



## THE VIEWS OF PROSPECTIVE PHYSICAL EDUCATION TEACHERS ABOUT THE NATURE OF SCIENCE

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### Abstract:

Physical education teachers' gaining the perception of physical education as a discipline and putting their NOS (Nature of science) notion into operation are crucial for the promotion of educational success. The main purpose of this study is to determine prospective physical education teachers' and physical education graduates' nature of science perceptions and their attitudes towards using scientific knowledge in their teaching process. This study was carried out through random sampling method. The participants were 232 prospective physical education teachers studying pedagogical formation at Hitit University and Amasya University and undergraduate students studying physical education and sports at Amasya University in 2015-2016 academic years. "The Nature of Scientific Knowledge Scale" developed by Rubba and Anderson and translated and adapted in Turkish by Kılıç, Sungur, Çakıroğlu and Tekkaya (2005) was used as the data collection tool. It was revealed in the study that while the variables related to subjects' gender, grade level and whether they follow scientific developments or not cause statistically differences the variables related to the type of master programme and their ages cause no differences. Through the findings of the study, physical education teachers' NOS perceptions have been determined and some suggestions have been offered for further studies.

**Keywords:** physical education, sport, nature of science

## 1. Introduction

Concept of science is basically described as the complex process of systematic studies on structure and behaviour of the physical and natural world through observations and experiments. It's result of systematized knowledge and humankind's efforts to reach the fact regardless of the era or geography. While Turkish Language Society defines science as a systematic knowledge concerning one part of events or whole universe and the act of approving the results into law through observations and experiments, Çepni (2005) defines "science" as a process of accurate thinking, exploring the truth and knowledge, getting systematic knowledge through scientific research means and efforts to comprehend and describe the universe.

The perception of science as the accumulation of knowledge clustered to change when nature of physical sciences began to be emphasized. A great number of studies on NOS have been performed in last 40 years. Some scientists including Giggins, Lederman, Cleminson, Ryan, Aikenhead have mentioned that a positive approach to science which accepts science as the cumulating knowledge gathered by deduction, observations and experiments should be replaced with a postpositive one which argues that science is a rather dynamic and tentative activity. It cannot be realized through a simple scientific method or cannot be restricted by political, cultural and social factors. They have also asserted that science has interdisciplinary function (Türkmen & Yalçın, 2008).

Nowadays, due to lack of science and scientific literacy insights, it's hard to raise an individual who has sense of wonder and problem solving ability (Beşli, 2008). Therefore, it should be a matter of priority that pupils must be taught the nature of science as to catch up with developed countries. From this point of view, getting the students adopt a NOS notion, let them deal with science as a human activity and make sense of objective reality just through subjective perception are extremely important for the functionality of science. This principle should be inserted in the goals of education (Çakıcı, 2009). Although there is no a unique NOS definition, McComas (2000) defines the term "...a fertile hybrid arena including the history, sociology philosophy of science combined with research from scientists operate as a social group and how society itself both directs and reacts to scientific endeavours."

Science literacy enables individuals to debate, analyse, and dwell on the developments and produce new knowledge. Consequently, it's necessary to modify students' NOS notion to let them gain adequacy of questioning, critical thinking, and decision making abilities. The emphasis of scientific studies at schools should be put on appealing students' NOS perceptions. Students should be taught that science is the outcome of human efforts and a rational activity operating through some special methods. It is necessary that the students should comprehend science as a dynamic field requiring social creativity and it covers undefined knowledge. Scientific knowledge can always be tested by various kinds of methods (Driver et al., 1996).

Social sciences refer to the fields of scientific studies concerned with society and relationships among individuals within a society (Duverger, 1990). As a branch of social sciences, physical education can be defined as the studies of movements which shape the students physically, socially, and mentally (Çöndü, 1999). The concept of sport as a social phenomenon at present might be examined as a process of health enhancing exercise habit formation according to certain scientific principals (Açıkada & Ergen 1990; Kuru 2000).

Sports is a multidisciplinary field which involves scientific findings, debates and methods aims to satisfy individuals' subconscious desires such as beating and winning and is carried out by a set of rules. It interacts with kinesiology, physiology, biomechanics ergonomic, anthropology, sports medicine, orthopedia and rehabilitation (Özbek, 2004). Sports, physical, psychological, social and economic deficiencies from above are also a multi-functional discipline (Mumcu and Çeviker). Sports is an achievement driven process requiring physical, mental, and technical efforts for the participants and activities which appeal sense of aesthetic and amusement. As a scientific domain sports emphasizes the necessity for scientific literacy in order that students can achieve their affective, psychomotor and cognitive goals (Semerci, 2002). It is a known fact that physical capacity alone is not enough in increasing sports performance and success (Sekeroğlu, 2017). All students take physical education and sports lessons since the beginning of primary school. Whilst some of physical education and sports teachers have bachelor degree, the others are college graduates with pedagogical formation. Sports teachers are expected to get specialized both in science literacy and their own field during university education. When reviewed the literature, it is observed that sports teachers' perception of sports as a scientific domain but there is a lack of investigation about their NOS notions.

