THE EFFECTS OF SOME SELECTED DEMOGRAPHIC CHARACTERISTICS ON IN-SERVICE TEACHERS' VIEWS OF NATURE OF SCIENCE AND PROCESS SKILLS

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Abstract. The objectives of this study were to explore in-service teachers' views of the nature of science and process skills (NOS and PS), compare teachers' views of NOS and PS in terms of some selected demographic variables such as gender, work experience, grade levels, and subjects they teach. In addition, measure the effect of these demographic variables on teachers' views of NOS and PS. Cross-sectional descriptive survey employed. Convenience and purposive samplings used to select study subjects. Data collected by using VNOS- form D that modified by Ling et als in 2006. Frequency count, Kruskal Wallis Test, two-ways ANOVA, and multiple regressions used to analyze data. The findings indicated, in-service teachers had naïve views in nine or 39.1% questions out of 23 questions about NOS and PS. In comparing groups, there are significant difference in gender, work experience, and grade level they teach. From effect analysis, gender and work experience had significant effect on views of NOS. There is no significant interaction effect of all paired variables. The regression indicates, demographic characteristics had significant contributions on views of NOS and PS ($F(4, 222) = 4.78$, $p = .001$). Generally, the findings indicated, there is effect of demographic variables on teachers' views of NOS, though it is small. Thus, when developing school curricula, integrating concepts related to NOS suggested in different level. In addition, when developing college curricula for in-service teachers, the effect of demographic characteristics on their views NOS and PS needs consideration. Therefore, may college and school curricula revision in terms of NOS. In addition, seminars, mentoring, and reflective readings suggested to minimize problems related to in-service teachers' views of NOS and PS.

Keywords: grade level teachers teach; in-service primary school teachers; views of nature of science and process skills; gender; subject teachers teach; work experience.

INTRODUCTION

There are many factors that affect students' achievement in science education. They may categorize into school-related factors, student-related factors, and teacher related factors (Dossett & Munoz, 2003). Teacher-related factors had significant contribution on student achievement (Goldhaber, 2004). Thus, when developing school and college curricula, teacher related factors need special consideration. Due to this, researchers and policymakers have regarded improving teacher quality as a successful way to improve student achievement (Greenberg, Rhodes, Ye, & Stancavage, 2004). The study finding by Wenglinsky (2002) and Zhang &Danhui (2008) indicates that there is significant effect of teacher related factors such as teacher education level, teaching experience, and teacher behaviors on student achievement. In addition, college curricula had significant impact on teacher related factor (Zhang, & Danhui, 2008), then it may directly or indirectly affect school students achievement. Since, teacher learns to teach, due to this, the aim of college of teachers' education (CTEs) is not only to teach science but also to teach them the methods how science taught or learned (Tesfaye, 2010). Teacher related factors such as teaching discipline, gender, education level, teaching experience and regional work location had also relation with their understanding of concepts related to NOS and PS in science (Ayhan,2017). Then these factors had significant impact on students achievement/views of NOS and PS. This implies that, teacher behavior has direct relation with students' achievement and their knowledge of science and about science.

Science teachers should have an adequate understanding about nature of science and processes skills (NOS and PS) in science education (Lederman & Lederman, 2016). In addition, pedagogical knowledge to teach about science and science had significant contributions for effective classroom delivery (Mudavanhu & Zezekwa, 2017). Therefore, educational organizations (CTEs) are expected to help teachers to acquire informed views of NOS and PS (Lederman & Lederman, 2016). However, studies indicated that there is incompetency of teachers and students about NOS and PS concepts (Baloyi, et als, 2017; Blanchard, Annetta, &Southerland, 2008; Ramarian, 2016). This implies, the problem is not only relating with students but also includes teachers. One of the causes for this gap is related with integration and implementation of generic components of science lessons (Badri & Shri, 2013; Maccmort, 2013). Due to these gaps in science education, a considerable number of teachers working in elementary and secondary schools suffer from inadequate education that they received about NOS concepts (Abd-El-Khalick, Akerson,2004; Herman, Clough, & Olson, 2013). These gaps affect both students' and teachers' views of NOS and PS. Thus, it is critical to minimize problems regarding both teacher and students understanding of NOS and PS. However, before generating supporting strategies to minimize the problems regarding teachers' views about NOS and

PS related concepts, first explore and identifying the specific factors influencing teachers views of NOS is important.

Based on this idea, this study proposed the following questions that leads the study such as what are in-service primary school science and mathematics teachers views of NOS and PS? Is there difference among groups of in-service teachers in terms of some selected demographic characteristics such as gender, work experience, grade level and subject they teach in their views of NOS? What are the effects of these variables on their views of NOS and PS? In addition, what are the effects and association demographic variables with teachers views of NOS and PS?

The reason is that, in science education, students' learning at highest level is epistemic knowledge. Because, it is considered as meta-cognitive level (Krathwohl, & David *,2002).* This knowledge related with knowledge about science. The reason is that, NOS and PS is an epistemology that measures how knowledge or science is constructed or acquired (Lederman & Lederman, 2016; Mudavanhu & Zezekwa, 2017; NSTA, 2016). Thus, it has direct relation with epistemological domains of society (teacher & students) and practices employed by scientific community (teacher & students) in schools or colleges. The main component of this knowledge is under nature of science and science process skills. This knowledge level incorporates the overall understanding about the concepts in science. Therefore, educational researchers have long considered about understanding of NOS and PS to be a critical component of education and science literacy (Lederman, 2011). Thus, in science education the concepts related to NOS and PS have recently become an indispensable instructional outcome all over the world (Sadler, Chambers, & Zeidler,2004). The basic components of NOS that identified in many research works are: tentativeness of scientific knowledge, observations and inferences. In addition, subjectivity and objectivity nature of science, creativity and rationality in science or imaginations and logical reasoning in scientific knowledge construction. Moreover, social and cultural embeddeness in science, scientific theories and laws are the main components in NOS. Furthermore, scientific methods single/universal and/or varieties of methods used in scientific investigations are the main components of NOS and PS (Lederman, Abd-El-Khalick, Bell, & Schwartz, 2002; Laing et als,2009).

