no meaningful difference between the scores that group are gained from the VNOS-C survey about the elements of the nature of science ($p>0.05$). As a result of this, the level of the opinion about the nature of science of groups are same before the research.

3.2. The Results Gathered from the Comparison of the Post-Tests of the Research Groups

On this part, the comparison of the VNOS-C survey post-test scores that used after the application and elements of the nature of science as on the following.

3.2.1. '*Scientific Knowledge is open to change (Changeability)*' the statically comparison of the post-test of the groups about the elements of the nature of science

To understand if there is meaningful difference between the groups, the Anova test has applied (Table 4).

Table 4. *The Anova test results of the study groups for scientific knowledge is open to change dimension*

	Sum of Squares	df	Mean Square	F	p
Between Groups	608,640	3	202,880	9,587	000*
Within Groups	2327,774	110	21,162		
Total	2936,414	113			

*p<.05, is meaningful statistically ** is not meaningful statistically.

As it is seen on the Table 4, there is meaningful difference at least between the two of the groups. Which groups has that difference between them is identified with the Tukey Test (Table 5).

Table 5. *The Turkey test results of the study groups for scientific knowledge is open to change dimension*

(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	p
Control A	Control B	1,23030	1,29123	,776**
	Experiment C	-4,57386(*)	1,27404	,003*
	Experiment D	-,01970	1,29123	1,000**
Control B	Control A	-1,23030	1,29123	,776**
	Experiment C	-5,80417(*)	1,16905	,000*
	Experiment D	-1,25000	1,18776	,719**
Experiment C	Control A	4,57386(*)	1,27404	,003*
	Control B	5,80417(*)	1,16905	,000*
	Experiment D	4,55417(*)	1,16905	,001*
Experiment D	Control A	,01970	1,29123	1,000**
	Control B	1,25000	1,18776	,719**
	Experiment C	-4,55417(*)	1,16905	,001*

*p< .05, is meaningful statistically ** is not meaningful statistically.

As it is seen on the Table 5, there is a meaningful difference between the Experiment C classroom and the others. This difference is in favor to the Experiment C classroom (the classroom that process based activities applied by the teacher who got TNS education) (p<0.05).

3.2.2. '*Scientific Knowledge has an Experimental Nature (Experimentalism)*' the statically comparison of the post-test of the groups about the elements of the nature of science

To understand if there is meaningful difference between the scores that groups are gained, the Anova test has applied (Table 6).

Table 6. *The Anova test results of the study groups for the experimentalism dimension of the nature of science*

	Sum of Squares	df	Mean Square	F	p
Between Groups	1601,273	3	533,758	23,094	,000*
Within Groups	2542,385	110	23,113		
Total	4143,658	113			

*p< .05, is meaningful statistically ** is not meaningful statistically.

As it is seen on the Table 6, there is a meaningful difference at least between the two of the groups. Which groups has that difference between them is identified with the Tukey Test (Table 7).

Table 7. *The Turkey test results of the study groups for the experimentalism dimension of the nature of science*

(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	p
Control A	Control B	1,44394	1,34944	,708**
	Experiment C	-8,06960(*)	1,33148	,000*
	Experiment D	-3,02273	1,34944	,119**
Control B	Control A	-1,44394	1,34944	,708**
	Experiment C	-9,51354(*)	1,22176	,000*
	Experiment D	-4,46667(*)	1,24131	,003*
Experiment C	Control A	8,06960(*)	1,33148	,000*
	Control B	9,51354(*)	1,22176	,000*
	Experiment D	5,04688(*)	1,22176	,000*
Experiment D	Control A	3,02273	1,34944	,119**
	Control B	4,46667(*)	1,24131	,003*
	Experiment C	-5,04688(*)	1,22176	,000*

*p< .05, is meaningful statistically ** is not meaningful statistically.

As it is seen on the Table 7, there is a meaningful difference between the Experimental C classroom and the others. This difference is in favor to the Experiment C classroom (the classroom that process based activities applied by the teacher who got TNS education) (p<0.05). On the other hand, there is a meaningful difference between the Experimental D classroom (the classroom that process based activities applied by the teacher who has not got TNS education) and Control B classroom (the classroom that process based activities did not apply by the teacher who has not got TNS education) (p<0,05). This difference is in favor to the Experiment D classroom (the classroom that process based activities applied by the teacher who has not got TNS education).

3.2.3. 'Scientific Knowledge is depending on not only the observation but also the inference (Observation and Inference)' the statically comparison of the post-test of the groups about the elements of the nature of science.

To understand if there is meaningful difference between the scores that groups are gained, the Anova test has given on Table 8.

Table 8. *The Anova test results of the study groups for the observation and inference relations dimension of the nature of science*

	Sum of Squares	df	Mean Square	F	p
Between Groups	294,832	3	98,277	9,659	,000*
Within Groups	1119,238	110	10,175		
Total	1414,070	113			

*p< .05, is meaningful statistically ** is not meaningful statistically.

As it is seen on the Table 8, there is a meaningful difference at least between the two of the groups. Which groups has that difference between them is identified with the Tukey Test and it has given on Table 9.

