Preservice Science Teachers' Views on the NOS-based Knowledge

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Abstract

Well-prepared teachers produce more successful learners. Even though teaching and learning science in a class context was implemented within interactions among teacher, students, and content, the teacher is a key factor for effective learning in science education. However, the larger study associated the NOS focused students in Korea, there was little discussion and study about pre- and in-service science teacher program and teachers' views on the NOS. In this study, we are interested in pre-service science teachers' experience and knowledge about history of science and NOS. The purposes of this study were to investigate how different is the tendency about NOS-based knowledge of the pre-service science teachers in each grade. The results indicated that there is not different and increasing tendency by grade, neither.

Keywords: NOS, pre-service teachers, NOS-based knowledge

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Introduction

Over the last decade, one distinctive issue to improve science education is an approach that recognizes the importance of students' nature of science (NOS) and use history of science in learning science (Backhus & Thompson, 2006; Lederman , 1986, 1992, 1999; Lee, 2002; Meichtry, 1992). The national science education standards (NSES) in the U.S., was published by National Research Council (NRC) in 1996, puts a great emphasis on the inclusion of the 'history and nature of science' through all grade levels as an important domain with 'the principles & concepts of science' and 'reasoning & procedural skills of scientists'. The following excerpt from NSES attest to the significance of use of NOS and history related to science teaching and learning.

> In learning science, students need to understand that science reflects its history and is an ongoing, changing enterprise. The standards for the history and nature of science recommend the use of history in school science programs to clarify different aspects of scientific inquiry, the human aspects of science, and the role that science has played in the development of various cultures. (NRC, 1996, p. 107)

In addition, other important talked-about issue in science education is to help students to improve their scientific literacy. Based upon the previous studies related to NOS, there has been strong support for the NOS as a way to enrich science learning experiences for the science teachers and improve students' scientific literacy (Goodwin, 1999; Wenglinsky, 2000). There is strong evidence that well-prepared teachers produce more successful learners. Even though teaching and learning science in a classroom context was implemented within interactions among teacher, students, and contents, the teacher is a key factor for effective learning in science education. However, the larger study associated the NOS focused on students in Korea, there was little discussion and study about pre- and in-service science teacher program and teachers' views on the NOS. In this study we are interested in pre-service science teachers' experience and knowledge about history and NOS. The ground research about preservice science teachers' perceptions about NOS based scientific knowledge are expected to provide insight and empirical evidence to other science teachers who are interested in the NOS, and to researchers, curriculum developers, and teacher educators. The purposes of this study were to investigate preservice science teachers' view on the NOS-based knowledge. The specific questions to be addressed in this study are:

1. How do the preservice teachers' views on the NOS-based scientific knowledge differ by grade?
2. How do the preservice teachers' views on the NOS-based scientific knowledge differ between two groups?

Method

Subjects

Since this study was an exploratory study, we are not attempting to generalize our results . The selection of universities was one of convenience. The data for this study were collected f rom two universities undergraduate student groups in Chungbuk(CU) and Daegu(DU). As can be seen in Table 1, the subjects consisted of 76 students from CU and 62 students from DU.

Table 1.

Sample sizes by grade

Group	CU					DU				
Grade	Freshman	Sophomore	Junior	Senior	Sum	Freshman	Sophomore	Junior	Senior	Sum
n	19	19	20	18	76	19	13	14	16	62

Questionnaire

The questionnaire used in this study was developed by Chen (2006). A test–retest correlation coefficient of this questionnaire was achieved 0.82 in his study. It is a valid and practical tool that can be used to determine participants' conceptions and attitudes toward teaching NOS. After receiving his permission, we transcribed the questionnaire into Korean. The Korean version was reviewed and assessed by three professors and five science educators. The pilot tests were performed to three students in CU and five students in DU for the appropriate reading and understanding. In order to analyze and understand their experience related to any coursework in a university related to the NOS, three questions were added to the final version of the questionnaire.