In science education, teachers practiced different levels and types of components in NOS and PS due to their differences in culture, educational background, work experience, gender, grade level, and subject they teach. Thus, the difference in views of NOS and PS expected among groups of teachers in their demographic characteristics. However, teachers teaching the same grade level (primary school), and educational background not be significant. Due to this, the so called teacher development (TDP) designed for in-service teachers in colleges to minimize gaps among teachers (MOE,1994, 2018). The study finding by Ayhan (2017) support this fact, teachers in views of NOS are different due to different educational background, gender, work experience, the subject and grade level they teach, and work environment. However, this study has limitations in comparing extremely different groups in work experience 0 and 20, and educational background Bachelor and master degree holders.

Different studies in the area (related to NOS and PS) had given more attention for exploring pre and in-service teachers' views of NOS and PS in terms of culture, educational background, gender (Ayhan, 2017; Wenglinsky, 2002; Zhang, Danhui, 2008) . Similarly, comparing effects different pedagogies on NOS and PS are rare (Baloyi, et.als, 2017). Some studies developing tools to measure teachers and/or students views of NOS and PS (Lederman, Abd-El-Khalick, Bell, & Schwartz, 2002; Ling et al., 2006; Welch, 1966). Some few studies conducted on measuring the effect of implicit or explicit approach of NOS and PS on students views of NOS and PS (Clough, 2011). A few studies conducted on the effects of teacher related factors (demographic characteristics) on students views of NOS and PS (Ayhan, 2017; Zhang, & Danhui, 2008). However, there are still gaps in identifying the influence of teacher related factors on their views of NOS and PS. An effort made in this study is to fill these gaps. This study explores in-service trainers' views of NOS and PS. In addition, compare in-service teachers with respect to some selected demographic characteristics such as work experience, gender, grade level and subjects they teach. At the same time, measure the effect of these variables on teachers' views of NOS and PS concepts. Moreover, measure the association of selected demographic variables with in-service teachers' views of NOS.

The following are both scientific and naïve views about NOS and PS. When exploring views of NOS and PS, it used as reference.

Table 1. Naïve and scientific views about nature of science and process skills

Components of Nature of science	Scientific/Constructivist views about Nature of Science	Naïve/Traditional views about Nature of Science
Tentativeness science	• Scientific knowledge is tentative and/or subject to change • It is a view of truth according to individual Scientific knowledge is never absolute or certain	• There is definite, correct or unchangeable scientific knowledge • There is universal truth
Subjectivity of science	• Scientific knowledge is empirically-based evidence has significant role	• Science using concrete data • Science is searching to prove or truth
Single/universal and varieties of scientific methods	• Observation/Scientific knowledge is theory-laden. • Observations guided by theories. • There are varieties of methods	• There is single scientific method • Science starts with neutral/objective observations
Imagination and creativity in scientific knowledge	• Imagination and creativity are used in all stages of scientific method (planning and design, data collection, and after data collection) • Involves explanation, and generating scientific because science is knowledge constructed by human	• Imagination and creativity are needed in scientific, however they used in investigations during the planning and design stages
Social and cultural embedness	• Scientific investigations are socially and culturally embedded • Science is a human enterprise • Scientists' methods depend on their prior knowledge	• Science is universal • Scientific knowledge must perform the norms of culture that held by scientific community
Observations and inferences in science	• Observations are affected by personal beliefs. • Inferences drove scientific constructs/concepts	• Any measurement /Observations are neutral/objective that cannot be affected by personal beliefs • Inferences in science are statement about phenomena that are not directly accessible by senses
Relationships or difference between scientific theories and laws	• Scientific laws describes what is observed • Theories explain the how and why of the observed phenomena • There is no hierarchical relationship between theory and law	• Scientific laws are absolute and certain. It cannot change because they are proven facts • Theories are unproven • Theories are alternative beliefs • There is hierarchical relationship that theories becomes laws with the accumulation of evidence

Adapted from Abd-El-Khalick et al., 1998; Akerson et al., 2000; Behiye Akçay, & Işıl Koç,2009; Lederman, 1999; Palmer, 2009.

Since there are gaps in science education literatures that identify the impacts of demographic characteristics such as gender, work experience, the subject and grade levels they teach in terms of in-service primary school science and mathematics teachers on their conception of NOS and PS with control of educational background. Thus, this study tried to fill these gaps in terms of analyzing the effect of the above mentioned characteristics on primary in-service science and mathematics teachers' views of NOS and PS those who are taking training in college of teachers' education. As initial evidence, women are less informed about science and nature of science compared to men as pointed out by (Chuk&Chidubem,2018). Similarly, it is logical that work experience of teachers results difference in their views of NOS and PS because as the teacher experienced s/he may gradually become well informed about NOS and PS due to practicing different levels and types of PS. In the same way, when teacher teaches different subjects and different

grade level, they are likely to experience different levels of view about NOS and PS. However, this relation not much studied in science education.

The aim of college of teacher education is to teach science and how to teach science(Tesfaye, 2010). Thus, the main aim of in-service training of colleges of teachers' education is to set the same flat form about science and for common understanding about science, and to minimize gaps in terms of concepts in science, pedagogical knowledge, and skill among teachers those teaching in primary schools. In addition, to minimize gaps among teachers due to differences in culture, gender, work experience, teaching grade and subjects in science education. However, in science education literature there are limitations to measure the association and effects of in-service teachers' demographic characteristics on their views of NOS and PS. Though, the study findings by Ayhan (2017), Wenglinsky (2002), and Zhang &Danhui (2008) indicated that, there is relationship of teaching discipline, gender, education level, teaching experience and regional work location with teachers' views of NOS. However, in these studies there are limitations. They comparing different groups in educational background, and comparing work experiences between 0 and 20 years.