## 2. Purpose of the Study

The aim of this study is to identify and examine NOS notions of university students who attend physical education and sports teaching programme at Amasya University and prospective sports teachers studying pedagogical formation at Hitit University and Amasya University in accordance with certain variables.

For this purpose, the questions below have been tried to be answered

- a) Are there any differences between undergraduate sports and physical education students' and prospective teachers' NOS notions?
- b) Are there any differences between undergraduate sports and physical education students' and preservice teachers' NOS notions according to demographic features?
- c) Do undergraduate sports and physical education students' NOS notions range according to the variables such as whether they have studied science history, science philosophy lessons or they involve in scientific studies?

### **3. Method**

#### **3.1 Research Model**

The research has been carried out by using survey model. Descriptive survey research model refers to gathering data in a certain period of time by comparing the relations among the variables and identifying the relations among specific events in order to achieve significant goals (Karasar, 1999).

#### **3.2 Population and Sample**

The research has been conducted on undergraduate physical education students attending Amasya University during the fall semester in 2015-2016 academic years and prospective teachers or final year university students who have studied coaching, sports management and recreation in sports academies and taking formation education during the same period. Subjects participating in the study were selected by random sampling. Random sampling means the type of the sampling which is capable of representing the whole universe statistically and determined completely randomly.

The participants of the study were 147 university students who were studying at physical education teaching and sports department at Amasya University and 85 prospective teachers who were studying pedagogical formation at Hitit University. 81 of the participants were female prospective teachers (34.9%), and 151 of them were male prospective teachers (65.1%). 31 of the participants were freshmen (13.4%), 33 of them were second year university students (14.2%), 40 of them were third year university students (17.2%), 86 of them were final year university students (37.1%), and 42 of them were graduate prospective teachers (18.1%). While 43 of them were at and under the age of 20 (18.5%), 82 of them at the age of 21-22 (35.3%), 45 of them were at the age of 23-24 (19.4%), and 62 of them were at and above the age of 25 (26.7%). 42 participants were science, social sciences Anatolian high school graduates (18.1), 128 participants were general high school graduates (55.2%), 40 participants were vocational high school graduates(17.2%), and 22 of them were Art and Sports High School graduates (9.5%).

#### **3.3 Data Collection Tools**

In order to collect data a questionnaire was prepared. The questionnaire consists of two parts. In the first part of the form, the items ask for information about participants' age, gender, grade levels, high school graduation, master programme and their state of following scientific studies, whether they had a course related to science such as science history, science philosophy during their university education, whether they follow developments in their teaching field. In the second part of the form, participants were asked to answer "Nature of Scientific Knowledge Scale" (NSKS).

#### **3.4 Nature of Scientific Knowledge Scale (NSKS)**

Developed by Rubba and Anderson (1978), the scale was translated in and adapted to Turkish by Kılıç, Sungur, Çakıroğlu, Tekkaya (2005). The subscales consist of 48 items and 6 dimensions and they are based on following ideas;

1. Amoral: Scientific knowledge provides people with some specific abilities but it doesn't support information about how to use it.
2. Creative: Scientific knowledge is the product of human intelligence. Imagination and Creativity have roles in getting scientific knowledge.
3. Developmental: Scientific knowledge can be changed and developed.
4. Parsimonious: Scientific knowledge tends to be simple and easy rather than being complicated and hard.
5. Testable: Scientific knowledge can be testable and experimental.
6. Unified: Whole systematized knowledge contributes to science by its explanatory and predictive features.

The scale's validity and reliability were tested by both university and high school students. Reliability coefficient (Cronbach's  $\alpha$ ) was conducted between 0.65 and 0.88 (Aslan, 2009; Çilingir et al., 2013).

### 3.5 Data Analysis

SPSS 15 was employed to analyse the data. Independent variables for prospective teachers were identified as gender, age, grade level, high school they graduated from, and their state of interest in scientific studies.

## 4. Findings

The score which prospective teachers get from NSKS and subscales are presented in Table 1.

**Table 1:** General Score Mean of Prospective Teachers According to NSKS and Subscales

Scale	Scores	Min	Max	Mean	S
Whole	General	70.00	204.00	146.84	18.57
	Mean	1.46	4.25	3.06	0.39
Amoral	General	11.00	36.00	24.16	3.98
	Mean	1.38	4.50	3.02	0.50
Creative	General	12.00	37.00	24.66	4.00
	Mean	1.50	4.63	3.08	0.50
Developmental	General	12.00	37.00	24.36	4.46
	Mean	1.50	4.63	3.04	0.56
Parsimonious	General	11.00	38.00	24.73	4.17
	Mean	1.38	4.75	3.09	0.52
Testable	General	8.00	36.00	24.58	4.15
	Mean	1.00	4.50	3.07	0.52
Unified	General	12.00	35.00	24.34	3.96
	Mean	1.50	4.38	3.04	0.50

According to Table 1, general score mean for NSKS was 148.48 and standard deviation was 18.57. The top score obtained is 240.00 and the bottom score 48.00 from 48 itemed scale. The maximum score received from the scale was 204.00 and minimum score was 70.00. When evaluated on the base of mean score, mean of NSKS is 3.06 and standard

deviation value is 0.39. The value  $\bar{X}=3.06$  pairs up “indecisive” option in five pointed likert scale.

