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Comparison of Pre-Service Science and Pre-Service Primary School Teachers' Nature of Science Views

By

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Abstract

The study aims to investigate pre-service science and primary school students' views of nature of science and compare the views of them. The descriptive scanning method has been used in the study. Pre-service science teachers (PST) and pre-service primary teachers (PPT) who attend Sütçü İmam University, Faculty of Education, Departments of Science and Primary School Education in the fall semester of 2015-2016 Academic Year have been participated in the study. Views of Nature of Science Questionnaire C Form (VNOS-C) has been administered to the participants. The participants responses to the questions in VNOS-C form has been analyzed and the responses have been grouped into 3 categorizes as "ell-informed", "moderate" and "naive". The responses to the each of the questions in the VNOS-C form have been analyzed and the results given in % frequency. The responses of the PSTs and PPTs have been compared. When the percentages of the "well-informed" responses of the participants for each of the questions in the VNOS-C form examined, it is clear that the percentages of the well-informed responses have been increased due to the increase of grade level. Findings have displayed that pre service science teachers have more adequate nature of science views than pre service primary school teachers. Especially, freshmen pre service teachers have naive views relating to the subject. But, the findings reported that most of the pre service teachers have naive views relating to the nature of science.

Keywords: *Pre service science teachers, pre service primary school teachers, views of nature of science*

1. Introduction

Scientific literacy can be defined as being aware of scientific concepts, theory and processes and their relationship with the society (Abd-el Khalick, Bell ve Lederman,1998). The concept of scientific literacy consists of sub-dimensions (Shwartz, Ben-ZviandHofstei, 2005): a) understanding the nature of science, the nature of scientific knowledge, scientific methods and norms; b)understanding of the key scientific concepts, laws and theories (the context of science); c) understanding how science and technology work in daily life; d) understanding the effect of science and technology and appreciate it; e) understanding scientific information, reading and writing about it; f) adapting scientific knowledge to the daily life experiences. Scientific literacy was determined as the key goal of the studies relating to the development of new science and technology curriculum in 2004 in Turkey (Köseoğlu et al., 2008). Researchers highlight the importance of understanding nature of science (NOS) and scientific knowledge while increasing scientific literacy (Lederman, 1992; Meichtry, 1999; Akerson and Donnelly, 2010). Lederman (1999) states that when students understand science, they will become a conscious consumer and make right decisions in daily discussions. Zeidler, Walker, Ackett and Simmons (2002) state that students' NOS views effect their views relating to the scientific ethic and decisions about socio-scientific issues. According to Bell, Lederman, and Abd-El-Khalick (1998), the general characteristics of knowledge can be stated as: the scientific knowledge is temporal and empirical, it is based on theory, it is partly a product of human imagination and it has connections with culture and society. NOS which is a major goal of science education (Alters,1997) plays an important role while developing scientific literacy but up to know unfortunately NOS hasn't been understood completely. In the schools, the NOS instruction hasn't been successful. Studies indicate that students' have naive views relating to the NOS. Kang, Scharmann and Noh (2004) search for the NOS views of the students and their results report that they have inadequate views related to the NOS. Kangand and Wallace (2004) report that elementary students' have

insufficient views related to the NOS. Abd-El-Khalick and BouJaoude (2003) search for the NOS views of secondary school students' and teachers. The results repot that most of the student and teachers have naive views related to the NOS. There are similar problems relating to the NOS views of students in Turkey too. For example, Macaroğlu et al. (1999) state that students have inadequate views relating to the NOS. Similarly, Gürses et. al report that students have naive views relating to the NOS and also they have misconceptions relating to the subject. Balkı et al.(2003) state that students have inadequate views both relating to the NOS and the studies of scientists. Teachers play an important role for students to develop well-informed views of NOS. Abd-El-Khalick and Akerson (2009) state that pre-service teachers should have proper understanding of NOS and by this way they can increase their students' academic achievement. But unfortunately, most of the teachers have inadequate NOS views. In many studies which search for teachers' NOS views, results report that not only pre-service teachers and but also science teachers have naive views relating to the NOS (Akçay and Koç,2009; Aslan, Yalçın and Taşar, 2009; Doğan, Bora and Abd-El-Khalick, 2008; Akerson et al., 2000; Abd-El-Khalick and Lederman, 2000b; Abd-El-Khalick, Bell & Lederman, 1998). Without proper information about science and the characteristics of scientific knowledge, it isn't possible to teach science properly. Aguirre, Haggerty and Linder (1990) state that pre-service teachers have naive views relating to the NOS and there is a connection between teachers' understanding of NOS and their teaching strategies.