This study based on these gaps in the area of study. Thus, this study aims to first explore in-service primary school science and mathematics teachers who were taking in-service training in colleges (i.e control educational background) views of NOS and PS. In addition, compare their views of NOS and PS in terms of gender, work experience, subject and grade level they teach. Moreover, measures the interaction effects of gender, work experience, subjects, and grade level they teach with their views of NOS and PS, and to measure the association of gender, work experience, the subject and grade level they teach with NOS and PS. Therefore, this study findings had significant contribution for developing science curricula for both primary school students and teachers who are teaching science and mathematics. In addition, to develop workshops, seminars---etc, in college and schools to capacitate teachers' views of NOS and PS based on teacher demographic characteristics.

Hence, this study has significant contribution and implications in transforming the existing science education reality in schools and colleges of teachers' education. This study may also fill the gaps of science education literatures in analyzing the effects of demographic characteristics on in-service teachers' views of NOS and PS. When doing this, this study supports the study findings by Laing et al (2009) , Lederman & Lederman(2016), Mudavanhu & Zezekwa (2017), Senler (2015) which says, even though teachers took different courses about NOS and PS explicitly or implicitly in colleges, they still have naïve view about NOS and PS. In view of this study, one of the causes for the teachers' inadequate view of NOS and PS may be lack of treatment conducted in terms of their demographic variables. Perhaps, the reason behind is that if teachers teach in primary schools are significantly different in terms of gender, work experience, grade level and subject they teach, that may cause negative impacts on students learning outcomes (Korur & Eryilmaz, 2018). Thus, this study gives constructive feedback to take proactive constructive activities on teachers' views of NOS and PS.

OBJECTIVES

1. To explore in-service science teachers views of nature of science and process skills.
2. To compare in-service teachers' views of NOS and PS in terms of gender, work experience, grade levels, and subjects they teach.
3. To measure the effect of gender, work experience, grade levels, and subjects they teach on in-service science teachers views of NOS and PS.
4. To measure the association of gender, work experience, grade levels, and subjects they teach with in-service science and mathematics teachers views of NOS and PS.

HYPOTHESIS

H_{01}. There is no significant difference among in-service teachers in their views of NOS in terms of gender, work experience, grade levels, and subjects they teach.

H_{02}. There is no significant effect of gender, work experience, grade levels, and subjects they teach on in-service science teachers views of NOS and PS.

H_{03}. There is no significant association of gender, work experience, grade levels, and subjects they teach with in-service science and mathematics teachers views of NOS and PS.

METHODOLOGY

Research Design

To attain objectives of this study, a cross-sectional descriptive survey employed. Hence, descriptive (frequency count), comparative, and an association studies employed. Descriptive (frequency count) used to explore teachers' views about NOS and PS, whereas comparative study employed to compare teachers' views of NOS and PS in terms of gender, work experience, grade level and subject they teach. In addition, to measure the effect of gender, work experience, and grade level and subject they teach on their views of NOS and PS association study employed.

Population and sampling

The populations of this study were in-service Mathematics and environmental science teachers who were taking in-service training in Arbaminc college of teacher education (Ethiopia). The in-service trainees are fourth year summer (vacation time for teachers in Ethiopia) program students. The total numbers of in-service trainees in Mathematics and environmental science department were 1286. Out of these 913 were men and 373 were women. These students grouped (clustered) into 24 groups in the college for course deliverance. In each group, in average there are 53 students. Students (in-service teachers) came from different catchment area of the college with different cultural background, however they assigned randomly in each group. Both purposive and convenience sampling methods used to select study subjects. In the college, there are nine departments in science stream such as physics linear, physic laboratory technicians, chemistry linear, chemistry laboratory technicians, biology linear, biology laboratory technicians, mathematics, integrated science, mathematics and environmental science. Thus, to select study subjects', first purposive sampling used to select one department in science who took more courses related to NOS and PS either explicitly or implicitly in terms of college curricula. By this method, Mathematics and environmental science graduate (fourth year) department students selected. Convenience sampling used to select most accessible groups for the researcher. Because, in the academic year of this study conducted, 6 physics teachers assigned to teach phy-301 different groups. The researcher was one of those teachers assigned to teach for 4 groups. Thus, these groups are comprehensively taken as study subjects. In these groups there are 227 students, out of these 164 are men, and 63 are women.

Instrument and Validation

In this study, likert scaled questioner used to collect data. VNOS form-D that modified by Ling et als (2006) used in this study. To test clarity, readability, and face validity English, Amharic, Physics, Chemistry and Biology teachers participated. By this, 24 items in Ling et als (2006) minimized to 23, by margining two items that are about social and cultural embedness in scientific findings. The words in the items " how" and "why" confused when translated to Amaharic. Due to these the two concepts merge and taken as one item. The Amaharic and English versions simultaneously administered as an alternative to understand the concepts. This method used to minimize language effect. Amharic language selected, because it is official and most spoken language in Ethiopia, especially in Southern Ethiopia. Forward and reveres translation conducted. The reliability (internal consistency) tested by using Cronbach alpha. The values obtained in pilot test in context of the study area is $\alpha = 0.843$. Thus, the objective of the pilot test is exploratory, because to identify the nature of tool in context of study area. When we compare this value with Ling et.als (2006) is $\alpha = 0.67$, it is better and in acceptable range.

