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PERCEPTION OF PRE SERVICE SCIENCE TEACHERS TOWARDS NATURE OF SCIENCE: - A STUDY

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Abstract

The research paper documents the Perception of Pre service Science Teachers towards Nature of Science in secondary teacher education institutions. Objectives-The data were collected through a self-developed questionnaires from 304 preservice science teachers, out of which 137 male preservice science teachers and 167 female preservice science teachers from twelve teacher education institutions running under Higher Education Department, Govt. of Odisha. Data was analysed using descriptive and inferential statistics. i.e Mean, standard deviation and t -test. The findings revealed that, the mean scores for understanding the empirical nature of science are 4.21 for males and 4.13 for females, with standard deviations of 0.386 and 0.369. The t-value of 1.842 indicates no significant difference, showing both genders have a similar understanding towards Nature of Science.

Keywords: *Nature of Science, Scientific literacy, Science education, Preservice teachers*

Introduction

Understanding the Nature of Science (NOS) is crucial for preservice teachers as it significantly influences their pedagogical practices. The objectives of science education are to provide enough understanding and enhance students' scientific attitudes in teaching learning process. Preservice Science Teacher plays a very important role to train students at School in scientific literacy and help them to acclimate to the rapid development of science and technology. The evolutionary change is always associated with changing the nature of knowledge and science. In school curriculum, science concepts are placed in line with this

changing nature. Researches conducted on perception of teachers on Nature of Science at different levels. One of the study revealed that there was no significant difference in pre-service teachers view of Nature of Science between males (M = 3.76, SD = .389) and females (M = 3.79, SD = .376), t (229) = - .707, p = .48(D. Philip,2020). Additionally, science education is adopted as a goal for resolution of social problem by inquiry. Science continuously interacts with the social environment. This shows that socio scientific issues which have conceptual relationships with science (Abd-El- Khalick et al.,1988; Turkmen et al.,2017; Ke at al., 2021). Science develops with social needs, and society uplifts with scientific developments. These changes and developments may cause dilemmas for accepting in society. Complex scientific issues containing dilemmas are defined as socio-scientific issues (Topçu, 2015). Thus, this study investigated the perception of Pre-service Science Teachers towards nature of science with respect to gender both male & female.

Conceptual Framework

Teachers represent the most important variable in the classroom learning equation. Even well-designed Nature of Science (NOS) instructional packages that are at odds with the philosophical orientations of teachers may not be effective. Duschl, (1985) write that in spite of attempts to "teacher proof" schooling through the enforcement of strict curriculum guidelines and teaching models, teacher will continue to make the most critical decisions in the education of students. In order for students to become scientifically literate, they should develop an understanding not only in science concept but also an understanding of the enterprise of science and nature of scientific knowledge (NOS).Interms of scientific literacy ,understanding NOS is necessary to make sense of scientific information encountered in everyday life ,understand socio scientific issues and participate in the decision-making process(Driver et al.1996).Research identifies teacher as the most influential factor in classroom learning(Lumpe 2007; Miller 2001) ,so it is no surprise that students 'failure to grasp NOS as focused researchers attention on teachers while research has been effective in identifying ways to address gaps in preservice and in-service teachers 'understanding of NOS(Akerson et al.,2000; Lin and Chen 2002;Mc Donald 2010),research on teachers 'classroom practice indicates that knowledge NOS is a necessary ,but not sufficient condition for effective NOS instruction(Abd-El-Khalick et al,1998,Akerson and Abd-El -Khalick 2003;Akerson and Volrich 2006; Lederman et al.2001).

The major element of nature of science are: scientific knowledge is (a) tentative, i.e., subject to change; (b) empirically based, i.e., based on observations of the natural world; (c) theory-

laden, i.e., subjective; (d) derived in part from human inference, imagination, and creativity, and se) surrounded by social and cultural aspects of society (Abd-El-Khalick et al., 1998; Lederman, 2007; Duc Dat et al., 2023).). Science teacher knowledge has been the focus of research for more than 50 years now, and it has been studied in different ways by many researchers (Abell, 2007; Carlson & Daehler, 2019; Shulman, 1986).