The teachers views and beliefs relating to the NOS effect their instructional activities they designed in learning environments (Pajares, 1992). In a study of Dogan and Abd-El-Khalick (2008), the results display that teachers' and their students' NOS views are similar and most of them have naive views related to the NOS. Teachers' instructional methods and their level of information effect students' learning. For this reason, when the teachers are well-educated relating to the science and scientific issues, they will teach science properly and develop students' views of NOS. In the study, the NOS views of pre service science teachers and pre service primary teachers have been examined. In our country, primary school teachers teach science classes for 3rd and 4th grades. In this context, the primary school teachers play an important role while teaching basic and fundamental concepts of science. Science teachers teach science classes for 5th, 6th, 7th and 8th grades. At these grades, students are switched to more abstract issues and concepts in parallel with the growth of their age. During primary and secondary school education, constructing a strong background will help students to develop positive attitudes towards science in high school. At this point, investigating the views of pre-service science teachers' and pre-service primary school teachers' NOS views and comparing their views will help to search for the reasons of their lack of knowledge relating to the NOS and promote solutions to these problems.

The aim of the study

The study aims to investigate pre-service science and primary school students views of nature of science and compare the views of them.

2. Method

The descriptive scanning method has been used in the study. Pre-service science teachers (PST) and pre-service primary teachers (PPT) who attend Sütçü İmam University, Faculty of Education, Departments of Science and Primary School Education in the fall semester of 2015-2016 Academic Year have been participated in the study. Views of Nature of Science Questionnaire C Form (VNOS-C) has been administered to the participants. The participants responses to the questions in VNOS-C form has been analyzed through a literature research related to the views of NOS (Milwood & Sandoval, 2004; Thye & Kwen, 2003). The responses have been grouped into 3 categorizes as "ell-informed", "moderate" and "naive". The responses to the each of the questions in the VNOS-C form have been analyzed and the results given in % frequency. The responses of the PSTs and PPTs have been compared.

Data collection tool

Views of Nature of Science C Form (VNOS-C): VNOS-C developed by Lederman et al. (2002) form has been used to determine the NOS views of pre-service teachers. There are 3 versions of Views of

Nature of Science Form (VNOS-A, VNOS-B and VNOS-C). The latest version is VNOS-C. The VNOS-C form has been administered to the participants and their responses have been evaluated.

Samples

177 pre-service science teachers (PST) (47 of them freshmen; 48 of them 2nd year; 39 of them 3rd year; 43 of them 4th year students) and 259 pre-service primary school teachers (PPT) studying at Kahramanmaraş Sütçü İmam University in Turkey have been participated in the study.

3. Findings

Views of Nature of Science C (VNOS-C) Form has been administered to the PSTs and PPTs. The responses of the samples to the questions in the form have been categorized as "well informed", "moderate" and "naive". The percentages of the responses to the questions in VNOS-C form have been reported in Table 1.

Table 1. The percentages of the responses of the PSTs and PPTs to the VNOS-C form

	Pre-service science teachers (%)				Pre-service primary school teachers (%)			
Que.	Well info.	Moderate	Naive	N	Well info.	Moderate	Naive	N
Q1	30,50	57,06	12,41	177	31,66	43,62	24,70	259
Q2	31,07	61,01	7,90	177	35,52	47,10	17,36	259
Q3	31,63	61,01	7,33	177	28,95	52,12	18,56	259
Q4	30,50	57,62	11,85	177	23,55	50,96	25,47	259
Q5	24,29	63,27	12,42	177	19,69	45,94	34,36	259
Q6	36,15	40,67	23,15	177	15,05	40,54	44,39	259
Q7	28,24	48,02	26,41	177	30,11	40,54	29,34	259
Q8	28,81	47,45	23,72	177	28,95	40,54	30,49	259
Q9	25,42	62,14	12,71	177	30,11	54,44	15,44	259
Q10	38,98	45,76	15,24	177	26,64	52,12	21,22	259

When Table 1 is examined, the findings can be summarized as follows:

The percentage of PSTs and PPTs who have well informed views related to the 1st question [*What, in your view, science? What makes science (or a scientific discipline such as physics, biology, etc.) different from other disciplines of inquiry (e.g., religion, philosophy)?*] is round about 30 %. On the other hand, % 24,70 of the PPTs and 12,41 % of PSTs have naive views related to the 1st question.