Statistical Treatment Techniques used in the study

To assess in-service teachers' views of NOS by using VNOS-form-D, frequency count used. Whereas, to compare unequal (not proportional) number of groups in gender, work experience, grade level and subjects they teach, in terms of views of NOs and PS Kruskal Wallis Test used. In addition, to measure the effects of demographic variables on teachers views of NOS and PS two ways ANOVA used. Finally, to identify the association of gender, work experience, grade level, and subject teachers teach on NOS and PS, multiple regression employed.

RESULTS OF THE STUDY

In-service mathematics and science teachers view of nature of science

In the following section, the overall conception of teachers views about NOS and PS treated by using frequency count of the sum of positive (SA + A) and negative (SD + D) load responses. SA refer to strongly agree, A agree. SD, strongly disagree and D refer to disagree. If the question is negative and the majorities of the respondent positively answered or vice-versa (SA + A > SD + D), it indicates naive views of teachers about the concepts under the questions. If the question is negative and the majorities of the responded answered it negatively and vice-versa, it indicates teachers have scientific views about the concepts under the questions. The detail questions and data presented in appendix-1 table-2. The identified conceptions of in-service science and mathematics primary school teachers about NOS and PS organized under the themes of observation and inferences, scientific theory and law, social and cultural embedding, and scientific method. The followings are the findings.

Observation and inferences

For questions 1.2- "*The observation of Scientists' about the same event will be the same because of scientists are objective*", almost half of respondents agreed, i.e. they perceive as scientists are objective to observation and inferences, and small number of respondents were uncertain to answer.

Also for item 1.3- "*The observation of Scientists' is the same for the same event because observations are facts"*, more than half of the participants agreed; that means they perceive as any observation is fact. Small numbers of students were uncertain to answer. The finding indicates that attention needed to inform teachers about as scientist observation and inferences may be different due to background knowledge about the observation and materials they used to observe. In addition, any observation is not fact, rather it is an alternative knowledge we construct about the phenomena.

Scientific theory

For question 2.4- *"Theories in science developed based on accurate experimentation not changed"* about half of respondents agreed, that means they perceive as consistent reality could be achieved by experimentation. Small number of respondents were uncertain to answer.

In the same way, for item 3.1 *"Theories in science are exist in the natural world and discovered through scientific investigations"* most students responded as they agree. This indicates that students perceive those scientific theories existed in natural world and discovered by scientific investigation, i.e they perceive theory as natural phenomena. However, theory is an alternative knowledge constructed about the phenomena. The result of the respondents indicates that majority of in-service teachers perceive that, theory naturally existed thing and can be discovered. Thus, they believe that it is possible to attain consistent reality via experimentation. This implies that they are less informed as theory is relatively well-organized form of knowledge that constructed by human mind about natural phenomena, however it is changeable.

Scientific law

For question 3.3 *"Laws in science are theories that have proven",* most students agreed. That means they perceive law as proved theories. This indicates that in-service science and mathematics teachers less informed views about as law is general description of natural phenomena.

Social and cultural effect on science

For question 4.1 *"Researchers in science are not affected by society and culture because scientists are educated to conduct unbiased studies"* more than half of the respondents answered positively (they agreed), i.e they perceive that scientist are objective, and culture and society do not influence science. However, as science is human mind construct, thus it is affected by society and culture.

Also, for item 4.3 *"In all cultures, scientific research conducted in the same way because science is universal and independent of society and culture"* about half number of in-service teachers showed in their response that there is the same/universal method which is used to conduct scientific research anywhere. This indicates that teachers are less informed about social and cultural embedenes in scientific investigations, and as scientists use varieties of methods in scientific investigation-based problem at hand and on the field of study.

Scientific method

For item 6.2 *"When scientists conduct scientific investigation, they follow the same step-by-step scientific processes"* about 81.06% perceive that there is a single step-by-step scientific method to conduct any research.

In the same way for item 6.3, *"When scientists conduct scientific investigation, if they measure correctly, their results are true and accurate"* about 81.50% believe that any scientific method can give accurate and true result. The finding from the above two items shows that in-service teachers lack awareness about the existence of varieties of scientific methods used in different way of thinking, and that the findings obtained by experimentation are relative but not accurate due to uncertainties in any measurement in science.

In addition to the above findings, in average greater than 13% are uncertain to answer all questions related to NOS and PS (see table 1 in the appendix).

Generally, the findings from descriptive (frequency count) indicates that in-service science and mathematics teachers have naïve views in some areas of nature of science and process skills. In addition, in-service teachers are uncertain to answer each question related to NOS and PS. The misconceptions organized under the themes and interpreted in comparison with information in table-1. The finding indicates that, in-service science and mathematics teachers' curricula and/ or school science curricula suggested to integrate concepts related to NOS and PS in a way different from current use. In addition, supportive programs such as workshops, seminars and self-reflective reading suggested.

Comparing groups in terms of some selected demographic characteristics

In the following section teachers compared in terms of selected demographic variables such gender, work experience, grade level they teach (1-4, and 5-8), and subject they are teaching in their views NOS and PS.

The hypothesis used is(H_{01}): There is no significant difference among groups in terms gender, work experience, grade level and subject they teach in their views of NOS and PS.

Due to unequal number of groups in selected demographic variables, Kruskal Wallis test employed.

Table 3. Descriptive statistics of Views of nature of science and process skills of teachers

	N	Mean	SD	Min	Max
Total NOS and PS	227	53.1806	6.19720	23.00	70.00
Teaching Different Subject	227	1.7974	.79456	1.00	3.00
Gender	227	1.2775	.44877	1.00	2.00
Work experience	227	1.1542	.36192	1.00	2.00
Grade level teaching	227	1.2467	.43204	1.00	2.00

From table-3, we can see that, the mean value of groups of teaching different subject is greater than gender, work experience, and grade level they teach. The SD for teaching different subject is greater compared to others. This implies teachers in groups of teaching different subject are different compared to other grouping of teachers in their views of NOS and PS.