Table 9. *The Turkey test results of the study groups for the observation and inference relations dimension of the nature of science*

(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	p
Control A	Control B	,69545	,89535	,865**
	Experiment C	-3,18892(*)	,88344	,003*
	Experiment D	,26212	,89535	,991**
Control B	Control A	-,69545	,89535	,865**
	Experiment C	-3,88438(*)	,81063	,000*
	Experiment D	-,43333	,82361	,953**
Experiment C	Control A	3,18892(*)	,88344	,003*
	Control B	3,88438(*)	,81063	,000*
	Experiment D	3,45104(*)	,81063	,000*
Experiment D	Control A	-,26212	,89535	,991**
	Control B	,43333	,82361	,953**
	Experiment C	-3,45104(*)	,81063	,000*

*p< .05, is meaningful statistically ** is not meaningful statistically.

As it is seen on the Table 9, there is a meaningful difference between the Experimental C classroom and the others. This difference is in favor to the Experiment C classroom (the classroom that process based activities applied by the teacher who got TNS education) ($p<0.05$).

3.2.4. 'Scientific Theories and Scientific Laws Are Different Types of Information (Theory and Law Relation)' the statically comparison of the post-test of the groups about the elements of the nature of science.

To understand if there is meaningful difference between the scores that groups are gained, the Anova test has given on Table 10.

Table 10. *The Anova test results of the study groups for the theory and law relations dimension of the nature of science*

	Sum of Squares	df	Mean Square	F	p
Between Groups	63,093	3	21,031	16,419	,000*
Within Groups	140,898	110	1,281		
Total	203,991	113			

*p< .05, is meaningful statistically ** is not meaningful statistically.

As it is seen on the Table 10, there is a meaningful difference at least between the two of the groups. Which groups has that difference between them is identified with the Tukey Test and it has given on Table 11.

Table 11. *The Turkey test results of the study groups for the theory and law relations dimension of the nature of science*

(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	p
Control A	Control B	,06515	,31768	,997**
	Experiment C	-1,67756(*)	,31345	,000*
	Experiment D	-,15152	,31768	,964**
Control B	Control A	-,06515	,31768	,997**
	Experiment C	-1,74271(*)	,28762	,000*
	Experiment D	-,21667	,29222	,880**
Experiment C	Control A	1,67756(*)	,31345	,000*
	Control B	1,74271(*)	,28762	,000*
	Experiment D	1,52604(*)	,28762	,000*
Experiment D	Control A	,15152	,31768	,964**
	Control B	,21667	,29222	,880**
	Experiment C	-1,52604(*)	,28762	,000*

*p< .05, is meaningful statistically ** is not meaningful statistically.

As it is seen on the Table 11, there is a meaningful difference between the Experimental C classroom and the others. This difference is in favor to the Experiment C classroom (the classroom that process based activities applied by the teacher who got TNS education) (p<0.05).

3.2.5. 'Scientific Knowledge is loaded with Theory (Theory Loaded)' the statically comparison of the post-test of the groups about the elements of the nature of science.

To understand if there is meaningful difference between the scores that groups are gained, the Anova test has given on Table 12.

Table 12. *The Anova test results of the study groups for the theory loaded dimension of the nature of science*

	Sum of Squares	df	Mean Square	F	p
Between Groups	121,656	3	40,552	7,390	,000*
Within Groups	603,625	110	5,487		
Total	725,281	113			

*p< .05, is meaningful statistically ** is not meaningful statistically.

As it is seen on the Table 12, there is a meaningful difference at least between the two of the groups. Which groups has that difference between them is identified with the Turkey Test and it has given on Table 13.

Table 13. *The Tukey test results of the study groups for the theory loaded dimension of the nature of science*

(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	p
Control A	Control B	,31364	,65753	,964**
	Experiment C	-2,15199(*)	,64878	,007*
	Experiment D	,04697	,65753	1,000**
Control B	Control A	-,31364	,65753	,964**
	Experiment C	-2,46563(*)	,59532	,000*
	Experiment D	-,26667	,60484	,971**
Experiment C	Control A	2,15199(*)	,64878	,007*
	Control B	2,46563(*)	,59532	,000*
	Experiment D	2,19896(*)	,59532	,002*
Experiment D	Control A	-,04697	,65753	1,000**
	Control B	,26667	,60484	,971**
	Experiment C	-2,19896(*)	,59532	,002*

*p< .05, is meaningful statistically ** is not meaningful statistically.

As it is seen on the Table 13, there is a meaningful difference between the Experimental C classroom and the others. This difference is in favor to the Experiment C classroom (the classroom that process based activities applied by the teacher who got TNS education) (p<0.05).

3.2.6. 'Scientific Knowledge Contains Imagination and Creativity (Imagination and Creativity)' the statically comparison of the post-test of the groups about the elements of the nature of science.

To understand if there is meaningful difference between the scores that groups are gained, the Anova test has given on Table 14.

Table 14. *The Anova test results of the study groups for the imagination and creativity dimension of the nature of science*

	Sum of Squares	df	Mean Square	F	p
Between Groups	1095,406	3	365,135	14,465	,000*
Within Groups	2776,716	110	25,243		
Total	3872,123	113			

*p< .05, is meaningful statistically ** is not meaningful statistically.

As it is seen on the Table 14, there is a meaningful difference at least between the two of the groups. Which groups has that difference between them is identified with the Tukey Test and it has given on Table 15.