Limitation

Due to the specific goals of this study, one limitation is that the questionnaire involves only questions related to the NOS-based scientific knowledge from Chen's (2006). Specifically, we chose the ten items of three domains from Chen's questionnaire which were closely related scientific knowledge rather than beliefs (see Table 2).

Table 2.

Domains and items of the questionnaire

Validation of scientific knowledge	*Tentativeness*	*Scientific Methods*
a1=Empirical evidence a2=paradigm, a3=Parsimony, a4=Authority, a5=Intuition	b1=Revolutionary, b2=Cumulative, b3=Evolutionary,	c1=The universal scientific method, c2=Diverse methods,

Analyzing Method

The computer program, Statistical Program for the Social Sciences (SPSS) was utilized for statistical analyses. One-way ANOVA and Kruskal-Wallis test were conducted to determine any significant differences by grade and between the groups. Significance was determined at the 95% confidence level ($\alpha = 0.05$). When ANOVA result was significant at a 95 % confidence level, the follow-up Scheffé test in parametric statistic method and Mann-Whitney U test in nonparametric statistic method were conducted to determine any significant differences by grades and between groups.

Results

1. Differences each grade in CU

As can be seen in table 3, the mean of item b1 show that the preservice teachers have positive views about revolutionary development of science and neutral or negative about others.

Table 3.
Mean of each item in CU

	Validation of scientific knowledge					Tentativeness			Scientific Methods	
	a1	a2	a3	a4	a5	b1	b2	b3	c1	c2
Freshman	2.94	2.71	2.05	2.47	2.11	3.53	2.95	3.21	2.68	3.49
Sophomore	2.69	3.06	1.84	2.89	2.21	3.58	2.47	3.47	2.51	3.23
Junior	2.68	3.08	1.85	3.30	1.95	3.95	3.50	3.45	2.27	3.13
Senior	2.25	3.25	1.89	2.78	2.17	3.45	2.56	3.49	2.41	3.19

The results of one-way ANOVA test for c2 showed that there was not difference within each grade statistically (F=1.300, p=0.281). The Kruskal-Wallis test for other items was as following table 4.

Table 4.
Kruskal-Wallis test of CU

	Items	a1	a2	a3	a4	a5	b1	b2	b3	c1
CU	χ^2	6.755	4.337	1.191	7.015	0.990	5.169	14.713	3.717	11.855
	Asymp. Sig.(2-tailed)	0.080	0.227	0.755	0.071	0.804	0.160	0.002*	0.294	0.008*

*p <0.05

As can be seen in Table 4, b2 and c1 showed statistically significant difference and the others were no statistically significant difference. According to the results of post verification of b2, there were statistically significant difference in freshman - junior (U=82.00, p=0.001) and junior - senior (U=82.00, p=0.002). In addition the item c1 was statistically significant difference in freshman – junior (U=99.000, p=0.008) and freshman – senior (U=74.000, p=0.003). Therefore, the views of preservice teachers in CU were not different within grades except for 'Cumulative' and 'The universal scientific method' items.

2. Differences each grade in DU

The means of item b1, b3 showed that the preservice teachers have positive views about revolutionary development of science and neutral or negative about others (see Table 5).

Table 5.

Mean of each item in DU

	Validation of scientific knowledge					Tentativeness			Scientific Methods	
	a1	a2	a3	a4	a5	b1	b2	b3	c1	c2
Freshman	2.74	2.92	1.63	2.89	1.74	4.21	3.16	3.84	2.33	3.58
Sophomore	2.89	3.43	2.15	2.69	2.08	4.00	2.77	4.00	2.38	3.56
Junior	2.71	2.97	2.14	3.14	1.93	3.93	3.07	3.93	2.21	3.52
Senior	2.50	3.28	2.50	3.63	2.25	3.75	2.75	3.75	2.25	3.25

The results of one-way ANOVA test for a1, a2 showed that there was not difference within each grade statistically (a1 F=0.823, p=0.487; a2 F=1.694, p=0.178).
The Kruskal-Wallis test for other items was as following table 7.

Table 6.