Table 4. Mean rank of groups Views of nature of science and process skills.

Grouping Variables	Groups	N.	Mean Rank
Subject teaching	Teaching maths	99	109.77
	Teaching Environmental science	75	107.83
	Teaching mixed subject	53	130.62
Gender	Male	164	121.44
	Female	63	94.63
Work experience	Experience 0-4 years	192	118.02
	Experiencegraterthan4 years	35	91.97
Grade level teaching	Teaching KG-4	171	108.27
	Teaching 5-8	56	131.48

From the table 4, about mean rank order comparison in views of NOS and PS, teachers teaching grade 5-8 have greater mean rank than all other groups, the second one is teachers teaching mixed subjects, and the last one is groups of teachers with work experience greater than four years. This implies that, teachers teaching grade 5-8 have better views in NOS and PS than teaching KG-4, and lest one is the groups of teachers with work experience greater than four.

Table 5. Test statistics of groups in terms selected demographic variables about NOS and PS

	Grouping variables			
	Subject teaching	**Gender**	**Work experience**	**Grade level teach**
Chi-Square	4.481	7.606	4.670	5.284
Df	2	1	1	1
p.	.106	.006	.031	.022

From table 5, in comparing un equal number of groups in terms of gender, work experience, grade and subjects they teach, the test indicated that, there are significant differences among in-service science and mathematics teachers in their view of NOS and PS with respect of gender(p=0.006), work experience(p=0.031), and grade level they teach(p=0.022), however not significant in the subject they teach(p=0.106).

The effect of selected demographic variables on teachers views of NOS and PS

The following section the effect gender, work experience, the subject and grade level they teach on their views of NOS and PS analyzed. In addition, the combined interaction effect of pairs of variables on NOS and PS analyzed by using two-way ANOVA. The hypotheses used to test the effects are:

H_{02}: There is no significant effect of gender, work experience, the subject, and grade level they teach on in-service teachers views of NOS and PS.
H_{03}: There is no significant interaction effect combination of gender, work experience, the subject and grade level they teach on in-service teachers views of NOS and PS.

Table 6. Levene's Test of Equality of Error Variances for views of NOS and PS

F	**df1**	**df2**	**p.**
.509	17	209	.947

From table-6 presenting equality of error of variances across the groups. Levenes test indicated that the error variance is not significant (p=0.947). So, the error variance of the dependent variable is equal across groups; thus, the groups are similar in their variance. Therefore, it is possible to use parametric tests.

Table 7. Descriptive statistics of between-subject factors of some selected demographic variables

Work experience	**Grade level teaching**	**Subject teaching**	**Male**			**Female**		
			Mean	**SD**	**N**	**Mean**	**SD**	**N**
Experience 0-4 years	Teachin KG-4	Teaching maths	54.0455	5.78271	44	51.5417	7.70081	24
		Teaching Environmental science	53.7500	5.62329	36	51.9200	5.58211	25
		Teaching mixed subject	52.9091	6.13929	11	53.6000	4.50555	5
	Teaching 5-8	Teaching maths	53.7222	7.18500	18	44.0000	.	1
		Teaching Environmental science	60.0000	.	1			
		Teaching mixed subject	55.9630	6.02866	27			
Experience greterthan4 years	Teaching KG-4	Teaching maths	49.3333	4.74342	9	42.0000	.	1
		Teaching Environmental science	53.2857	4.71573	7	47.5000	5.00999	6
		Teaching mixed subject	52.0000	5.56776	3			
	Teaching 5-8	Teaching maths	52.0000	4.24264	2			
		Teaching mixed subject	56.1667	6.49359	6	51.0000	.	1

From table 7, comparing the groups in terms of SD values. Except single category of variables, the SD value is large. That indicates, teachers within group comparison are different, i.e male and female are different in subjects they teach, work experience, and in grade level they teach within a group.

Table 8. Tests of Between-Subjects Effects on teachers views of NOS and PS.

Source	Df	MS	F	P	η^2
Corrected Model	17	59.570	1.624	.060	.117
Intercept	1	147184.651	4012.258	.000	.950
Gender	1	246.382	6.716	.010	.031
Work experience	1	169.966	4.633	.033	.022
Grade level teaching	1	20.205	.551	.459	.003
Subject teaching	2	55.956	1.525	.220	.014
Gender * Work experience	1	49.704	1.355	.246	.006
Gender * Grade level teaching	1	46.525	1.268	.261	.006
Gender * Subject teaching	2	14.400	.393	.676	.004
Work experience * Grade level teaching	1	12.777	.348	.556	.002
Work experience * Subject teaching	2	18.178	.496	.610	.005
Grade level teaching * Subject teaching	2	14.918	.407	.666	.004
Gender * Work experience * Subject teaching	1	.492	.013	.908	.000
Work experience * Grade level teaching * Subject teaching	1	2.675	.073	.787	.000
Error	209	36.684			
Total	227				
Corrected Total	226				

From table 8, we can see that the effect of gender (p=0.010), and work experience (p=0.033) on teachers views of NOS and PS are significant. However, grade level they teach (p=0.458) and the subject they teach (p=0.220) have no significant impacts on their views of NOS and PS. Also combined interaction effect of two or three demographic variables had no significant (P>0.05) on teachers views of NOS and PS, i.e all paired variables have similar contributions on teachers views of NOS and PS. The partial eta squared of gender is 0.03(3%), work experience is by 0.02(2.0%) and subject they teaching is 0.014(1.4%). The partial eta squared for combined effect of two or more variables is close to zero, i.e. all paired variables have similar contributions on teachers views of NOS and PS.