Rationale of the study

Many research evident suggested that teacher must consider myriad factors when planning and implementing lessons, and that may explain the difficulty in always finding a direct relationship between teachers' views regarding the nature of science and their classroom practices .Robinssion (1969) assumed that a teachers conception of nature of science is an important of force in shaping his class behaviour. **Behnke (1961)** assessed the understandings of science teachers and scientists. He used an optional response format having three choices namely favouring, opposing, and neutral. He assessed information in four different categories namely the first was the nature of science second was science and society third was scientist and society and the fourth one was teaching of science. The sample consists of scientists and educators. After his analysis, he revealed that almost fifty percent of teachers and twenty percent of scientists believe that the findings done by the scientists are not tentative. They believe that the scientist produces information or knowledge that cannot be changed. Teachers are not able to cater to needs of every student. Students learn science at their own pace and they need proper understanding in science.

Teachers' views of NOS affect how teachers perceive their teaching methods, and can influence students' perceptions. Teachers' responses about NOS have become part of their own teaching materials, so that the NOS that students have can indirectly be influenced by the views of the teachers who teach them. This causes the teacher's view of NOS and the importance of NOS hold key aspect for teachers, because teachers have the responsibility to teach NOS so that students can understand the meaning of NOS at the correct level. If the teachers' understanding is not accurate the knowledge built on wrong understanding will be faulty and incomplete. Thus these arise many queries on the understanding of different aspects of nature of science. Schwartz and Lederman (2002) feel that that in order to teach the nature of science effectively a teacher must not only have a firm understanding of the nature of science, but also knowledge of effective pedagogical practices relative to the nature of science.

Research questions

The research questions were posed to reveal the ground realities are:

1) What are the perception of preservice Science Teachers towards Nature of Science ?

2) Is there any significant difference between male and female pre-service Science teachers perception towards Nature of Science?

Objectives of the Study

1) To study the perception of preservice teachers towards Nature of Science?

2) To investigate whether statistically significant differences exist in the perception of the Nature of Science (NOS) between male and female pre-service science teachers.?

Methodology

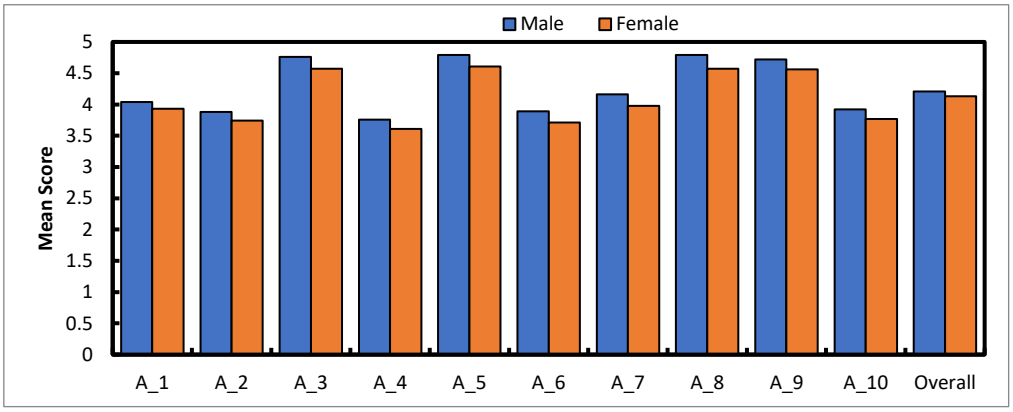
Survey design was employed to explore the Perception of Pre service Science Teachers towards Nature of Science. A Sample of 304 preservice science teachers was selected through purposive sampling technique. Out of which 137 male preservice science teachers and 167 female preservice science teachers were taken in 304 sample. The sample was selected from twelve numbers of secondary teachers 'training institutions running under Higher Education Department of Odisha. A self-developed tool was used for data collection., 'Questionnaire on Perception of Preservice Science Teachers about Nature of Science'. In the present study, this questionnaire is designed and is employed to obtain the perception of preservice Science teachers about understanding the nature of science. i.e. Empirical Nature of Science. The tool was designed and prepared on the basis of six dimensions on Nature of Science. Each dimension was consisted of ten items, but here researcher was taken one dimension i.e. Empirical Nature of Science in her study. The validation of questionnaire was done by taking the opinions of expert. The data were analysed using the Mean, SD and t-test Statistical techniques.

Table-1: Mean, SD and t-test on scores of male and female preservice teachers towards understanding different aspects of Empirical Nature of Science.