In accordance with this result, it is concluded that prospective teachers are indecisive in terms of nature of scientific knowledge.

The top score taken from subscales is 40.00 and bottom score is 8.00 as each dimension consists of 8 items. Analysed the NSKS subscales it is seen that mean scores of Amoral ( $\bar{X}=3.02$ ), Creative ( $\bar{X}=3.08$ ), Developmental ( $\bar{X}=3.04$ ), Parsimonious ( $\bar{X}=3.09$ ), Testable ( $\bar{X}=3.07$ ) and Unified ( $\bar{X}=3.04$ ) subscales pair up with indecisive option in five pointed likert scale.

The variations in prospective teachers’ nature of scientific knowledge notions regard to the programme they study were analysed according to independent samples t-test and the results are presented below.

**Table 2:** T-Tests Results of Prospective Teachers’ NSKS Scores Regard to the Master Programme They Study at University

NSKS Subscales	State of Education	n	Mean	sd	df	t	p
Whole Scale	Physical Ed. Teaching	147	148.02	18.93	230	1.27	0.20
	Pedagogical Formation	85	144.78	17.82			
Amoral	Physical Ed. Teaching	147	24.24	3.92	230	0.42	0.66
	Pedagogical Formation	85	24.01	4.10			
Creative	Physical Ed. Teaching	147	24.80	3.96	230	0.71	0.47
	Pedagogical Formation	85	24.41	4.08			
Developmental	Physical Ed. Teaching	147	24.41	4.60	230	0.25	0.79
	Pedagogical Formation	85	24.25	4.21			
Parsimonious	Physical Ed. Teaching	147	25.06	4.26	230	1.58	0.11
	Pedagogical Formation	85	24.16	3.95			
Testable	Physical Ed. Teaching	147	24.80	4.27	230	1.06	0.28
	Pedagogical Formation	85	24.20	3.91			
Unified	Physical Ed. Teaching	147	24.69	3.90	230	1.77	0.07
	Pedagogical Formation	85	23.74	4.00			

It has been seen that the prospective teachers’ studying pedagogical formation or attending physical education teaching department at university causes no difference in terms of their NOS notions ( $t_{230}=1.27$ ;  $p=0.20>0.05$ ). Also, when subscales are analysed it is seen that there is no difference between the students attending physical education teaching department and prospective teachers studying pedagogical formation.

The variations in prospective teachers’ nature of scientific knowledge notions regarding to their age according to independent samples t-test and the results are presented below.

**Table 3:** T-Test Results of Prospective Teachers' NSKS According to Age Variable

NSKS Subscales	Gender	n	Mean	sd	df	t	p
Whole Scale	Female	81	143.98	15.78	230	1.71	0.08
	Male	151	148.36	19.77			
Amoral	Female	81	23.51	3.89	230	1.80	0.07
	Male	151	24.50	4.00			
Creative	Female	81	24.54	3.65	230	0.32	0.74
	Male	151	24.72	4.19			
Developmental	Female	81	23.51	4.18	230	2.11	0.03*
	Male	151	24.80	4.54			
Parsimonious	Female	81	24.27	3.74	230	1.23	0.21
	Male	151	24.98	4.36			
Testable	Female	81	23.96	4.01	230	1.67	0.09
	Male	151	24.91	4.19			
Unified	Female	81	24.17	3.37	230	0.48	0.62
	Male	151	24.43	4.24			

(\*p<0.05)

According to Table 3 in terms of gender variable there is no statistically difference in physical education prospective teachers' NSKS scores. Female participants' mean score is  $\bar{X}_{\text{Female}} = 143.98$ , and male participants' mean score is  $\bar{X}_{\text{Male}} = 148.36$ . Similarly there is no statistical difference in prospective teachers' NOS notions according to parsimonious, testable, unified subscales ( $p > 0.05$ )

There is a difference on behalf of male participants according to developmental subscale ( $t_{230} = 2.11$ ;  $p = 0.03$ ). The mean score of male participants is  $\bar{X}_{\text{Male}} = 24.80$  and mean score of female participants is  $\bar{X}_{\text{Female}} = 23.51$ .

The descriptive statistics of physical education teachers' NSKS scores according to the age variable is presented in Table 4a and results of single factorial analysis of variance (ANOVA) are presented in Table 4b.