Table 15. *The Tukey test results of the study groups for the imagination and creativity dimension of the nature of science*

(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	p
Control A	Control B	1,30303	1,41026	,792**
	Experiment C	-6,50426(*)	1,39149	,000*
	Experiment D	-,83030	1,41026	,935**
Control B	Control A	-1,30303	1,41026	,792**
	Experiment C	-7,80729(*)	1,27682	,000*
	Experiment D	-2,13333	1,29725	,358**
Experiment C	Control A	6,50426(*)	1,39149	,000*
	Control B	7,80729(*)	1,27682	,000*
	Experiment D	5,67396(*)	1,27682	,000*
Experiment D	Control A	,83030	1,41026	,935**
	Control B	2,13333	1,29725	,358**
	Experiment C	-5,67396(*)	1,27682	,000*

*p< .05, is meaningful statistically ** is not meaningful statistically.

As it is seen on the Table 15, there is a meaningful difference between the Experimental C classroom and the others. This difference is in favor to the Experiment C classroom (the classroom that process based activities applied by the teacher who got TNS education) (p<0.05).

3.2.7. 'Scientific Knowledge gets Effected by Social and Cultural Values (Social and Cultural Effect)' the statically comparison of the post-test of the groups about the elements of the nature of science.

To understand if there is meaningful difference between the scores that groups are gained, the Anova test has given on Table 16.

Table 16. *The Anova test results of the study groups for the social and cultural effect dimension of the nature of science*

	Sum of Squares	df	Mean Square	F	p
Between Groups	149,182	3	49,727	5,112	,002*
Within Groups	1069,960	110	9,727		
Total	1219,143	113			

*p< .05, is meaningful statistically ** is not meaningful statistically.

As it is seen on the Table 16, there is a meaningful difference at least between the two of the groups. Which groups has that difference between them is identified with the Tukey Test and it has given on Table 17.

Table 17. *The Tukey test results of the study groups for the social and cultural effect dimension of the nature of science*

(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	p
Control A	Control B	,91667	,87542	,722**
	Experiment C	-2,09375	,86377	,078**
	Experiment D	-,15000	,87542	,998**
Control B	Control A	-,91667	,87542	,722**
	Experiment C	-3,01042(*)	,79259	,001*
	Experiment D	-1,06667	,80527	,549**
Experiment C	Control A	2,09375	,86377	,078**
	Control B	3,01042(*)	,79259	,001*
	Experiment D	1,94375	,79259	,073**
Experiment D	Control A	,15000	,87542	,998**
	Control B	1,06667	,80527	,549**
	Experiment C	-1,94375	,79259	,073**

*p< .05, is meaningful statistically ** is not meaningful statistically.

As it is seen on the Table 7, within the *'scientific knowledge gets effected by social and cultural values'* element there is a meaningful difference between the Experimental C classroom (the classroom that process based activities applied by the teacher who got TNS education) and Control B Classroom (the classroom that process based activities did not apply by the teacher who has not got TNS education). This difference is in favor to the Experiment C classroom (the classroom that process based activities applied by the teacher who got TNS education) ($p<0.05$). On the other hand, there is not any meaningful difference between the Experimental D classroom (the classroom that process based activities applied by the teacher who has not got TNS education) and Experimental C Classroom and Control A classroom (the classroom that process based activities did not apply by the teacher who has got TNS education) ($p<0,05$).

4. Discussion and Results

When the literature has examined about our countries' researches, it is seen that they are studies performed on a unit of the curriculum which are about the activities prepared with the different approaches of the nature of science or the due diligence of the teachers and students' opinion about the nature of science (Sarkar, 2010; Damlı-Pervan, 2011; Baraz, 2012; Eroglu, 2012; Onen, 2013; Aglarcı, 2014). In this study the activities applied to make teaching the nature of science happen in all the units belonging to the curriculum to reach understanding of the nature of scientific knowledge that targeted as a basic skill on the biology curriculum which released at 2013. On the other hand, it is mentioned in many studies that the necessity of teachers should get the nature of science education to improve students' opinion about the nature of science (Dogan, 2005; Can, 2008; Muslu, 2008; Onen, 2011; Koyuncu, 2011). It is understood from this studies' outcome that getting education about the nature of science is not enough for the teachers only by itself. But when the teacher who gets the education about this matter applies the directly reflected activities that prepared process based to teach the nature of science, it makes great contribution to improving the students' understanding the nature of science on all the examined dimensions of the nature of science.

According to results of the research, it is seen that the students who applied directly reflected activities that prepared process based has better level of improvement than the students who gets the nature of science education only from the activities on the MEB's 9th course book by the teacher who did not get the TNS education on the *experimental nature of scientific knowledge* dimension (Table 7). So this results shows us that the activities and experiments on the MEB's 9th grade course book should be enriching with the directly reflected activities that prepared process based. After this general results of the research, the results for dimensions of the nature of science has explained as on the following.

To understand the results of the research the codes of the classrooms on the study group has given at this section again.

Control A Classroom: The classroom that process based activities has not applied by the teacher who has got TNS education.

Control B Classroom: The classroom that process based activities has not applied by the teacher who has not got TNS education.