21,07 % of PSTs and 35,52 % of the PPTs have well informed views related to the 2nd question [*What is an experiment?*]. But when the other categories examined, 61,01 % of the PSTs and 47,10 % of the PPTs have moderate, 7,90 % of the PSTs and 17,36 % of the PPTs have naive views related to the 2nd question.

31,63 % of the PSTs and 28,95 % of the PPTs have well-informed views related to the 3rd question [*Does the development of scientific knowledge require experiments?.Explain the reason of your reply*]. The percentage of moderate views of PSTs (61,01 %) is higher than the percentage of moderate views of PPTs (52,12 %). When the naive category is examined, 7,33 % of the PSTs and 18,56 % of the PPTs have naive views.

30,50 of PSTs and 23,55 % of the PPTs have well-informed views related to the 4th question [*After scientists have developed a scientific theory (e.g. atomic theory, evolution theory), does the theory ever change? Explain your reply with examples*]. When the naive category is examined, 11,85 % of the PSTs and 25,47 % of the PPTs have naive views.

24,29 % of the PSTs and 19,69 % of the PPTs have well-informed views related to the 5th question [*Is there a difference between a scientific theory and a scientific law? Illustrate your answer with an example*]. 12,42 % of PSTs and 34,36 % of the PPTs have naive views related to the 5th question.

36,15 % of the PSTs and 15,05 % of the PPTs have well-informed views related to the 6th question [*Science text-books often represent the atom as a central nucleus composed of protons (positively charged particles) and neutrons (neutral particles) with electrons (negatively charged particles) orbiting that nucleus. How certain are scientists about the structure of the atom? What specific evidence do you think scientists used to determine what an atom looks like?*]. When the naive category is examined, 23,15 % of the PSTs and 44,39 % of the PPTs have naive views.

28,34 % of the PSTs and 30,11 % of the PPTs have well-informed views related to the 7th question [*Science text-books often define a species as a group of organisms that share similar characteristics and can inter breed with one on other to produce fertile offspring. How certain are scientists about their characterization of what a species is? What specific evidence do you think scientists used to determine what a species is?*]. But when the moderate category is examined, 48,02 % of the PSTs and 40,54 % of the PPTs have moderate views related to the question. When the naive category is examined, 23,71 % of the PSTs and 29,34 % of the PPTs have naive views.

28,81 % of the PSTs and 28,95 % of the PPTs have well-informed views related to the 8th question [*It is believed that about 65 million years ago the dinosaurs became extinct. Of the hypotheses formulated by scientists to explain the extinction, two enjoy wide support. The first, formulated by one group of scientists, suggest that a huge meteorite hit the earth 65 million years ago and led to a series of events that caused the extinction. The second hypothesis, formulated by another group of scientists, suggests that massive and violent volcanic eruptions were responsible for the extinction. How are these different conclusions possible if scientists in both groups have Access to and use the same set of data to derive their conclusions?*]. But when the moderate category is examined, 47,45 % of the PSTs and 40,54 % of the PPTs have moderate views related to the question. When the naive category is examined, 23,72 % of the PSTs and 30,49 % of the PPTs have naive views.

25,42 % of the PSTs and 30,11 % of the PPTs have well-informed views related to the 9th question [*Some claim that science is infused with social and cultural values. That is, science reflects the social and political values, philosophical assumptions, and intellectual norms of the culture in which it is practiced. Others claim that science is universal. That is, science transcends national and cultural boundaries and is not affected by social, political and philosophical values, and intellectual norms of the culture in which it is practiced. Explain your answer with examples*]. But when the moderate category is examined, 62,14 % of the PSTs and 54,44 % of the PPTs have moderate views related to the question. When the naive category is examined, 12,71 % of the PSTs and 15,44 % of the PPTs have naive views.