**Table 4a:** Descriptive analysis of physical education teachers' NSKS scores according to age

	Age Groups									
	20 years and under (n=43)		Between 21-22 (n=82)		Between 23-24 (n=45)		25 years and above (n=62)		Total (n=232)	
	Mean	sd	Mean	sd	Mean	sd	Mean	sd	Mean	sd
Whole Scale	145.81	16.79	146.70	19.02	148.75	17.30	146.32	20.27	146.83	18.56
Amoral	23.69	4.23	24.26	3.66	24.13	3.60	24.35	4.51	24.15	3.98
Creative	24.51	3.64	24.39	4.14	25.02	3.89	24.85	4.19	24.65	4.00
Developmental	23.95	4.21	24.56	4.54	24.44	4.68	24.30	4.41	24.35	4.45
Parsimonious	24.60	3.94	24.58	4.37	25.46	4.05	24.48	4.15	24.73	4.16
Testable	24.81	4.01	24.45	4.23	24.82	4.16	24.41	4.19	24.58	4.14
Unified	24.23	3.57	24.45	3.78	24.86	3.97	23.90	4.44	24.34	3.96

**Table 4b:** ANOVA Results of Physical Education Teachers' NSKS Scores according to Age

	Variance Resource	Sum of Squares	sd	Mean of Squares	F	p
Whole Scale	Among groups	228.429	3	76.143	0.219	0.88
	In group	79397.347	228	348.234		
	Total	79625.776	231			
Amoral	Among groups	12.538	3	4.179	0.261	0.85
	In group	3654.561	228	16.029		
	Total	3667.099	231			
Creative	Among groups	15.171	3	5.057	0.313	0.81
	In group	3688.928	228	16.180		
	Total	3704.099	231			
Developmental	Among groups	10.915	3	3.638	0.181	0.90
	In group	4580.391	228	20.089		
	Total	4591.306	231			
Parsimonious	Among groups	30.566	3	10.189	0.584	0.62
	In group	3976.865	228	17.442		
	Total	4007.431	231			
Testable	Among groups	7.953	3	2.651	0.152	0.92
	In group	3968.491	228	17.406		
	Total	3976.444	231			
Unified	Among groups	25.815	3	8.605	0.545	0.65
	In group	3598.599	228	15.783		
	Total	3624.414	231			

When prospective teachers' NSKS scores are compared according to age variable scores in whole aspect ( $F_{3-231}=0.219$ ;  $p=0.88$ ) and subscales, there has found no difference ( $p>0.05$ ).

The descriptive statistics and variance analysis results of physical education teachers' NSKS scores in whole aspect and subscales according to grade level variable are presented Table 5a and Table 5b.

**Table 5a:** Descriptive Analysis of Prospective Physical Education Teachers' NSKS Scores According to Their Grade Levels

	Grade Levels											
	1 <sup>st</sup> Grade (n=31)		2 <sup>nd</sup> Grade (n=33)		3 <sup>rd</sup> Grade (n=40)		4 <sup>th</sup> Grade (n=86)		Graduate (n=42)		Total (n=232)	
	Mean	sd	Mean	sd	Mean	sd	Mean	sd	Mean	sd	Mean	sd
Whole Scale	143.35	15.54	151.18	26.31	149.67	15.47	144.91	17.04	147.21	18.82	146.83	18.56
Amoral	22.83	3.90	24.69	4.29	24.80	3.63	24.12	3.73	24.16	4.52	24.15	3.98
Creative	23.80	3.79	25.42	5.09	24.87	3.33	24.54	3.92	24.71	3.98	24.65	4.00
Developmental	23.61	4.27	25.30	5.63	24.80	4.15	23.80	4.37	24.88	3.93	24.35	4.45
Parsimonious	24.64	3.84	24.84	5.48	25.20	4.24	24.48	3.67	24.76	4.23	24.73	4.16
Testable	24.64	4.33	24.93	5.70	24.95	3.57	24.19	3.75	24.69	3.98	24.58	4.14
Unified	23.80	2.98	25.96	5.70	25.05	3.07	23.75	3.61	24.00	4.08	24.34	3.96



**Table 5b:** ANOVA Results of Physical Education Prospective Teachers' NSKS Scores  
 According To Grade Level

	Variance Resource	Sum of Squares	sd	Mean of Squares.	F	p	Source of Difference
Whole Scale	Among groups	1643.493	4	410.873	1.196	0.31	
	In group	77982.283	227	343.534			
	Total	79625.776	231				
Amoral	Among groups	80.110	4	20.027	1.267	0.28	
	In group	3586.990	227	15.802			
	Total	3667.099	231				
Creative	Among groups	44.939	4	11.235	0.697	0.59	
	In group	3659.160	227	16.120			
	Total	3704.099	231				
Developmental	Among groups	92.537	4	23.134	1.167	0.32	
	In group	4498.769	227	19.818			
	Total	4591.306	231				
Parsimonious	Among groups	14.584	4	3.646	0.207	0.93	
	In group	3992.847	227	17.590			
	Total	4007.431	231				
Testable	Among groups	22.953	4	5.738	0.329	0.85	
	In group	3953.491	227	17.416			
	Total	3976.444	231				
Unified	Among groups	150.833	4	37.708	2.464	0.04	1-2 Grade
	In group	3473.580	227	15.302			2-4 Grade
	Total	3624.414	231				2-Graduate