Experiment C Classroom: The classroom that process based activities has applied by the teacher who has got TNS education.

Experiment D Classroom: The classroom that process based activities has applied by the teacher who has not got TNS education.

4.1. The Results Related to the Scientific Knowledge is Open to Change (Changeability) Nature of Science Element

There is no meaningful difference between the students who are from the control and experiment classrooms that constituent the sample before the research (Table 3, p>,05). After the application it is identified that there is a meaningful difference between the Experiment C Classroom's students' scores which teaching the nature of science applied by depending on directly reflective process based activities by the teacher who has got TNS education and the scores of the other groups' students (Table 5, p<.05). But when we search the reason of this improvement of the students about this dimension, it is significant that there is no meaningful difference between the post-tests of the Control A and Control B classrooms which are meant to be to show the effect of the nature of science education gets by the teacher via distance education. Also the same way, it is significant that there is no difference statistically between the Control A classroom that activities has not applied by the teacher who got TNS education and Experiment D classroom that activities applied by the teacher who has not got the education which shows the effect of the activities that depends on process. After these results, it can be said that only getting the education by the teachers via distance education or only giving the nature of science education to the students via the activities that are depending on the process is not causing any difference to the students about this dimension. This result is matching up with the study of Schwartz and Lederman (2002) which is a study about comparing the teaching the nature of science to the students after a program about the nature of science (MAT) participated by the two biology teachers who has different NOS knowledge, scientific history and experience. This study tells that the nature of science is not teaching well enough and teachers' beliefs, pedagogical content knowledge, intention and classroom activities has an important role for teaching the nature of science to the students. This improvement is complying with the results of the study of Akerson and Volrich (2006), the improvement that is resulting from running together the teaching of the nature of science depending on the activities prepared with the directly reflected opinion and getting the TNS education by the teacher. On their study Akerson and Volrich (2006) gave an education to a candidate teacher and after this education it is seen that the candidate teacher is planning the open-challenging approach well on teaching the nature of science and the teacher is teaching the nature of science in accordance with the advised reforms and resulting of these it is understood that the 1st grade students can understand the nature of science. This study shows resemblance with the results of the other studies done by Lederman and O'Maley (1990), Lederman and Abd-El-Khalick, (1998), Akerson, Abd-El-Khalick and Lederman (2000), Küçük (2006) Lederman and Lederman (2004) which are the result of the education that done in accordance with the nature of science element '*Scientific Knowledge is open to change'*.

4.2. The Results Related to the Scientific Knowledge has an Experimental Nature (Experimentalism) Nature of Science Element

It is seen that there is a meaningful difference after the application between the Experiment C classroom that the nature of science education applied which is depending on the activities prepared with the directly reflective opinion by the teacher who got TNS education and the other classrooms (Table 7, $p<.05$) while there is no difference between the opinions of the control and experiment classrooms' students about this dimension before the research (Table 3, $p>.05$). It is obvious that this difference resulting from applying the directly reflective activities that are depending on the process more than the teacher's got TNS education. It is seen from the results of the research that applying of the process based activities in the classroom is more effective than the in-service training by the distance education alone by itself on this dimension of teaching the nature of science. Because it is seen that there is a statically meaningful difference in favor of the students who are from the Experiment classroom that activities are applied between the control and experiment classroom's students of the teacher who did not get TNS education. It is seen that the improvement on the nature of science dimension that *'Scientific knowledge has an experimental nature'* is resulting because of the applied activities on the classroom that process based activities applied. These results are matching with the Kucuk's study (2008) which is aiming to improve the opinion of the 20 candidate teachers about the nature of science by using the directly reflected activities and after the application the improvement has seen on their opinion about *'experimentalism of the scientific knowledge'*. It is also showing some similar results with the studies of Koksal (2010) and Onen (2011) which are about *'experimentalism of the scientific knowledge'.*

4.3. The Results Related to the Scientific Knowledge is Depending on Inference Besides the Observation (Observation and Inference Relation) Nature of Science Element

There is no difference between the opinions of the control and experiment classrooms' students about this dimension before the research (Table 3, $p>.05$). It is identified that there is a meaningful difference between the other classrooms of the sample and Experiment C classroom that the nature of science education applied which is depending on the activities prepared with the directly reflective opinion by the teacher who got TNS education (Table 9, $p<.05$).

It is understood that getting the nature of science education via distance education by teacher is not enough by alone on this dimension of the nature of science and this is showed us with the post-tests' results of the Control A and Control B classrooms (Table 9, $p>.05$). On the other hand, we understood that process based activities are not enough by alone on the improvement of the students' opinion about this dimension of the nature of science and this is understood by seeing that there is no statically meaningful difference between the post-tests of the Control A classroom that process based activities has not applied by the teacher who got TNS education and Experiment D classroom that process based activities has applied by the teacher who has not got the education (Table 9, p>.05). These results are showing us that getting the education via distance education by the teacher is alone by itself or giving the nature of science education to the students with the process based activities is alone by itself is not making any progress to the students on this dimension. We are seeing the similar situation on the students as this one on the studies of Onen (2011) and Koksal (2010) and these studies' results are showing us that there is no single method on science and the students has wrong ideas about the observation-inference relation. It is also showing some similar results with the study of Liu and Lederman (2002) which they did via open-challenging teaching and they could not find any significant difference related to this dimension of the nature of science.