38,98 % of the PSTs and 26,64 % of the PPTs have well-informed views related to the 10th question [*Scientists perform experiments /investigations when trying to find answers to the questions they put forth. Do scientists use their creativity and imagination during their investigations? Explain your answer with examples.*]. When the naive category is examined, 15,24 % of the PSTs and 21,22 % of the PPTs have naive views.

The percentages of the responses to the questions in VNOS-C form according to the grade level have been reported in Table 2.

Table 2. The percentages of the responses of the PSTs and PPTs to the VNOS-C form according to the grade level

1st year pre-service teachers								
	Pre-service science teachers (%)				Pre-service primary school teachers(%)			
Que.	Well info.	Moderate	Naive	N	Well info.	Moderate	Naive	N
1	14,89	61,7	23,41	47	16,9	36,62	46,48	71
2	12,77	70,21	17,02	47	14,08	46,48	39,44	71
3	17,02	70,21	12,77	47	18,31	53,52	28,17	71
4	10,64	70,21	19,15	47	8,45	47,89	43,67	71
5	8,51	72,34	19,15	47	4,23	46,48	49,29	71
6	23,4	55,32	21,27	47	4,23	35,21	60,57	71
7	17,02	55,32	27,66	47	9,86	30,99	59,15	71
8	21,28	46,81	31,91	47	25,35	36,62	38,03	71
9	8,51	78,72	12,76	47	22,54	56,34	21,12	71
10	34,04	48,94	17,03	47	12,68	53,52	33,80	71
2nd year pre-service teachers								
	Pre-service science teachers (%)				Pre-service primary school teachers(%)			
Question	Well info.	Moderate	Naive	N	Well info.	Moderate	Naive	N
1	27,08	64,58	8,34	48	30,51	55,93	13,56	59
2	27,08	66,67	6,25	48	37,29	54,24	8,47	59
3	29,17	60,42	10,41	48	25,42	61,02	13,55	59
4	22,92	64,58	12,50	48	8,47	81,36	10,17	59
5	10,42	75,00	14,58	48	11,86	59,32	28,81	59
6	27,08	39,58	33,34	48	22,03	44,07	33,89	59
7	37,5	35,42	27,08	48	27,12	50,85	22,03	59
8	25,00	60,42	14,58	48	23,73	59,32	16,95	59
9	20,83	54,17	25,00	48	32,20	66,10	1,69	59
3rd year pre-service teachers								
	Pre-service science teachers (%)				Pre-service primary school teachers(%)			
Question	Well info.	Moderate	Naive	N	Well info.	Moderate	Naive	N
1	41,03	56,41	2,56	39	59,38	31,25	9,37	64
2	41,03	58,97	0,00	39	67,19	26,56	6,25	64
3	33,33	66,67	0,00	39	40,63	43,75	15,63	64
4	38,46	53,85	7,69	39	48,44	32,81	18,75	64
5	30,77	53,85	15,38	39	50,00	34,38	15,63	64
6	35,9	30,77	33,34	39	9,38	42,19	48,44	64
7	15,38	53,85	30,77	39	56,25	29,69	14,07	64
8	28,21	43,59	28,21	39	53,13	31,25	15,63	64
9	30,77	61,54	7,69	39	48,44	40,63	10,94	64
10	38,46	48,72	12,82	39	40,63	43,75	15,63	64
4th year pre-service teachers								
	Pre-service science teachers (%)				Pre-service primary school teachers(%)			
Question	Well info.	Moderate	Naive	N	Well info.	Moderate	Naive	N
1	41,86	44,18	13,94	43	21,54	52,31	26,16	65
2	46,51	46,51	6,97	43	26,15	61,54	12,31	65
3	48,83	46,51	4,64	43	32,31	50,77	16,92	65
4	53,48	39,53	6,97	43	29,23	44,62	26,16	65
5	48,83	46,51	4,65	43	13,85	44,62	41,54	65
6	60,46	34,88	4,65	43	26,15	41,54	32,31	65
7	41,86	48,83	9,29	43	29,23	52,31	18,46	65
8	41,86	37,20	20,93	43	13,85	36,92	49,23	65
9	44,18	53,48	2,32	43	18,46	55,38	26,16	65
10	53,48	46,51	0,00	43	20,00	61,54	18,46	65