Aspects	Gender	N	Mean	Std. Dev.	t-value
Science is an empirical study	Male	137	4.04	0.542	1.750 NS
	Female	167	3.93	0.539	
Scientific explanations rely on evidence.	Male	137	3.88	0.685	1.774 NS
	Female	167	3.74	0.678	
Scientist uses through human senses.	Male	137	4.76	0.957	1.893 NS
	Female	167	4.57	0.836	

Aspects	Gender	N	Mean	Std. Dev.	t-value
Scientific theories are broader than observations.	Male	137	3.76	0.885	1.691 NS
	Female	167	3.61	0.665	
The idea of scientists having different interpretations.	Male	137	4.79	1.005	1.548 NS
	Female	167	4.61	1.033	
Science thrives on imagination and creativity.	Male	137	3.89	0.889	1.807 NS
	Female	167	3.71	0.837	
Experiments are not the only source of scientific evidence.	Male	137	4.16	0.943	1.761 NS
	Female	167	3.98	0.850	
Models are mental constructs.	Male	137	4.79	1.269	1.517 NS
	Female	167	4.57	1.25	
Observation is the heart of science.	Male	137	4.72	0.741	1.747 NS
	Female	167	4.56	0.787	
Science is interdisciplinary in nature.	Male	137	3.92	0.729	0.907 NS
	Female	167	3.77	0.717	
Overall understanding of Empirical Nature of Science	Male	137	4.21	0.386	1.842 NS
	Female	167	4.13	0.369	

N.B:- NS – Not Significant at 5% level (P>0.05) for DF=302.



N.B:- A_1 - Science is an empirical study, A_2 - Scientific explanations rely on evidence, A_3 - Scientist uses through human senses, A_4 - Scientific theories are broader than observations, A_5 - The idea of scientists having different interpretations, A_6 - Science thrives on imagination and creativity, A_7 - Experiments are not the only source of scientific evidence, A_8 - Models are mental constructs, A_9 - Observation is the heart of science, A_10 - Science is interdisciplinary in nature, Overall - Overall understanding of Empirical Nature of Science.

Figure-4.1: Mean scores of male and female preservice teachers towards understanding different aspects of Empirical Nature of Science.

Table-1 depicts the mean scores, standard deviations, and t-values for male and female preservice teachers on items of the empirical nature of science. For the **Aspect-1** (Science is an empirical study), males scored an average of 4.04 and females 3.93, with standard deviations of 0.542 and 0.539, respectively. The t-value of 1.750 indicates no significant difference at the 5% level (P>0.05) with 302 degrees of freedom even though both are numerically different, suggesting both male and female preservice teachers hold similar and agreeable views. In the **Aspect-2** (Scientific explanations rely on evidence), males scored 3.88 and females 3.74, with standard deviations of 0.685 and 0.678. The t-value of 1.774 also shows no significant difference between the two even though both are numerically different, indicating their agreeableness on this. For **Aspect-3** (Scientists use human senses), males averaged 4.76 and females 4.57, with standard deviations of 0.957 and 0.836. The t-value of 1.893 is not significant, indicating strong agreeableness from both male and female preservice teachers on this statement. In the **Aspect-4** (Scientific theories are broader than observations), males scored 3.76 and females 3.61, with standard deviations of 0.885 and 0.665. The t-value of 1.691 shows no significant difference between the two even though both are numerically different, reflecting similar perspectives and agreeableness. For the **Aspect-5** (The idea of scientists having different interpretations), males averaged 4.79 and females 4.61, with standard deviations of 1.005 and 1.033. The t-value of 1.548 indicates no significant difference even though both are numerically different, suggesting strong agreeableness by both male and female preservice teachers on this statement. Regarding **Aspect -6** (Science thrives on imagination and creativity), on average males scored 3.89 and females 3.71, with standard deviations of 0.889 and 0.837. The t-value of 1.807 is not significant even though both are numerically different, indicating similar and agreeable views by both male and female preservice teachers. **Aspect-7** (Experiments are not the only source of scientific evidence), males averaged 4.16 and females 3.98, with standard deviations of 0.943 and 0.850. The t-value of 1.761 shows no significant difference even though both are numerically different, reflecting similar, and agreeable opinions by both groups on this statement. For **Aspect -8** (Models are mental constructs), on average males scored 4.79 and females 4.57, with standard deviations of 1.269 and 1.25. The t-value of 1.517 indicates no significant difference even though both are numerically different, showing strong agreeableness by male and female preservice teachers on this. In **Aspect-9** (Observation is the heart of science), males averaged 4.72 and females 4.56, with standard deviations of 0.741 and 0.787. The t-value of 1.747 is not significant even though both are numerically different, indicating strong agreeableness by male and female preservice teachers