4.4. The Results Related to the Scientific Theories and Scientific Laws Are Different Types of Information (Theory and Law Relation) Nature of Science Element

There is no difference between the opinions of the control and experiment classrooms' students about this dimension before the research (Table 3, p>.05). It is identified that there is a meaningful difference between the other classrooms of the sample and Experiment C classroom that the nature of science education applied which is depending on the activities prepared with the directly reflective opinion by the teacher who got TNS education (Table 11, p<.05).

It is a significant result that there is no difference between the post-tests' results of the Control A and Control B classrooms which are making possible to examine the effect of getting the nature of science education by the teacher via distance education on this dimension (Table 11, p>.05) and also it is significant that there is no statically meaningful difference between the post-tests of the Control A classroom that process based activities has not applied by the teacher who got TNS education and Experiment D classroom that process based activities has applied by the teacher who has not got the education (Table 11, p>.05). These results are showing us that getting the education via distance education by the teacher is alone by itself or giving the nature of science education to the students with the process based activities is alone by itself is not making any progress to the students on this dimension. This result is matching with the studies of Kucuk (2006), Dogan and his friends (2011) which are showing there is not enough progress on the students' opinion about the dimension of 'scientific theories and scientific laws are different types of information'. It is also harmonizing with the results of the researches of Metz (2002) and Gul (2014) which are shows after the application, it is identified that the existing misunderstanding of the students related to the theory and laws are quelled.

4.5. The Results Related to the Scientific Knowledge Loaded with the Theory (Theory Loaded) Nature of Science Element

There is no difference between the opinions of the control and experiment classrooms' students about this dimension before the research (Table 3, p>.05). It is identified that there is a meaningful difference between the other classrooms of the sample and Experiment C classroom that the nature of science education applied which is depending on the activities prepared with the directly reflective opinion by the teacher who got TNS education (Table

13, p<.05). Same as the other dimensions of the nature of science that examined in this study, here in this dimension we come across that there is no difference between the post-tests' results of the Control A and Control B classrooms which are making possible to examine the effect of getting the nature of science education by the teacher via distance education on this dimension (Table 13, p>.05) and also that there is no statically meaningful difference between the post-tests of the Control A classroom that process based activities has not applied by the teacher who got TNS education and Experiment D classroom that process based activities has applied by the teacher who has not got the education (Table 13, p>.05). This situation is showing us that getting the education via distance education by the teacher is alone by itself or giving the education to the students with the process based activities is alone by itself is not making any progress to the students on this dimension. This result is resembling with the study of Cil (2010) which is done to search the nature of science with the directly reflected approach and conceptual change pedagogy and resulted with enough level of improvement at the end.

This research has similarities with the studies of Akerson, Abd-El-Khalick and Lederman (2000), Lederman and Lederman (2004), Kucuk (2006) and Ozcan (2013) but it is different from the studies of Lederman and Abd-El-Khalick (1998), Liu and Lederman (2002) which are showing less improvement on the content knowledge after the application.

4.6. The Results Related to the Scientific Knowledge Contains Imagination and Creativity (Imagination and Creativity) Nature of Science Element

There is no difference between the opinions of the control and experiment classrooms' students about this dimension before the research (Table 3, p>.05). It is identified that there is a meaningful difference between the other classrooms of the sample and Experiment C classroom that the nature of science education applied which is depending on the activities prepared with the directly reflective opinion by the teacher who got TNS education (Table 15, p<.05).

These results are matching up with the results of the researches such as (Akerson and others, 2006; Kucuk 2006; ayvacı 2007; Metin 2009) which are identified effective for teaching the 'imagination and creativity' element of the directly reflected approach activities in the literature. Similar as these results, on a study done by Koksal (2010) it is identified that the opinion of the students related to the imagination and creativity on science was enough before the application and it even become more enough after the application. Besides there is matching results with this study on the studies of Cavus (2010), Onen (2011) and Ozcan (2013). On the other hand, this research has similarities with the studies of Abd-El- Khalick 1998; Akerson, Abd-El-Khalick and Lederman (2000), Akerson and Abd-El-Khalick (2003), Lederman and Lederman (2004) and Kucuk (2006) which are showing less improvement on the content knowledge after the application but it is different from the study of Khishfe and Abd-El- Khalick (2002) in the literature.

4.7. The Results Related to the Scientific Knowledge Gets Effected by the Social and Cultural Values (Social and Cultural Effect) Nature of Science Element

There is no difference between the opinions of the control and experiment classrooms' students about this dimension before the research (Table 3, p>.05). After the application it is identified that there is meaningful difference between Experiment C classroom that the nature of science education applied which is depending on the activities prepared with the directly reflective opinion by the teacher who got TNS education and Control B classroom that the study group that the process based activities has not applied by the teacher who has not got the TNS education (Table 17, $p<.05$). Also it is identified that there is no meaningful difference between the post-tests of the Experiment C classroom and Control A classroom that teacher has got the TNS education and Experiment D classroom that process based activities applied by the teacher who has not got the TNS education (Table 17, $p>.05$). And these results are showing us that getting TNS education by the teacher and applying the directly reflected activities in the classroom has positive effect on the improvement of the students' opinion about the nature of science on this dimension.

