

Pseudo-Scientific Beliefs and Knowledge of The Nature of Science in Pre-Service Teachers

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Article Info

Article History

Received:

10 April 2022

Accepted:

17 September 2022

Keywords

Nature of science

Pre-service teachers

Pseudo-science

Pseudo-scientific beliefs

Teacher training

Abstract

This study aimed to determine the levels of pre-service teachers' nature of science (NOS) knowledge, assess their pseudo-scientific beliefs, and examine the relationship between aspects of their NOS knowledge and these beliefs. It also aimed to determine whether NOS knowledge and pseudo-scientific beliefs depended on the discipline and gender. A survey method was conducted in this study. Data were collected from 215 pre-service teachers who are being educated in different fields in a state university. Two different five-point Likert scales were applied. Scale 1, which has three factors, measured pseudo-scientific beliefs, while Scale 2, which has seven factors, measured NOS knowledge. As a result, pre-service teachers' NOS knowledge was found to be inadequate and their pseudo-scientific beliefs were excessive. All factors of Scale 1 were positively correlated with each other, and they were correlated with some components of NOS knowledge. Significant differences were found between disciplines in the analysis of the factors of Scale 2; however, no significant differences were found between genders.

Introduction

The nature of science (NOS) is an important component of scientific literacy (Michaels, Shouse, & Schweingruber, 2008; Williams & Rudge, 2019). NOS has thus been a dominant topic within science education (Allchin, 2011; Erduran & Dagher, 2014; Irzik & Nola, 2011). Norris and Phillips (2003) refer to NOS as one of the eleven features that define scientific literacy and claim that it is necessary to “distinguish between what is and what is not science”. The NOS is a way of understanding science that includes features such as the experimental nature of scientific knowledge, observation, inference, creativity and imagination, scientific theories and laws, theory-dependency, and sociocultural values (Turgut, 2009). Understanding the NOS gives students the ability to correctly understand and interpret the scientific knowledge that they will be exposed to throughout their lives, and allows them to apply appropriate scientific research principles at all levels and for all purposes. (Lederman & Lederman 2014). If this does not occur, pseudo-science may replace science.

Pseudo-science refers to arguments and theories that are not supported by empirical evidence and violate the known laws of science, but which use scientific language to appear valid science (Shermer, 2002). The importance of raising awareness about the negativity of pseudo-scientific beliefs and the positive effect of the NOS is obvious

Conclusion

Understanding the NOS depends primarily on the correct learning of science-related concepts, such as laws, theories, observation, inference, etc. Failure to acquire these concepts as they are used in science causes the different meanings placed on them in daily life to prevail. If people's understanding of the basic concepts of science is improperly structured, then their entire sense of what science is will be wrong. It is especially important that pre-service teachers have the correct understanding, because they are responsible for passing on this knowledge to future generations.

The changeability of scientific knowledge is often misinterpreted. Not understanding the nature of scientific theories and not understanding that scientific knowledge is changeable are mutually reinforcing. This leads people to question theories based on scientific knowledge. Perceptions about the subjectivity of scientific knowledge also support these misinterpretations. This may then reduce individuals' reliance on scientific knowledge, causing them to turn to pseudoscientific information as alternative information. The main problem is that people may think, "Theories are only assumptions. They are not proven and they can change. Also, the findings of scientists are subjective. So, claims that are today called pseudo-scientific claims may one day become scientific knowledge." This is to misinterpret and misunderstand how specific concepts are used in science. It is a very dangerous way of reasoning, leading to false and inappropriate conclusions.

Having any kind of pseudo-scientific beliefs makes it more likely to have other pseudo-scientific beliefs. One of the reasons for the spread of pseudo-scientific beliefs is that society finds science increasingly complex and difficult to understand. It is critical that science educators simplify scientific information and present it to the public in an appropriate. Social awareness of the unscientific nature of some topics, such as astrology, has increased through the work of science educator. However, this awareness remains insufficient, and many pseudo-scientific beliefs, particularly pseudo-medical beliefs continue to persist. For example, folk remedies are still commonly used.

The pre-service teachers in NSMT areas were slightly more fortunate than the SSAT colleagues. The education they have received provided them with a better understanding of the concepts related to the NOS, although it did not protect them from believing in some pseudo-scientific claims. However, understanding these concepts alone is insufficient to understand the NOS and to be able to distinguish what is scientific from what is not. Although the NSMT pre-service teachers had a more accurate knowledge of the concepts, they had trouble interpreting them. On the other hand, contrary to many scientific studies, the fact that in the current study the gender variable did not affect beliefs about the NOS and pseudo-scientific beliefs may indicate that this knowledge and the ability to discriminate can be provided to both genders in the same way.

Limitations and Recommendations

The main limitation of this study was that COVID-19 restrictions prevented additional data-collecting methods, such as interviews, from being used. A number of practical problems limited the sample size. Many pre-service

teachers could not be reached. Therefore, the number of pre-service teachers in some disciplines was limited in the sample.

Studies focused on the components of the NOS can make it easier for people to acquire scientific literacy. This will help the number of pseudo-scientific beliefs prevalent in society to be reduced. Teachers and pre-service teachers play a significant role in this. In their study, Mihlandız and Doğan (2017) concluded that inadequacies in the teaching of the NOS were due to low a level of self-efficacy. It can be recommended that the NOS should be taught as a separate course in teacher education programs. The history of pseudo-science also offers an ideal opportunity for teaching the NOS (Allchin, 2004). As well as attending to this recommendation in the literature, the results of this study suggest that a separate NOS course, including examples of the differences between pseudo-science and science, should be included in high school. In addition, the specific features, concepts and limits of science should be emphasized in this course. It was an expected result that science-related concepts and knowledge of the NOS that were independent of gender variables were more common in NSMT fields. However, basic education on the NOS should also be provided in SSAT subjects.

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