on this dimension. For **Aspect-10** (Science is interdisciplinary in nature), males scored 3.92 and females 3.77, with standard deviations of 0.729 and 0.717. The t-value of 0.907 indicates no significant difference even though both are numerically different, suggesting similar and agreeable views by male and female preservice teachers on this dimension. Overall, the mean scores for understanding the empirical nature of science are 4.21 for males and 4.13 for females, with standard deviations of 0.386 and 0.369. The t-value of 1.842 indicates no significant difference even though both are numerically different, showing that both genders have a similar and agreeable understanding of the empirical nature of science.

Assessment of scores of preservice teachers on ten Aspects of the empirical nature of science reveals the following:

- **Aspect-1 (Science is an empirical study):**

  Males scored 4.04 (SD = 0.542) and females 3.93 (SD = 0.539), with a t-value of 1.750, indicating no significant difference (P>0.05) with 302 degrees of freedom. Both genders hold similar and agreeable views on this dimension despite numerical differences.

- **Aspect-2 (Scientific explanations rely on evidence):**

  Males scored 3.88 (SD = 0.685) and females 3.74 (SD = 0.678), with a t-value of 1.774, showing no significant difference, indicating agreeableness in both groups.

- **Aspect-3 (Scientists use human senses):**

  Males averaged 4.76 (SD = 0.957) and females 4.57 (SD = 0.836), with a t-value of 1.893, indicating both genders hold similar and strong agreeableness on this dimension despite numerical differences.

- **Aspect-4 (Scientific theories are broader than observations):**

  Males scored 3.76 (SD = 0.885) and females 3.61 (SD = 0.665), with a t-value of 1.691, reflecting similar perspectives and agreeableness on this dimension despite numerical differences.

- **Aspect-5 (Scientists having different interpretations):**

  Males averaged 4.79 (SD = 1.005) and females 4.61 (SD = 1.033), with a t-value of 1.548, suggesting strong agreeableness in both groups.

- **Aspect-6 (Science thrives on imagination and creativity):**

  Males scored 3.89 (SD = 0.889) and females 3.71 (SD = 0.837), with a t-value of 1.807, indicating similar views despite numerical differences.

- **Aspect-7 (Experiments are not the only source of scientific evidence):**

  Males averaged 4.16 (SD = 0.943) and females 3.98 (SD = 0.850), with a t-value of 1.761, reflecting similar and agreeableness on this dimension despite numerical differences. in both groups.

- **Aspect-8 (Models are mental constructs):**

  Males scored 4.79 (SD = 1.269) and females 4.57 (SD = 1.25), with a t-value of 1.517, showing and strong agreeableness despite numerical differences in both groups.

- **Aspect-9 (Observation is the heart of science):**

  Males averaged 4.72 (SD = 0.741) and females 4.56 (SD = 0.787), with a t-value of 1.747, indicating similar and strong agreeableness on this.

- **Aspect-10 (Science is interdisciplinary):**

  Males scored 3.92 (SD = 0.729) and females 3.77 (SD = 0.717), with a t-value of 0.907, suggesting similar agreeable views.

Result & Discussion

Overall, the mean scores for understanding the empirical nature of science are 4.21 for males and 4.13 for females, with standard deviations of 0.386 and 0.369. The t-value of 1.842 indicates no significant difference, showing both genders have a similar understanding. The study found that there was no significant difference in view of NOS between males and females' pre-service teachers. This is consistent with other studies for example Adedoyin, and Bello, (2017), found that there was no significant difference in the number of correct conceptions about the nature of science held by male and female undergraduate pre-service teachers.

Conclusion: Pre-service teachers (both male & female) have no difference in views given for NOS, as it is essential that NOS instruction should be considered to improve their views of NOS such that they can provide appropriate instruction to their students in future. The views by Wong, Firestone, Ronduen, and Bang, (2016), Science teachers need to understand NOS because it is a critical component of scientific literacy. If teachers themselves do not have appropriate conceptions of NOS, they cannot help their students to develop correct & clear view of science and scientific knowledge (Wong et al, 2016). It is suggested that at the stage of teacher preparation, understanding the Nature of Science plays vital role in the development of science pedagogy by giving ample scope for including the historical and philosophical aspect of science .This helps science teacher (both male /female) to use suitable and compatible strategies & methods in teaching learning process at school .

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