There has found no difference among the grade levels according to whole scale NSKS scores ( $F_{4-231}=1.196$ ;  $p=0.31$ ). Mean score of 1<sup>st</sup> grade students is 143.35, mean score of 2<sup>nd</sup> grade students is 151.18. Mean score of 3<sup>rd</sup> grade students is 149.67, mean score of 4<sup>th</sup> grade students is 144.91 and mean score of graduates is 147.21. As it is seen as in Table 5a 2<sup>nd</sup> grade students' subscale mean scores are higher than the other grade levels. When subscales means are compared it is seen that there is only difference in unified subscale ( $F_{4-231}=2.464$ ,  $p=0.04$ ) and no difference has been found in other dimensions ( $p=0.05$ ). There is a difference in unified subscale of NSKS between 1<sup>st</sup> and 2<sup>nd</sup> grade students (23.80- 25.96), between 2<sup>nd</sup> and 4<sup>th</sup> grade students (25.96-23.75) and between 2<sup>nd</sup> grade students and graduates (25.96-24.00).

The independent sample t-test results of physical education prospective teachers' NOS notions variations according to their interest levels of science are presented in Table 6.

**Table 6:** T-Test Results According to Physical Education Teachers' Levels of Science Interest

NSKS Subscales	Interest in Science	n	Mean	sd	df	t	p
Whole Scale	Interested	59	144.08	23.10	230	1.32	0.18
	Not interested	173	147.77	16.71			
Amoral	Interested	59	23.47	4.31	230	1.53	0.12
	Not interested	173	24.39	3.85			
Creative	Interested	59	24.61	5.06	230	0.10	0.91
	Not interested	173	24.67	3.59			
Developmental	Interested	59	23.71	4.82	230	1.29	0.19
	Not interested	173	24.57	4.31			
Parsimonious	Interested	59	24.50	4.42	230	0.47	0.63
	Not interested	173	24.80	4.08			
Testable	Interested	59	23.72	4.89	230	1.83	0.06
	Not interested	173	24.87	3.83			
Unified	Interested	59	24.05	4.79	230	0.65	0.51
	Not interested	173	24.44	3.64			

According to Table 6, there is no difference among their NSKS scores according to their interests in science and scientific studies. Mean score of prospective teachers who say "I am interested in science and scientific studies" is  $\bar{X}_{\text{Interested}} = 144.08$ , and mean score of the prospective teachers who say "No, I am not interested in science and scientific studies" is  $\bar{X}_{\text{Not interested}} = 148.36$ . Similarly there has found no statistically difference in subscales such as amoral, creative, parsimonious, testable, unified ( $p=0.05$ ).

**Table 7:** T-Test Results According to Taking Related NOS Courses

NSKS Subscales	The state of having taken Nature of science, science philosophy etc. courses	n	Mean	sd	df	t	p
Whole Scale	Taken	34	149.76	16.07	230	0.99	0.32
	Not taken	198	146.33	18.95			
Amoral	Taken	34	24.44	3.34	230	0.08	0.65
	Not taken	198	24.11	4.09			
Creative	Taken	34	25.32	3.29	230	0.26	0.29
	Not taken	198	24.54	4.11			
Developmental	Taken	34	25.23	4.49	230	0.72	0.21
	Not taken	198	24.20	4.44			
Parsimonious	Taken	34	24.76	3.21	230	0.08	0.96
	Not taken	198	24.72	4.31			
Testable	Taken	34	24.79	3.60	230	0.56	0.74
	Not taken	198	24.54	4.24			
Unified	Taken	34	25.20	4.43	230	0.43	0.17
	Not taken	198	24.19	3.86			

As shown in Table 7 whole scale scores has no statistically difference according to prospective teachers' taking science philosophy and nature of science courses during undergraduate education. The mean score of prospective teachers who have studied science philosophy, nature of science courses during undergraduate education is

$\bar{X}_{\text{taken}} = 149.76$ , while the mean score of prospective teachers who haven't studied science philosophy and nature of science courses during university education is  $\bar{X}_{\text{not taken}} = 146.33$ . Similarly the findings indicated that there was no statistically significant difference in amoral, creative, parsimonious testable and unified subscales of scientific knowledge ( $p > 0.05$ ).

Prospective teachers' whole scale NSKS scores and variations in subscales according to following the developments in their teaching field have been analysed and independent t-test results are presented in Table 8.