When Table 2 is examined, the findings can be summarized as follows:

The findings display that 14,89 % of the 1st year PSTs, 27,08 of the 2nd year PSTs, 41,03 % of the 3rd year PSTs and 41,86 of the 4th year PSTs have well-informed views related to the 1st question. For the same question, 16,90 % of the 1st year PPTs, 30,52 % of the 2nd year PPTs, 59,38 % of the 3rd year PPTs and 21,54 % of the 4th year PPTs have well-informed views.

The frequency analysis displays that 12,77 % of the 1st year PSTs, 27,08 of the 2nd year PSTs, 21,54 % of the 3rd year PSTs and 46,51 of the 4th year PSTs have well-informed views related to the 2nd question. For the same question, 14,08 % of the 1st year PPTs, 37,29 % of the 2nd year PPTs, 67,19 % of the 3rd year PPTs and 26,15 % of the 4th year PPTs have well-informed views.

It is reported that 17,02 % of the 1st year PSTs, 29,17 of the 2nd year PSTs, 33,33 % of the 3rd year PSTs and 48,83 of the 4th year PSTs have well-informed views related to the 3rd question. For the same question, 18,31 % of the 1st year PPTs, 25,42 % of the 2nd year PPTs, 40,63 % of the 3rd year PPTs and 32,31 % of the 4th year PPTs have well-informed views.

Then, 10,64 % of the 1st year PSTs, 22,92 of the 2nd year PSTs, 38,46 % of the 3rd year PSTs and 53,48 of the 4th year PSTs have well-informed views related to the 4th question. For the same question, 8,35 % of the 1st year PPTs, 8,47 % of the 2nd year PPTs, 48,44 % of the 3rd year PPTs and 29,33 % of the 4th year PPTs have well-informed views.

Also, it is reported that 8,51 % of the 1st year PSTs, 10,42 of the 2nd year PSTs, 30,77 % of the 3rd year PSTs and 48,43 of the 4th year PSTs have well-informed views related to the 5th question. For the same question, 4,23 % of the 1st year PPTs, 11,86 % of the 2nd year PPTs, 50,00 % of the 3rd year PPTs and 13,85 % of the 4th year PPTs have well-informed views.

And 23,40 % of the 1st year PSTs, 27,08 of the 2nd year PSTs, 35,90 % of the 3rd year PSTs and 60,46 of the 4th year PSTs have well-informed views related to the 6th question. For the same question, 4,23 % of the 1st year PPTs, 22,03 % of the 2nd year PPTs, 9,38 % of the 3rd year PPTs and 26,15 % of the 4th year PPTs have well-informed views.

The frequency analysis displays that 17,02 % of the 1st year PSTs, 37,50 of the 2nd year PSTs, 15,38 % of the 3rd year PSTs and 41,86 of the 4th year PSTs have well-informed views related to the 7th question. For the same question, 9,86 % of the 1st year PPTs, 27,12 % of the 2nd year PPTs, 56,25 % of the 3rd year PPTs and 29,13 % of the 4th year PPTs have well-informed views.

The findings display that 21,28 % of the 1st year PSTs, 25,00 of the 2nd year PSTs, 28,21 % of the 3rd year PSTs and 41,86 % of the 4th year PSTs have well-informed views related to the 8th question. For the same question, 22,35% of the 1st year PPTs, 23,73% of the 2nd year PPTs, 53.13 % of the 3rd year PPTs and 13,85 % of the 4th year PPTs have well-informed views.

It is also noted that 8,51 % of the 1st year PSTs, 20,83 of the 2nd year PSTs, 30,77 % of the 3rd year PSTs and 44,18 of the 4th year PSTs have well-informed views related to the 9th question. For the same question, 22,54 % of the 1st year PPTs, 32,20 % of the 2nd year PPTs, 48,44 % of the 3rd year PPTs and 18,46% of the 4th year PPTs have well-informed views.