Association of selected demographic variables with NOS and PS

In the following section the association of gender, work experience, grade level and subject teachers teach with in-service teachers views of NOS and PS analyzed.

The hypothesis used to test is (H_{04}): There is no significant association of gender, work experience, the subject and grade level they teach with teachers views of NOS and PS.

Table 9. Descriptive statistics of NOS and PS as a Function of selected demographic variables

Variables	Descriptive Statistics (N=227)		Correlation				
	Mean	SD	Total NOS and PS	Gender	Work experience	Grade level teaching	Subject teaching
Total NOS	53.1806	6.19720	1.000	-.137	-.199	.158	.122
Gender	1.1542	.36192	-.137	1.000	-.047	.010	.078
Work experience	1.2775	.44877	-.199	-.047	1.000	-.309	-.090
Grade level teaching	1.2467	.43204	.158	.010	-.309	1.000	.314
Subject teaching	1.7974	.79456	.122	.078	-.090	.314	1.000

From Table 9, the mean value of groups of teachers in subjects they teach have greater than the rest variables. In addition, and teachers with group of work experience have smaller mean value compared to the others. Teachers views of NOS and PS has negative correlation with gender and work experience, but

has positive correlation with grade level and subject they teach. In addition, teachers views of NOS and PS has medium positive correlation with the subject teacher teach and grade level they teach. Moreover, work experience and grade level they teach have negative medium correlation with views of NOS and PS. This finding indicates that teachers views of NOS and PS has negative correlation with gender, i.e the mean score of male and female teachers are opposite. Similarly, the mean score of views of NOS and PS are opposite for teachers with work experience less than four and greater than 5 years. In the other hand, the mean score of teachers teaching grade level 0-4 and 5-8, and teaching different subjects (maths, mixed subjects, and environmental science) are similar.

In the following section the regression of each demographic variables with NOS and PS analyzed.

Table 10. Regression table of demographic characteristics on views of NOS and PS.

Analysis of variance								
Model	**Sum of Squares**		**Df**	**Mean Square**		**F**	**p.**	
Regression	688.299		4	172.075		4.780	.001	
Residual	7991.296		222	35.997				
Total	8679.595		226					
Variables in Equation								
Variable	**B**	**St.error**	**Beta**	**T**	**P**	**Correlations**		
						Zero-order	**Partial**	**Part**
Constant	56.597	2.435		23.240	.000			
Work experience	-2.621	1.107	-.153	-2.366	.019	-.137	-.157	-.152
Gender	-2.410	.936	-.175	-2.574	.011	-.199	-.170	-.166
Grade level teaching	1.100	1.019	.077	1.079	.282	.158	.072	.069
Subject teaching	.732	.531	.094	1.379	.169	.122	.092	.089

R=.282, R^2= .079, and adjusted Square=-.0.063.

From table 10, there is statistically significant contribution of selected demographic variables F(4, 222) = 4.78, p = .001) on teachers views of NOS and PS. The overall effect is R^2= 0.079(7.9%). The effect is small (Cohen, 1988). From the regression equation, we can see that:

$R^2 = \beta_{WexpX}r_{nos} + \beta_{genderX}r_{Nos} + \beta_{GttX}r_{Nos} + \beta_{Gtt}Xr_{Nos}) \times 100\%$

R^2x100%=0 .079x100%= (0.020961 + 0.034825+ 0.012166+0.011468) 100%

7.9%=3.4825%+ 2.0961 %+ 1.2166% + 1.1468%

Out of 7.9% contribution of all variables, work experience had 3.4825%, gender difference had 2.0672%, grade level they teach had 1.2166%, and subject they teach had 1.1468%. From the three variables, work experience and gender difference had large effect than the other. Also the adjust R square value was .063. This indicates that 6.3% of the variance in views of NOS and PS skills of teachers explained by gender, work experience, subject and grade level teachers teach. The identified equation to understand this relationship was:

VNOS and PS =56.602+(-2.621*work experience)+(-2.41*gender)+(1.10*grade level teach) +(.732 * subject they teach).

The liner regression equation will be:

Y =56.597+(-2.621*1.1542) + (-2.41*1.2775) + (1.10*1.2467) + (.732 * 1.7974).

53.1806=56.602-3.0251582-3.078775+1.37137+1.3156968=53.1758348

From the equation, we can see that, gender and work experience had negative impact, and grade level and subject they teach had positive impacts on teachers' views of NOS and PS**.** This finding indicates that, teachers in gender and work experience difference had negative effect on the scores of teachers' views of NOS and PS, i.e male and female teachers and teachers with different work experience differently perceive NOS and PS. At the same time, the contribution of grade level and subject teachers teach on their views of NOS and PS is positive, i.e teachers teaching different subject and grade level similarly perceive NOS and PS.

DISCUSSION

In this study, the findings indicated that generally in-service science teachers have naïve about NOS and PS in nine (39.1%) questions out of 23 questions that related to NOS and PS. In addition, in average greater than 13% students are uncertain to answer all questions. This finding to some extent related with finding of Jain, et als (2013), Ling, et als (2006), Mudavanhu & Zezekwa (2017), and Senler (2015). In this study the main findings are 1. Scientists are objective to observation and inferences, 2. Any observation is fact, 3. Consistent reality could be achieved by experimentation, 4. Scientific theories existed in natural world and discovered by scientific investigation, 5. Law is proved theories, 6. Scientists are objective, and culture and society do not influence science, 7. There is no social and cultural embedenes in scientific investigations, 8. There is a single step-by-step scientific method to conduct any research, 9. Any scientific method can give accurate and true result. This finding is to some extent related with the findings of Behiye, & işıl (2009), Gülcan, & Alev (2014), Leblebicioglu, Metin, &Yardimci (2012), and Mudavanhu & Zezekwa(2017). Hence, generally in-service mathematics and science teachers need support about NOS and PS related concepts in college curricula and/ or school curricula. In addition, tutor, seminar, and workshops suggested to improve their views about NOS and PS.