**Table 8:** T-Test NSKS Results According to Following Developments in Their Field of Study

NSKS Subscales	State of following developments in physical ed. and sports	n	Mean	sd	df	t	p
Whole Scale	Follow	147	145.38	18.73	230	1.56	0.11
	Not Follow	85	149.34	18.10			
Amoral	Follow	147	23.78	4.12	230	1.90	0.05
	Not Follow	85	24.81	3.65			
Creative	Follow	147	24.43	3.97	230	1.12	0.26
	Not Follow	85	25.04	4.04			
Developmental	Follow	147	24.15	4.44	230	0.90	0.36
	Not Follow	85	24.70	4.48			
Parsimonious	Follow	147	24.54	4.25	230	0.90	0.36
	Not Follow	85	25.05	4.00			
Testable	Follow	147	24.52	4.27	230	0.28	0.78
	Not Follow	85	24.68	3.94			
Unified	Follow	147	23.94	3.96	230	2.03	0.04
	Not Follow	85	25.03	3.88			

As shown in Table 8 prospective teachers' following developments in their field causes statistically no difference among their NSKS views. Mean scores of the prospective teachers who follow the developments in their field is  $\bar{X}_{\text{Follow}} = 145.38$ , and mean score of prospective teachers who don't follow the developments is  $\bar{X}_{\text{Not follow}} = 149.34$ . Similarly the findings indicates that there is no statistically significant difference in amoral, creative, development, parsimonious testable and unified subscales of scientific knowledge ( $p > 0.05$ ).

There has found out statistically differences in favour of prospective teachers who follow the developments in their field according to unified subscale ( $t_{230} = 2.03$ ;  $p = 0.04$ ). Mean scores of prospective teachers who don't follow the developments in their field is  $\bar{X}_{\text{Not follow}} = 25.03$  and mean score of prospective teachers who follow the developments is  $\bar{X}_{\text{Follow}} = 23.94$ .

Kruskall Wallis test results of Prospective teachers' NSKS whole scale scores and subscale scores according to graduate high school variable are presented in Table 9a.

**Table 9a:** Comparison of NSKS Scores  
 According to High School Graduation Kruskal Wallis Results

NSKS Subscales	High School Graduation	n	Mean of Rank	sd	$\chi^2$	P	Difference
Whole Scale	Science, Social Sciences, Anatolian High School (1)	42	126.39				
	General High School (2)	128	115.91	3	4.26	0.23	
	Vocational High School (3)	40	100.21				
	Art and Sport High School (4)	22	130.68				
Amoral	Science, Social Sciences, Anatolian High School (1)	42	123.82				
	General High School (2)	128	108.61	3	5.69	0.12	
	Vocational High School (3)	40	119.83				
	Art and Sport High School (4)	22	142.41				
Creative	Science, Social Sciences, Anatolian High School (1)	42	119.05				
	General High School (2)	128	116.93	3	0.17	0.98	
	Vocational High School (3)	40	113.30				
	Art and Sport High School (4)	22	114.95				
Developmental	Science, Social Sciences, Anatolian High School (1)	42	121.42				
	General High School (2)	128	120.92	3	4.07	0.25	
	Vocational High School (3)	40	97.30				
	Art and Sport High School (4)	22	116.32				
Parsimonious	Science, Social Sciences, Anatolian High School (1)	42	108.89				
	General High School (2)	128	122.36	3	2.23	0.52	
	Vocational High School (3)	40	108.34				
	Art and Sport High School (4)	22	111.77				
Testable	Science, Social Sciences, Anatolian High School (1)	42	119.49				
	General High School (2)	128	117.93	3	8.62	0.03	2-3, 3-4
	Vocational High School (3)	40	93.55				
	Art and Sport High School (4)	22	144.20				
Unified	Science, Social Sciences, Anatolian High School (1)	42	130.63				
	General High School (2)	128	114.36	3	15.32	0.00	1-3, 2-3, 2-4, 3-4
	Vocational High School (3)	40	88.71				
	Art and Sport High School (4)	22	152.52				

As shown in Table 9a graduation high school type doesn't cause statistically difference for prospective teachers' NSKS views.  $\chi^2$  (sd=3, n=232)=4.26, p>0.05.

Yet in Testable ( $\chi^2$  (sd=3, n=232)=8.62, p>0.05) and unified  $\chi^2$  (sd=3, n=232)=15.32, p>0.01) subscales differences have been found out due to the graduated high school type. In consideration of mean rank in Testable NSKS Subscale, it is seen that the highest score belong to prospective teachers who graduated from art and sports high school and following high schools are science high school, social sciences high school, Anatolian high school, general high school, vocational high school graduates. Once again, art and sports high school graduates have the highest scores due to unified NSKS

subscale following high schools are science high school, social sciences high school, Anatolian high school, general high school, vocational high school graduates.

Mann Whitney U test results of prospective teachers' NSKS whole scale scores and subscale scores according to graduate high school variable are presented in Table 9b.