With the results of this study high level improvements are gained on students and teachers' opinion about this dimension of the nature of science on the contrary to the studies of Abd-El-Khalick and Lederman (2000) that done together. Similarly, Matkins and Bellin (2007) identified on their study that the opinion of candidate teachers related socio-cultural nature of scientific knowledge is not enough. On the study of Vanderlinden (2007) after the application it is identified that students have more effective understanding on some dimensions of the nature of science such as the process diversity of structuring the science, social and cultural effect on the process of structuring the science. These results are supporting the results of this dimension of the research. At the result of this study it is seen that the need of in-service training for the teachers about the nature of science suggested by many researchers in the literature is not enough by itself on improving the opinion about the nature of science. When the teacher's in-service training is supported by the activities which are integrated to the curriculum, the improvement of the students' opinion about the nature of science will be high level.

The suggestions after the examination of the results from the research is as on the following;

1. It is obvious that the TNS education via distance education is convenience in terms of place, time and economically. In this study it is understood that this kind of education is effective about the TNS. If the models of TNS education via distance education is develope and generalize, more students can be improved about the TNS.

2. According to the results of the research, the nature of science activities on the MEB's 9^{th} grade biology course book has not enough contribution to the improvement of the students' opinion about the nature of science. Supporting the activities on the course book with the process based directly reflected activities will be helpful on the improvement of the student's opinion about the nature of science.

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References

Abd-El-Khalick, F., Bell, R. L. & Lederman, N. G. (1998). The nature of science and instructional practice: Making the unnatural natural. Science Education, 82(4), 417-436.

Abd-El-Khalick, F. & Lederman, N. G. (2000a). Improving science teachers conceptions of nature of science: A critical review of the literature. International Journal of Science Education, 22(7), 665-701.

Abd-El-Khalick, F., & Lederman, N.G. (2000b). The influence of history of science courses on students' views of nature of science. Journal of Research In Science Teaching, 37(10), 1057-1095.

Abd-El-Khalick, F. (2002). Rutherford's enlarged: A content-embedded activity to teach about nature of science. Physics Education, 37(1), 64-68.

Akçay, B. (2006). The analysis of how to improve student understanding of the nature of science: A role of teacher. Asia-Pasific Forum on Science Learning and Teaching, 7(2), 10.

Akerson, V. L., Abd-El-Khalick, F., & Lederman, N. G. (2000). Influence of a reflective explicit activity-based approach on elementary teachers‟ conceptions of nature of science. Journal of Research in Science Teaching, (37), 295–317.

Akerson, V. L., & Abd-El-Khalick, F. (2003). Teaching elements of nature of science: A yearlong case study of a fourth-grade teacher. Journal of Research in Science Teaching, 40(10),1025-1049.

Akerson V. L., & Volrich M.V. (2006). Teaching nature of science explicitly in a firstgrade internship setting. Journal of Research in Science Teaching, 43(4), 377-394.

Akerson, V. L., Morrison, J. A., & McDuffie A. R. (2006). One course is not enough: Preservice elementary teachers' retention of improved views of nature of science. Journal of Research in Science Teaching, 43(2), 194-213.

Akindehin, F. (1988). Effect of an instructional package on preservice science teachers' understanding of the nature of science and acquisition of science-related attitudes. Science Education, (72), 73–82.

American Association for the Advancement of Science. (1990). Science for All Americans. New York: Oxford University Press.

American Association for the Advancement of Science. (1993). Benchmarks for Science Literacy: A Project 2061 Report. New York: Oxford University Press.

Arı, Ü. (2010). Investigation of the preservice science teachers? and preservice classroom teachers? wiews on nature of science. Master Thesis, Fırat Unıversty Institute of Science and Technology, Elazığ.

Ayvacı, H. Ş. (2007). A study toward teaching the nature of science based on different approaches for classroom teachers in gravity content. Doctoral Dissertation, Karadeniz Technical Unıversty Institute of Science and Technology, Trabzon.

Büyüköztürk, Ş. (2007). What is Performance-Based Status Determination? Primary Teachers: Educators Journal, 8, 28-32.

Bybee, R. (2001). Teaching about evolution: Old controversy, new challenges. BioScience, 51(4), 309-312.

Can, B. (2005). Viwes of the preservice teachers about nature of science and science teaching. Master Thesis, Dokuz Eylül Unıversty Institute of Education Sciences, İzmir.

Can, B. (2008). The factors effecting elemantary school students? understanding on nature of science. Doctoral Dissertation, Dokuz Eylül Unıversty Institute of Education Sciences, İzmir.

Collette, A. T., & Chiappetta, E. L. (1987). Science ınstruction in the middle and secondary schools. Ohio: Merill Publishing Company.

Creswell, J. W. (2003). Research design: Qualitative, quantitative, and mixed methods approaches (2nd ed.). Thousand Oaks, CA: Sage.

Çavuş, S. (2010). Improving science and mathematics pre-service teachers' conseptions of nature of science. Master Thesis, Abant İzzet Baysal Üniversitesi Social Sciences Institute, Bolu.

Dass, P. M. (2005). Understanding the nature of science of scientific enterprise (nose) through a discourse with its history. International Journal of Science and Mathematics Education, 3, 87-115.