In comparing (H_{01} test) in-service teachers' views of NOS and PS in terms of groups of gender, work experience, subjects and grade level they teach, the result indicated that teachers are significantly different in terms of gender, work experience, and grade level they teach, however not significantly different in subjects they teach. Even though the groups took the same courses at the same time about NOS and PS in different courses in college and teach primary school level, they are significantly different in their views of NOS and PS in terms of gender, work experience, and grade level they teach. This finding to some extent supports the study findings by Ayhan (2017). However, the comparison in Ayhan study conducted among different educational background of teachers and work experience range of zero and twenty. However, in this study the comparison conducted in the same educational background, and work experience in range of 0 and <10.

This finding indicates that, even though in-service programs aim to minimize the significant gaps of teachers in their content knowledge and views of NOS and PS with regard to gender, work experience and grade level they teach in primary schools, the study showed that there is considerable differences among the groups. The identified difference of teachers in their views of NOS and PS in terms of grade levels they teach is expected and logical, because when they teach different grade levels, they may experience different level of NOS and PS. On the other hand, the study showed insignificant difference in teachers' views of NOS and PS regarding subjects they teach. This could indicate gaps in the school curricula because if teachers teach different subjects, they are likely to experience different levels of views about science, but in this study, groups of teachers across teaching different subjects hold similar views about NOS and PS. This means, teachers teaching different subjects in primary schools are similar in their views of NOS and PS. As well, even though teachers took the same courses in colleges about NOS and PS, the primary school curricula they teach had not significant impacts on their views of NOS and PS. In other words, it may be the balanced effect of college and school curricula on teachers' views of NOS and PS.

From effect analysis (H_{02} & H_{03} test) of gender, work experience, grade level and subject they teach on teachers' views of NOS and PS indicated that, the effect of gender and work experience had significant effect. However, this effect not expected since the aims of in-service training are narrowing these gaps. In another aspect, even though the effect of grade level and subjects they teach on their view of NOS and PS are expected and logical, but the result of the study does not prove this fact. This implies even though teachers teach different grade level and different subjects in primary schools, the effect of these variables on their views of NOS and PS is not significant, i.e. two variables have similar effect on teachers views of NOS and PS. In addition, the findings from interaction effects of pairing of two or more demographic variables (gender, work experience, grade level and subject they teach) indicate that, there is no significant

interaction effect difference on teachers' views of NOS and PS; however the effect was expected to be significant . In other words, all pairing of independent variables have the same effect. It is believed that when teachers (male or female) become more experienced, their views of NOS and PS change more likely. As well, teachers who are teaching different grade levels and subjects are more exposed to different levels and types of views of NOS and PS and which can lead them to change their views, but the result of the study does not prove this fact. Thus, further study or may reform of school or college curricula needed to fill the gaps in the area. This finding supports the study findings of Zhang, & Danhui, (2008). However, that study had limitations in comparing different educational background teachers and comparing groups with work experience of 0 and 20.

The association of variables analysis (H_{04} test) indicated that, the contribution of gender, work experience, subject and grade level they teach on teachers views of NOS and PS is significant ($F(4,222)= 4.780$, $p=0.001$). However, the overall contribution is 0.079(7.9%). From the equation of regression, gender and work experience had negative impact, but subject and grade level they teach had positive impact. These are logically acceptable, because teachers who took the same courses in the same way in college and taught the same grade level should not be significantly different in gender and work experience, thus negative effect in difference of teachers in their views of NOS, and PS is expected. Likewise, a positive impact of subject and grade level they teach on their views of NOS and PS is expected. Because, teachers took the same courses in colleges but are teaching different grade levels and subjects. Thus, primary school teachers who were taking continuous training in colleges' need additional support that considers gender and work experience difference to balance the significant difference among the groups. There is/are less even no direct related literatures which support or oppose the findings of this study with regard to the effects and association of gender, work experience, grade level and subject teachers teach on/with in-service teachers views of NOS and PS. This study conducted on the same educational background and in-service teachers who are taking in-service college program, and on specifically science and mathematics primary school in-service teachers.

The overall finding of this study indicated that, in-service math and Science teachers have inadequate understanding of NOS and PS. This implies that, the explicit and implicit instructions they received at colleges and their experience of teaching different subjects in school did not help teachers hold the required view of NOS PS. Thus, it necessitates the need to contextualizing the contents of college and school curricula with regard to NOS and PS. Moreover, it calls for the need to encompass courses or contents related to history and philosophy of science in college or school curricula in Ethiopia. Because, teachers are more affected by the curricula they teach in schools. The finding indicated this fact, college in-service training programs have less effect on teachers views of NOS and PS. It (the finding) also points out that, there may be strong correlation between primary school curricula and college curricula regarding NOS and PS. Therefore, college curricula need reform in terms of NOS and PS that considering demographic characteristics of in-service teachers when developing training programs in college. In addition to the above factors, the other possible factors that may affect teacher views of NOS and PS are courses deliverance methods and equipments available to teach science in colleges. Scholars suggest the use of argumentative and/or student-centered approach rather than didactic approach for teaching science subjects (Mekibib et als, 2018). Moreover, schools and colleges of teacher educations are required to fulfill science equipment to better practice science process skills, because that helps to understand nature of science (Gecer&Ozel, 2012).

CONCLUSIONS AND ITS EDUCATIONAL IMPLICATIONS

This study explored in-service science and mathematics primary school teachers views of NOS and PS who were taking training in colleges of teacher education in teachers development program (TDP) in Ethiopia in terms of capacity and quality improvement of teachers, and upgrade their career. The study compared teachers' views of NOS and PS in terms of selected demographic variables such as gender, work experience, grade level and subjects they teach. In addition, measure the effects and association of demographic on/ with teachers views of NOS and PS.