**Table 9b:** Comparisons of NSKS Scores According To High School Graduation U-Test Results

NSKS Subscales	High School Graduation	n	Mean Rank	Sum Rank	U	p
Testable	General High School (2)	128	88.75	11360.00	2016.00	0.04
	Vocational .high School (3)	40	70.90	2836.00		
Testable	Vocational .high School (3)	40	27.28	1091.00	271.00	0.01
	Art and Sport High School (4)	22	39.18	862.00		
Unified	Science, Social Sciences, Anatolian High School (1)	42	48.39	2032.50	550.50	0.00
	Vocational .high School (3)	40	34.26	1370.50		
Unified	General High School (2)	128	89.33	11434.00	1942.00	0.02
	Vocational .high School (3)	40	69.05	2762.00		
Unified	General High School (2)	128	71.75	9183.50	927.50	0.01
	Art and Sport High School (4)	22	97.34	2141.50		
Unified	Vocational High School (3)	40	26.40	1056.00	236.00	0.00
	Art and Sport High School (4)	22	40.77	897.00		

High school type they graduated from doesn't cause statistically meaningful difference for physical education prospective teachers' NSKS views in Testable and Unified Subscales. In consideration of Testable NSKS subscale mean rank, Vocational High School graduates have lower scores than General High School and Art and Sports High School graduates In Unified NSKS subscale Vocational High School Graduates have relatively lower mean rank than Science High School, Social Sciences High School, Anatolian High School, General High School and Art and Sports High School graduates. On the other hand, it can be seen that Art and Sports High School graduates have higher mean rank than General High School graduates.

Whole NSKS Scale Scores of Prospective Teachers Due to High School Department variable and descriptive statistics of variations of subscales scores are presented in Table 10.

**Table 10:** Comparison of NSKS Scores Due to High School Department Kruskal Wallis Results

NSKS Subscales	High School Department	n	Mean rank	sd	$\chi^2$	p
Whole Scale	Turkish Mathematics	122	111.08	3	3.92	0.26
	Science Mathematics	15	120.27			
	Social Sciences	72	128.67			
	Others (Vocational)	23	104.67			
Amoral	Turkish Mathematics	122	110.89	3	1.87	0.60
	Science Mathematics	15	125.73			
	Social Sciences	72	122.81			
	Others(Vocational)	23	120.50			
Creative	Turkish Mathematics	122	109.80	3	7.18	0.06
	Science Mathematics	15	125.27			
	Social Sciences	72	132.02			
	Others (Vocational)	23	97.74			
Developmental	Turkish Mathematics	122	111.52	3	3.13	0.37
	Science Mathematics	15	117.57			
	Social Sciences	72	127.69			
	Others (Vocational)	23	107.20			
Parsimonious	Turkish Mathematics	122	115.59	3	0.07	0.99
	Science Mathematics	15	119.80			
	Social Sciences	72	117.51			
	Others (Vocational)	23	116.04			
Testable	Turkish Mathematics	122	111.56	3	3.08	0.37
	Science Mathematics	15	107.40			
	Social Sciences	72	127.86			
	Others (Vocational)	23	113.07			
Unified	Turkish Mathematics	122	114.69	3	0.94	0.81
	Science Mathematics	15	117.33			
	Social Sciences	72	122.04			
	Others (Vocational)	23	108.20			

As shown in Table 10 there is no statistically difference among prospective teachers' NSKS views due to High school department variable.

Descriptive statistics of prospective teachers' interests in science and scientific studies are presented in Table 11.

**Table 11:** Prospective Teachers' State of Following Science and Scientific Studies

	n	%	
State of following science and scientific studies	Interested	59	25.4
	Not interested	173	74.6
	Total	232	100

According to Table 11, 59 (25.4%) of physical education teachers are interested in science and scientific studies, and 173 (74.6%) of the mare not interested in science and scientific studies

Descriptive statistics are shown in Table 12a, 12b, 12c related to prospective teachers' states of following developments in their field.

**Table 12a:** Prospective Teachers' States of Following Developments in Their Field

		n	%
State of following developments in sports and physical education	Follow	147	36.6
	Not follow	85	63.4
	Total	232	100

As it is seen in Table 12a while 147 of prospective teachers (36.6%) are interested in developments in physical education and sports, 85 of them (63.4%) express that they do not follow the developments in physical education and sports.

**Table 12b:** Number of Sources Prospective Teachers Who Follow the Developments in Their Field

		n	%
Sources to follow the developments	One source followers	73	49.7
	More than one source followers	74	50.3
	Total	147	100

According to Table 12b 73 of prospective teachers (49.7%) follow the developments through a source, 74 (50.3) of them say that they follow more than one source to catch up with the developments.

**Table 12c:** Sources Used By Prospective Teachers to Follow the Developments in Their Own Field

		n	%
Sources to follow the developments in physical ed. and sports	Academic publishing	10	6.7
	Federations	2	1.3
	İnternet	70	46.7
	course, Seminar, Conference	2	1.3
	Visual Media	23	15.3
	Social Media	19	12.7
	Printed Media	24	16.0
	Total	150	100

According to Table 12c prospective physical education teachers follow the developments mostly via internet (70- 46.7%). 24 (16.0%) of them follow the developments via printed media, 23 (15.3%) of them follow the developments via visual media, 19 (12.7%) of them follow via social media, 10 (6.7%) of them follow via academic journals, 2 (1.3%) of them follow via seminars, conferences and federation declarations.