Finally, 34,04 % of the 1st year PSTs, 31,25of the 2nd year PSTs, 38,46 % of the 3rd year PSTs and 53,48of the 4th year PSTs have well-informed views related to the 10th question. For the same question, 12,68 % of the 1st year PPTs, 35,59 % of the 2nd year PPTs, 40,63 % of the 3rd year PPTs and 20,00 % of the 4th year PPTs have well-informed views.

4. Results and Discussion

The responses of PSTs and PPTs to the VNOS-C form have been grouped into 3 categorizes as "well informed" moderate" and "naive". The percentages of the categorizes have been compared both in the groups and between groups.

When the percentages of the "well-informed" responses of the PSTs for each of the questions in the VNOS-C form examined, except of the 7th question, it is clear that the percentages of the well-informed responses have been increased due to the increase of grade level. Although similar increase can be seen for the 7th question, but for this question the percentage of 2nd year students' well-informed responses is higher than 3rd year students. Findings have reported that due to the increase of grade level, students have more information and more sufficient views related to the nature of science (NOS). When the percentages of the "well-informed" responses of the PSTs for each of the questions in the VNOS-C form examined, it has been seen that the percentages of the well-informed questions have been increased due to the increase of grade level, but this increase has not been regular. As with the PSTs, the percentages of well-informed responses of freshmen students have been lower than the other grades. Similarly, due to the increase of grade level, the PPTs have more information and more sufficient views related to the NOS. However, It can be seen that the percentage of the well-informed responses of 3rd year students has been higher than other ones. The reason for this significantly higher rate is thought to be attending Science and Technology Instruction I Class in 3rd grade. The VNOS-C Form has been administered in the first weeks of Fall semester of 2015-2016 Academic year. The first issues of Science and Technology Instruction I Class course have been "What is science?", "Characteristics of scientific knowledge", "Science process skills", "Science and technology literacy". Due to the new handling of these issues, students have higher level of knowledge related to the subject.

As a result, is can be stated that pre-service teachers have developed their information and views related to NOS during graduation program. However, when the responses of them examined, it is seen that most of the pre service teachers have naive views related to the subject. Increase of the percentages of well-informed responses due to the grade level has been insufficient. The classes they attend in the graduation process are thought to be the reason of the increase of the percentages of well-informed responses. However, the lack of sufficient growth suggests that some precautions should be taken to develop teacher candidates' views of NOS.

The responses of the 1st year PSTs and PPTs have been worrysome. The highest percentage of the well-informed responses of 1st year PSTs' is 34,04 and the lowest is 8,51. Similarly, the highest percentage of the well-informed responses of 1st year PPTs' is 25,35 and the lowest is 4,23. The PSTs have been trained in the field of science and math in high school. However, it is seen that their views on the nature of science is extremely inadequate. The students trained in the field of science and mathematics in high school would be expected to have a bit more adequate views. This statement gives information about the lack of science and mathematics education in our country. Students can solve given problems by using the formulas they memorized, but they don't have scientific processing skills and any sufficient information about the characteristics of scientific knowledge. Especially 1st year PPTs have poor views related to the NOS. Since the PPTs have trained in the field of Turkish language and mathematics in high school and almost don't attend any science classes, they cannot develop adequate views related to the NOS.

The highest percentage of the well-informed responses of 4th year PSTs' is % 60,46 and the lowest is % 41,86. But it is seen that even the half of the 4th year PSTs have well-informed views related to the nature of science. Conversely, the highest percentage of the well-informed responses of 4th year PPTs' is % 32,31 and the lowest is 13,85. Inadequate views of pre-service teachers who will be graduated at the end of the year are quite considerable. Similarly Gürses, Doğar and Yalçın (2005) searched for the views of pre-service teachers related to the NOS their results reported that pre service chemistry and primary

school teachers cannot give proper responses to the questions related to NOS and they have inadequate scientific understanding. Murcia and Schibeci (1999) reached for the NOS views of pre service primary school teachers. Their results displayed that pre-service teachers didn't have modern views related to the NOS and some of the them have views incompatible with today's scientific understanding. Yakmacı (1998) searched for pre service science teachers' and science teachers' views of NOS. The results of the study revealed that both teachers and pre-service teachers have misconceptions related to the NOS.