Kruskal-Wallis test of DU

Groups	Items	a3	a4	a5	b1	b2	b3	c1	c2
DU	χ^2	11.907	7.568	3.982	5.356	2.135	1.695	0.517	3.537
	Asymp. Sig.(2-tailed)	0.008*	0.056	0.263	0.148	0.545	0.638	0.915	0.316

*p <0.05

The results of Kruskal-Wallis test showed that the item a3 only showed statistically significant difference. The others were no statistically significant difference. According to the post verification by Mann-Whitney U test of a3, there were statistically significant difference in freshman - sophermore (U=75.500, p=0.023) and freshman - senior (U=74.000, p=0.002). Therefore, the views of preservice teachers in DU were not different within grades except for 'Cumulative' and 'The universal scientific method' items.

Discussion

In the relation to the items of 'Cumulative' and 'The Universal Scientific Methods', it was not found the increasing tendency by grade (see Figure 1 and Figure 2). It seemed that the there was no developing tendency in neither of CU and DU.

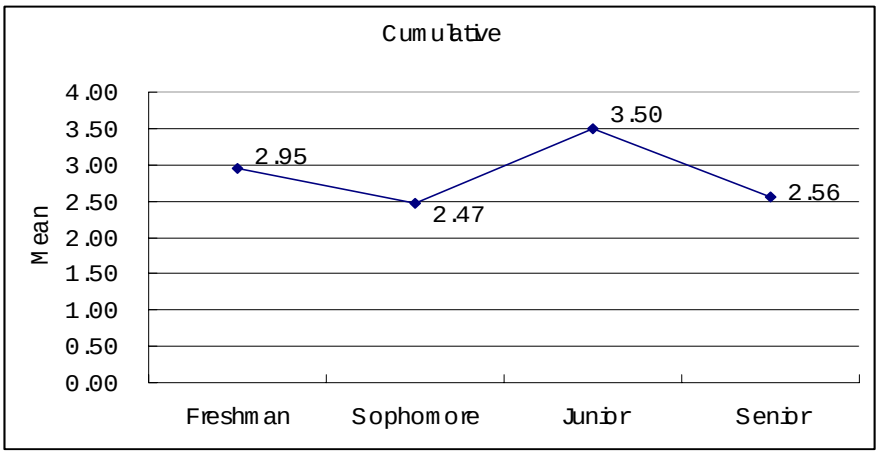

Figure 1. Views about *Cumulative* of CU.

The views of preservice teachers in DU about items of 'The Universal Scientific Methods' have the decreasing tendency by grade (see Figure. 2). The item of 'diverse method' was a part of scientific methods related to scientists' scientific inquiry process. The inquiry process began from recognizing the problem and finished in deriving conclusion. The scientists' inquiry processes were performed through general methodology in their own area, but their processes were not linear but complex (Reiff et al. 2002). The views of preservice teachers in DU about items of 'The Universal Scientific Methods' were generally negative (see Figure. 2). This result was considered as a positive one. However, as shown in Table 3, the content of area of 'Scientific Methods' need to be provided to preservice teachers, because the inservice teachers have the views linear steps about scientific inquiry process and followed the laboratory process as linear steps (Yang et al., 2006).