Dickinson, V. L., Abd-El Khalick, F., & Lederman, N. G. (2000). Changing elementary teachers' views of the nos: Effective strategies for science methods courses. ED, 441-680.

Doğan, N. B. (2005). Investigating science teachers' and high school students' views on the nature of science in Turkey. Doctoral Dissertation, Gazi Universty Institute of Education Sciences, Ankara.

Doğan, N., Çakıroğlu, J., Çavuş, S., Bilican, K., & Arslan, O. (2011). Developıng scıence teachers' nature of scıence vıews: the effect of ın-servıce teacher educatıon program. Hacettepe Universty Journal of Education, (40), 127-139.

Eick, C. J. (2000). Inquiry, nature of science, and evolution: The need for a more complex pedagogical content knowledge in science teaching. Electronic Journal of Science Education,http://unr.edu/homepage/crowther/ejse/eick.html sayfasından erişilmiştir.

Gül, E. M. (2014). The effect of two complementary courses which were designed with explicit–reflective approach to nature of science understanding. Master Thesis, İnönü Universty Institute of Education Sciences, Malatya.

Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. Educational Researcher, 33(7), 14-26.

Khisfe, R., & Abd-El-Khalick, F. (2002). Influence of explicit and reflective versus implicit inquiry- oriented instruction on sixth graders views of nature of science. Journal of Research in Science Teaching, 39(7), 551-578.

Koyuncu, B. (2011). Study of relationship between values, academic achievements and opinions of physics, chemistry and biology teacher candidates concerning the nature of science. Master Thesis, Gazi Universty Institute of Education Sciences, Ankara.

Köksal, M. S. (2010). The effect of explicit embedded reflective instruction on nature of science understandings, scientific literacy levels and achievement on cell unit. Doctoral Dissertation, Middle East Technical University, Ankara.

Köseoğlu, F., Tümay H., & Budak E. (2008). Paradigm changes about nature of science and new teaching aproaches. Gazi Universty, Gazi Education Faculty Journal, 28(2), 221-237.

Küçük, M. (2006). A study toward teaching the nature of science for seventh grade primary students. Doctoral Dissertation, Karadeniz Teknik University Institute of Science and Technology, Trabzon.

Küçük, M. (2008). Improving preservice elementary teachers' views of the nature of science using explicit- reflective teaching in a science, technology and society course. Australian Journal of Teacher Education, 33(2), 16-40.

Lederman, N. G., & Zeidler, D. L. (1987). Science teachers' conceptions of the nature of science: do they really ınfluence teaching behavior? Science Education, 71(5),721-734.

Lederman, N. G., & O'Malley, M. (1990). Students' perceptions of tentativeness in science: Development, use and source of change. Science Education, 74, 225-239.

Lederman, N. G. (1992). Students and teachers conceptions of the nature of science: Areview of the research. Journal of Research in Science Teaching, 29(4), 331-359.

Lederman, N. G., Wade, P. D., & Bell, R. L. (1998). Assessing the nature of science: what is the nature of our assessments? Science & Education, 7(6), 595-615.

Lederman, N. G., & Abd-El-Khalick, F. (1998). Avoiding de-natured science: Activities that promote understandings of the nature of science. In W. F. McComas (Eds.), The nature of science in science education: Rationales and strategies (pp. 83-126). Newyork:KluwerAcademic Publishers.

Lederman, N.G. (1999). Teachers understanding of the nature of science and classroom practice: factors that facilitate or impede the relationship. Journal of Research in Science Teaching, 36(8), 916-929.

Lederman, N. G., Abd-El-Khalick, F., Bell, R. L., & Schwartz, R. S. (2002). Views of natüre of science questionnaire: Toward valid and meaningful assessment oflearners' conceptions of nature of science. Journal of Research in Science Teaching, 39(6), 497-521.

Lederman J. S., & Lederman N.G. (2004, April). Early elementary students' and teacher's understandings of nature of science and scientific inquiry: Lessons learned from project ICAN. Paper Presented at the Annual Meeting of the National Association for Research in Science Teaching, Vancouver, British Columbia.

Lin, H. S., & Chen, C. C. (2002). Promoting preservice chemistry teachers‟understanding about the nature of science through history. Journal of Research in Science Teaching, 39(9), 773-792.

Liu, S. Y., & Lederman, N. G. (2002). Taiwanese students' views of nature of science. School Science and Mathematics, 102(3), 114-122.

Macaroğlu, E., Taşar, M. F., & Çataloğlu, E. (1998, April). Turkish preservice elementary school teachers' beliefsabout the nature of science. A paper presented at the annual meeting of National Association for Research in Science Teaching (NARST),San Diego.

Matkins, J. J., & Bell, R. (2007). Awakening the scientist ınside: Global climate change and thenature of science in an elementary science methods course. Journal of Science Teacher Education, 18, 137–163.

McComas, W. F. (1998). The principal elements of the nature of science: Dispelling the myths of science. In W. F. McComas (Eds.), The Nature of Science in Science

Education: Rationales and Strategies (pp. 53-70). Kluwer (Springer) Academic Publishers.