## 5. Discussion and Conclusion

Physical education prospective teachers are moderately indecisive in terms of nature of scientific knowledge. Exactly like the whole scale, prospective teachers are indecisive towards the nature of scientific knowledge according to the subscales. Prospective physical education teachers' being indecisive to nature of science can be associated with low ratio of taking science courses. In literature review, similar studies can be seen with similar results (Kılıç, Sungur, Çakıroğlu, Tekkaya, 2005; Abd-El-Khalick & Lederman, 2000).

Prospective teachers have not studied nature of science at university and also it is seen that they have only studied science philosophy at high school as not a unique course but as a unit of curriculum. Thereby it is not unexpected that they are indecisive about nature of science.

In contrast to our findings, Güneş (2010) found out that science and social science teachers are more decisive and have positive attitudes towards the nature of science more than moderate level. It has been ascertained that there is no difference among the prospective teachers' NOS notions according to the education program they follow. Yet, when Table 2 is analysed, it is seen that the students who attend physical education and sport teaching department have more positive attitude towards nature of science than prospective teachers studying pedagogical formation. No meaningful difference has been conducted according to whether prospective teachers have taken any similar courses except for vocational courses during their university education in terms of their NOS notions. Güneş (2010) has concluded similar findings with ours in terms of education programme. Education program doesn't cause meaningful difference in whole aspect of the scale but only causes a difference in Parsimonious subscale.

When prospective teachers' NOS notions are analysed in terms of gender difference it is concluded that there is no difference between male and female participants. The only subscale which causes a difference between male and female prospective teachers' NOS notion is Developmental.

The findings show that male prospective teachers have higher level mean scores in Developmental subscale compared to female prospective teachers ( $\bar{X}_{\text{male}}=24.80 > \bar{X}_{\text{female}}=23.51$ ). The difference between the scores show that statistically there is a difference between female and male prospective teachers ( $p < 0.05$ ). In a similar study, it is seen that gender variable doesn't cause a difference in whole aspect of the scale but it causes a difference in Unified subscale (Güneş, 2010).

When Physical education prospective teachers' NOS notions are analysed according to age variable, it has been concluded that there is no meaningful difference among the participants' NOS notions. The prospective teachers aged 23 and 24 have higher whole scale score mean compared to other age groups ( $\bar{X}=148.75$ ). The prospective teachers who are at the age of 23 and 24 relatively have more positive attitudes towards to nature of scientific knowledge.



When physical education prospective teachers' NOS notions are analysed according to grade level variable, it has been concluded that there is no difference among the participants' NOS notions. Yet according to the unified subscale, 2<sup>nd</sup> grade students ( $\bar{x}$ =25.96) have relatively more positive attitudes towards nature of science compared to 1<sup>st</sup> grade students ( $\bar{x}$ =23.80), 4<sup>th</sup> grade students ( $\bar{x}$ =23.75), and graduates ( $\bar{x}$ =24.00).

Physical education prospective teachers' interests in science and scientific studies the courses related to science they have attended previously, and the high school type they graduate from don't cause meaningful difference in their NOS notions.

Prospective teachers' following scientific developments in their field causes a difference only in unified subscale for the sake of ones who follow.

When physical education prospective teachers' graduation high school are analysed it seen that there are differences in testability and unified subscales. Vocational high school graduates relatively lower scores in nature of science perception according to testability subscale compared to senior high school, sports and fine art high school graduates. Similarly vocational high school graduates have relatively lower scores in their nature of science perceptions according to unified subscale compared to science, social sciences, Anatolian, sport and fine art high school graduates. Also it is observed that senior high school graduates relatively lower scores in their nature of science perceptions compared to sports and fine arts high school graduates.

While 74.6% of physical education prospective teachers don't deal with science and scientific studies it is seen that 63.4% of them don't follow the developments in their teaching field. While 50.3% of physical education prospective teachers follow the developments through more than one source, 49.7% of them only follow one source about field developments. While participants assert that they follow the developments mostly through internet (46.7%), 16.05% of them follow the developments through printed media, 15.3 of them follow through mass media, 12.75 of them follow through social media, 6.7% of them follow through academic journals, 1.3% of them follow through seminars, courses and conferences and 1.35% of them follow through federation. Most of the physical education prospective teachers are not interested in science and scientific studies. Moreover, they don't follow the developments in their professional teaching fields.

### 5.1 Suggestions

Teachers' adoption of a modern education understanding has a significant role to achieve educational goals in terms of the methods and applications selections. Therefore, teachers who have no knowledge beforehand should adopt a modern understanding of science as researchers, trainers and scientists. They should deal with their studies in accordance with this principle.

Science lessons such as science history, science philosophy, nature of science should be included in curriculum. Moreover, students should gain scientific literacy ability and get clear understanding of scientific developments. To serve as a model for their students, first of all physical education prospective teachers should deal with

science, scientific studies, and especially with the developments in their professional field.

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