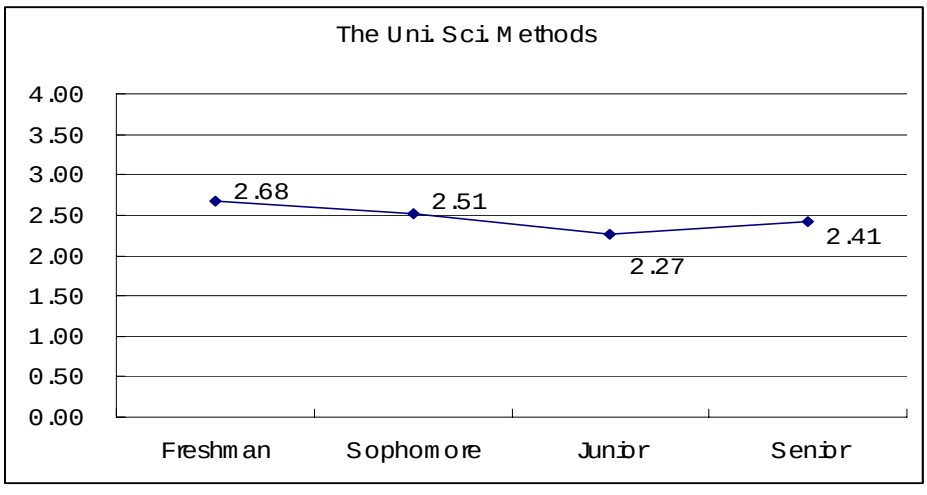

Figure 2. Views about the Universal Scientific Methods of CU.

The views associated with the item 'Parsimony' in two universities were negative. The view of CU was not different, while that of DU was different between freshman - sophomore,

junior, and senior. The result indicated that negative views about parsimony were decreasing by grade (see Figure 3). These negative views were also found in CU. Because scientific knowledge seems to be parsimonious, the contents of area about 'Parsimony' are needed to provide for preservice teachers.

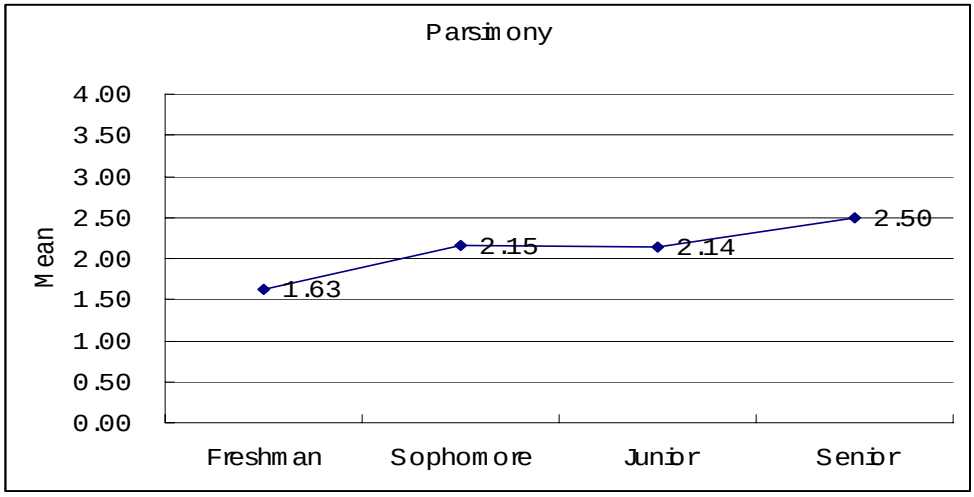

Figure 3. Views about Parsimony of DU.

Except for the item 'the Universal Scientific Methods' in CU, any tendency about views of the NOS-based knowledge was not found from both groups. These results indicated that their knowledge about the NOS did not increase. However, as you see in table 7, the responses of the question about 'Have you ever experienced any coursework in which the NOS were addressed?' showed that the content about NOS were addressed large part of the course works in their.

Table 7.

Percent of NOS experienced in their courseworks

	Freshman	Sophomore	Junior	Senior
CU	63.16	47.37	70.00	66.67
DU	52.63	69.23	100	100

Even though responding about dealing the content about NOS, negative results of preservice teachers' views in this study were grounded because their experiences were not impressive. Evaluation methods for the lecturer about areas dealing with the NOS were absent. Consequently, it needed for preservice teachers to have sufficient experiences and to use appropriate evaluating method.

Conclusion and Implication

The views of preservice teachers on the NOS were no significant difference by grade. There were no difference and no developing tendency in neither of university in Chungbuk

and Daegu. The science teachers have the most important role in increasing students' achievement in science. Science teachers' understanding about the NOS were necessary and sufficient condition (Abd-El-Khalick & Lederman, 2000). In addition, teachers' scientific knowledge may influence directly their teaching and learning activities (Brickhouse, 1990; Gallagher, 1991). Any effective educational programs that are dealing with the NOS-based knowledge can use for science teacher' training course.

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