The result indicated that there is significant difference in teachers' views of NOS and PS across groups of gender, work experience, and grade level they teach; however, the difference is insignificant in groups across subjects they teach. In addition, the finding showed that teachers gender difference and work experience have direct significant effect on their views of NOS and PS. Moreover, the interaction effects of two or more demographics variables on teachers' views of NOS and PS is not significant. Furthermore,

a unique association of some demographic characteristics with teachers views of NOS and PS obtained. This finding implies may there are gaps in schools and college curricula in integration and implementation regarding NOS and PS. Thus, both school and college curricula need to be revision so as to incorporate integration of NOS and PS and consequently minimize significant difference identified among the groups of teachers. In addition, to minimize significant effect of some demographic characteristics on teachers views of NOS and PS.

Though, there are limitations of this study in such a way that, the questions used in this study are not contextualized to the context of Ethiopia, the study used different subjects that are from different cultural background, and only scale questions in VNOS form-D used. However, the researcher believes that the findings of this study are very useful for further educational researches aim to explore the effects of demographic variables on in-service primary school teachers' views of NOS and PS.

While conducting this study, further research directions detected such as compare groups of teachers from different cultures in Ethiopia, teaching different subjects like natural science and social science, language, arts or music etc in service teachers. Other potential areas to be investigated may also include teaching teachers by using contextualized questions in context of Ethiopia. This approach can help to deeply investigate and find out teachers' view about NOS and PS to enhance the quality of science education nationally and internationally.

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APPENDIX 1

Table 2. Descriptive statistics of Views of nature of science and process skills of primary school teachers.

No.		Questions	(N=227) %							In terms to item
			SD	D	U	A	SA	SD+D	SA+A	
1.1	+	The observations of Scientists about the same event may be different because of scientists' prior knowledge affect their observations.	4.85	9.69	18.50	38.33	28.63	14.54	66.96	Consistent answer
1.2	-	The observation of Scientists' about the same event will be the same because of scientists are objective.	10.57	26.43	16.30	27.75	18.94	37.00	46.70	Opposite answer
1.3	-	The observation of Scientists' is the same for the same event because observations are facts.	4.41	18.50	18.50	22.03	36.56	22.91	58.59	Opposite answer
1.4	+	For the same observation, Scientists may make different interpretations.	6.61	7.49	9.69	35.24	40.97	14.10	76.21	Consistent answer
2.1	+	Theories in science are subject to continuous testing and needs revision.	3.08	3.96	7.93	29.96	55.07	7.05	85.02	Consistent answer
2.2	+	Theories in science may be completely replaced by new theories in light of new evidence and findings	5.73	14.54	16.74	30.40	32.60	20.26	63.00	Consistent answer
2.3	+	Theories in science may be changed because of scientists may reinterpret existing observations.	5.73	8.37	15.42	35.24	35.24	14.10	70.48	Consistent answer
2.4	-	Theories in science developed based on accurate experimentation not changed.	14.54	18.94	18.94	21.15	26.43	33.48	47.58	Opposite answer
3.1	-	Theories in science are exist in the natural world and discovered through scientific investigations.	5.29	3.08	11.89	24.67	55.07	8.37	79.74	Opposite answer
3.2	-	Theories in science are changeable but not laws are subject to change.	17.62	36.12	20.70	10.57	14.98	53.74	25.55	Consistent answer
3.3	-	Laws in science are theories that have proven.	5.29	3.96	12.78	23.79	54.19	9.25	77.97	opposite
3.4	+	Theories in science explain scientific laws.	4.41	4.85	7.93	26.87	55.95	9.25	82.82	Consistent
4.1	-	Researchers in science are not affected by society and culture because scientists are educated to conduct unbiased studies.	9.25	13.22	12.33	25.55	39.65	22.47	65.20	Opposite answer
4.2	+	Values in Culture determine what science should conducted and how it to be accepted.	10.13	15.42	22.47	28.63	23.35	25.55	51.98	Consistent answer
4.3	-	In all cultures, scientific research conducted in the same way because science is universal and independent of society and culture.	22.03	18.50	14.10	18.94	26.43	40.53	45.37	Opposite answer
5.1	+	When scientist conducts scientific investigation, they use their imagination and creativity when they collect data.	3.52	2.20	2.64	18.06	73.57	5.73	91.63	Consistent answer

5.2	+	When scientists conduct scientific investigation, they use their imagination and creativity in the phase when they analyze and interpret data.	4.41	1.76	7.05	31.28	55.51	6.17	86.78	Consistent answer
5.3	-	When scientists conduct scientific investigation, they do not use their imagination and creativity because these may conflict with their logical reasoning.	30.84	27.31	21.59	9.25	11.01	58.15	20.26	Consistent answer
5.4	-	When scientists conduct scientific investigation, they do not use their imagination and creativity because these can interfere with objectivity in science.	23.79	36.56	20.70	10.13	8.81	60.35	18.94	Consistent answer
6.1	+	When scientists conduct scientific investigation, they use a variety of methods to produce accurate results.	3.08	0.44	4.41	25.11	66.96	3.52	92.07	Consistent answer
6.2	-	When scientists conduct scientific investigation, they follow the same step-by-step scientific processes.	4.85	4.41	9.69	40.53	40.53	9.25	81.06	Opposite answer
6.3	-	When scientists conduct scientific investigation, if they measure correctly, their results are true and accurate.	1.76	7.05	9.69	27.31	54.19	8.81	81.50	Opposite answer
6.4	+	In process of construction scientific knowledge, experiments are not the only means used.	11.89	15.86	9.25	29.52	33.48	27.75	63.00	Consistent answer