When the responses to the VNOS-C form have been examined, the PSTs have more sufficient views related to the NOS in comparison with the PPTs in general. Only about 30 % of PSTs have well-informed views related to the question of "What is science?". Most of the participants' responses have been in moderate category but PPTs have more naive views related to the question when compared with the PSTs. The responses of the PPTs to the 4th question (After scientists have developed a scientific theory (e.g. atomic theory, evolution theory), does the theory ever change?) have displayed that they have naive views related to the subject.

Almost 1/4 of the PPTs don't have clear views related to the scientific theories and the changeability of theories. The percentage of the naive responses to the 5th question (Is there a difference between a scientific theory and a scientific law? Illustrate your answer with an example.) is 34,36 %. This result deepens the lack of sufficient views related to the previous question. The result displays that most of the PPTs don't know the difference between a scientific law and theory. 44,39 % of the PPTs have naive views related to the 6th question (How certain are scientists about the structure of the atom? What specific evidence do you think scientists used to determine what an atom looks like?). This rate is quite high. The result reveal that the PPTs don't have basic information about the structure of matter and how this information is obtained. 23,15 % of the PSTs have naive views related to the same question. Although the PSTs attend many chemistry classes, they cannot make reasoning about the subject. Since the pre-service teachers don't have proper understanding about a quite abstract concept of atom, they will have problems while teaching this concept. It will be difficult for teachers who don't have proper schemas related to the atom and the characteristics of the information to make little children to understand the concept of atom. 29,34 % of the PPTs and 23,71 % of the PSTs have naive views related to the 7th question (How certain are scientists about their characterization of what a species is? What specific evidence do you think scientists used to determine what a species is?). Although there are various issues related to the genetics in biology classes, pre-service teachers have insufficient information related to the basic concept of "species". The naive responses percentages of both the PSTs and PPTs to the 8th question related to the extinction of dinosaurs are quite high. Lack of sufficient scientific perspective on the events of pre-service teachers is considerable here.

In summary, as the grade level increases, both the PSTs and PPTs have more adequate views related to the NOS. However, very few of the pre-service teachers have adequate views of NOS. When the responses of the PSTs and PPTs to the VNOS-C form compared, it is clear that the PSTs have more sufficient responses than the PPTs for all questions in the form. This result displays that the PSTs have more information and more adequate than the PPTs related to the subject. However, as mentioned above, the pre-service teachers have serious shortcomings related to the science and scientific knowledge. The primary school teachers give Science and Technology Classes for K3 and K4 level. They are the ones who teach the children very basic concepts related to the science and developed a scientific perspective. However, it is observed that the majority of the PPTs have naive views related to the NOS. The causes of this problem may be various. In our country, the PPTs have trained in the field of Turkish language-Mathematics and they just attend some basic science classes in K9 level. When they started university education, they don't have almost any knowledge related to the science. During the four years of undergraduate education, the weekly hours for the physics, chemistry and biology classes are relatively low. In these classes, they have some difficulties while learning because of the lack of science background and lack of weekly hours. These are thought to be main causes of the naive views of NOS of the PPTs.

5. Suggestions

In order to develop primary school teachers' views related to the NOS, the weekly hours of science classes such as physics, chemistry and biology should be increased. The learning activities should be designed to show the relationship of science with everyday life events. The PPTs believe that they won't use the knowledge they have to learn in science classes so they believe that this knowledge is useless. Therefore, they have negative attitudes towards these classes. They should be aware of the necessity of science classes in their professional life. When they realize the importance of the knowledge they learnt and where they will use it, their attitudes towards science classes will be more positive. Results show that both the PSTs and PPTs have naive views related to the NOS. Even pre service teachers have information about a scientific subject they don't have any idea about how this knowledge get. Generally they make root learning about scientific subjects and cannot see the connections between the events, because they don't try to search for the knowledge, they are given knowledge in packages. The pre service teachers who take the given knowledge, don't need to ask for the scientific processing and don't develop views related to the NOS. When learning environments in which they designed experiments and get knowledge as a result of scientific processing, the pre-service teachers will have sufficient views related to the scientific knowledge and scientific processes. In classroom settings, organizing discussions about scientific events will help pre-service teachers to develop more accurate views related to the NOS.

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