McComas, W. F., Clough, M. P. & Almazroa, H. (2000). The role and the character of the nature of science. In W. F. McComas (Eds), The Nature of Science in Science Education:Rationales and Strategies (pp. 331-350). Dordrecht, Kluwer Academic Publishers.

Metin, D. (2009). The effectiveness of guided-inguiry and explicit nature of science activities applied at a summer science camp on sixth and seventh grade children?s views of the nature of science. Master Thesis, Abant İzzet Baysal Universty, Social Sciences Institute, Bolu.

Metz, D. J. (2002). Understanding the nature of science through the historical development of conceptual models. Doctoral dissertation, University of Manitoba, Winnipeg**.**

Mıhladız, G. (2010). Investigation of the preservice science teachers? pedagogical content knowledge about the nature of science, Doctoral Dissertation, Gazi Universty Institute of Education Sciences, Ankara.

Ministry of Education. (2005). Elementary Science and Technology Course, 4-8. Classes Curriculum. The Ministry of Education Board of Education, Ankara.

Ministry of Education. (2013). High School Biology Curriculum. The Ministry of Education Board of Education, Ankara.

Murcia, K., & Schibeci, R. (1999). Primary student teachers conceptions of the nature of science. International Journal of Science Education, 21(11), 1123-1140.

Muşlu, G. (2008). Determining the 6th grade students? questioning of the nature of science and improving it with various studies. Doctoral Dissertation, Marmara Universty Institute of Education Sciences, İstanbul.

National Science Teacher Association (NSTA) (1982). Science-Technology-Society:Science Education for the 1980 s: NSTA position statement. Washington, DC.

National Research Council (NRC). (1996). National Science Education Standards. Washington, DC:National Academy Press.

Önen, F. (2011). The impact of integrated and non-integrated explicit reflective teaching activities on preservice science teachers? view on nature of scientific knowledge: Atom and chemical bonds. Doctoral Dissertation, Marmara Universty Institute of Education Sciences, İstanbul.

Özcan, I. (2011). Development of an instrument for the nature of science beliefs and identifying of the nature of science believing of pre-service science teachers. Master Thesis, Marmara Universty Institute of Education Sciences, İstanbul.

Özcan, H. (2013). Development of pre-service science teachers' pedagogical content knowledge for nature of science embedded into science content. Doctoral Dissertation, Gazi Universty Institute of Education Sciences.

Öztuna-Kaplan, A. (2006). A case study: How prospective science teachers' epistemological beliefs inform their practice teaching. Doctoral Dissertation, Marmara Universty Institute of Education Sciences, İstanbul.

Saraç, E. (2012). Views of the elementary teachers and preservice elementary teachers about the nature of science. Master Thesis, Akdeniz Universty Institute of Education Sciences, Antalya.

Savaş, E. (2011). The 8th grade students' knowledge of the definition and characteristics of scientific knowledge. Master Thesis, Hacettepe Universty The Institute of Social Sciences, Ankara.

Schwartz, S. R., & Lederman, N. G. (2002). “It s the Nature of the Beast”: The influence of knowledge and intentions on learning and teaching nature of science. Journal of Research in Science Teaching, 39(3), 205-236.

Schwartz, R. S., Lederman, N. G., & Crawford, B. A. (2004). Developing views of nature of science in an authentic context: An explicit approach to bridging the gap between natüre of science and scientific inquiry. Science education, 88(4), 610-645.

Solomon, J., Duveen, J., Scot, L., & McCarthy, S. (1992). Teaching about the nature of science through history: Action research in the classroom. Journal of Research in Science Teaching, 29(4),409-421.

Tairab, H. H. (2001). How do pre-service and ın-service science teachers view the nature of science and technology? Research in Science & Technological Education, 19(2), 236-250.

Tashakkori, A., & Teddlie, C. (1998). Mixed methodology: Combining qualitative and quantitative approaches. Applied Social Research Methods Series, Thousand Oaks, CA: Sage.

Thye, T. L., & Kwen, B. H. (2003). Assessing the nature of science views of Singaporean pre-service teachers. A paper presented at the annual conference of the New Zealand/Australian Association for Research in Education, Auckland.

Turgut, H. (2005). The effect of constructivist design application on prospective science teachers' scientific literacy competence improvement at the dimensions of 'nature of science ' and 'science-technology-society interaction'. Doctoral Dissertation, Yıldız Teknik Universty, The Institute of social sciences, İstanbul.

Turgut, H. (2007). Scientific literacy for everyone. Journal of Faculty of Educational Sciences, 40(2), 233-256.

Vanderlinden, D. W. (2007). Teaching the content and context of science: the effect of historical narratives to teach the nature of science and esience content in an undergraduate introductory geology course. Doctoral dissertation, Iowa State University, Ames, Iowa.

Yıldırım, A. & Şimşek, H. (2011). Qualitative research methods in the social sciences. (8. Printing). Ankara: Seçkin Publishing.

Wahbeh, N. A. K. (2009). The effect of a content-embedded explicit-reflective approach on inservice teachers' views and practices related to nature of science. Doctoral Dissertation, University of Illinois, Urbana, Illinois.

Waters-Adams, S. (2006). The relationship between understanding of the nature of scienceand practice: The influence of teachers beliefs about education, teaching and learning. International Journal of Science Education, 28(8), 919–944.