



PROSPECTIVE TEACHERS' PERCEPTIONS OF THE NATURE OF SCIENCE

*M.V.K. Mallawa**

Siyane National College of Education, Veyangoda, Sri Lanka

INTRODUCTION

The pre-service teacher education programme in National Colleges of Education has been developed to orient the prospective teachers to the teaching profession. It is now widely recognized as one of the most promising practices in education field as a whole. It has effectively been documented through various studies carried out in different views. The nature of science is a complicated concept. Therefore, there is no one specific definition of the nature of science that science educators and philosophers of science agreed on. One of the most comprehensive definitions was given by McComas, Clough, and Almazroa (1998). According to them, the nature of science is closely related to different disciplines including history, philosophy, sociology and psychology. It is challenging for experts to define as it is for students to learn. They recommended that it is more appropriate to define the nature of science as a way of thinking. This particular way of thinking is strengthened by certain values and characteristics of an individual eg; curiosity, creativity, judgment, and observation. It may be influenced by society, culture and discipline that people are embedded. Several studies have shown that many teachers and prospective teachers do not possess an adequate understanding of the nature of science and have traditional science views (Dickinson, Abd-El-Khalick, & Lederman, 2000; Liang et al., 2009).

Prospective teachers' initial perceptions of the nature of science may result from their experiences as a student in their schooling period. Similarly, prospective teachers' experiences acquired during the pre-service teacher education programme in the National College of Education through the science lectures and discussions, relevant learner-centered activities, practical work at science laboratory and teaching practice are also influential in developing their perceptions about the nature of science. According to Lederman (1992), science teachers must understand the nature of science to teach it more effectively. Several studies explained several attempts to teach about the nature of science to teachers (Bell, Lederman, and Abd-El-Khalick, 2000). These studies show that it is challenging to teach science teachers to understand and implement the nature of science instruction. Therefore, it is imperative to determine how prospective teachers perceive the nature of science changing over time during pre-service teacher education programme. The purpose of this study was to explore prospective science teachers' perceptions about the nature of science and how these perceptions change as they complete a two-year institutional training period.

Objectives of the study

1. To find out prospective teachers' initial perception of the nature of science.
2. To examine what kind of coursework, assistance, and supervision is provided by the National Colleges of Education.
3. To find out how far the pre-service teacher education programme is supportive in changing prospective teachers' initial perception of the nature of science.
4. To study whether there were any changes in prospective teachers' prior perception of the nature of science during the study.

METHODOLOGY

Seventy-seven (77) prospective science teachers (Male 15, Female 62) were purposively selected from a population involved in a pre-service teacher education programme in the academic year 2017/2019 at Siyane National College of Education. Data were collected from these prospective teachers, both male and female using three techniques: the open-ended questionnaire, informal discussions, and semi-structured interviews during a two-year institutional training period in three phases. As this research explored prospective teachers' perceptions, a questionnaire that consisted of open-ended questions was administered, and informal discussions, semi-structured interviews were conducted to determine prospective teachers' views on the nature of science. In this context, three data collecting instruments were centered on their initial perspectives on the nature of



science and tracing what had influenced them to have such views and how their perceptions change. Due to the nature of the research process of the present study, it was divided into three phases in the two-year institutional training period. Table 1 presents the three phases of the study.

Table 1 Description of three phases of the study

Pre-service Teacher Education Programme (Three Years)						
Institutional Training Period (Two Years)					Internship Period (One Year)	
1 st year			2 nd year			3 rd year
1 st term	2 nd term	3 rd term	1 st term	2 nd term	3 rd term	
Phase I		Phase II		Phase III		

Semi-structured interviews were conducted soon after the recruitment of the prospective teachers and before they were educated on the essential components of the science curriculum and syllabuses (at the beginning of Phase I). It focused on prospective teachers' views of selected aspects of the nature of science. Data were collected again at the end of Phase II and the end of Phase III. Informal discussions were conducted, and a questionnaire with open-ended questions eliciting prospective teachers' views of the nature of science was administered during three phases of the study maintaining scheduled time intervals. Data from three techniques were analyzed qualitatively using content analysis and prospective teachers' perceptions of the nature of science were assessed.

RESULTS AND DISCUSSION

At the initial stage, prospective teachers' responses to the questionnaire revealed that they brought different ideas about the nature of science (Table 2). They were unable to describe the nature of science.

Table 2 Prospective teachers' most common ideas about the nature of science

Idea	No. of PTs	Percentage
Science is a body of knowledge that is tentative	73	95 %
Science is an effort to explain natural phenomena	69	89 %
Science is a process to solve the problems/to acquire knowledge	70	91 %
Science consist of factual information	69	89 %
Science deals with nature or a form of nature	52	68 %
Science challenges our everyday life through theory and experimentation	55	72 %
Science includes theory and laws, scientific laws and theories help to shape science	71	92 %

Total number of Prospective Teachers (PTs) who answered the questionnaire is 77.

These ideas are strengthened by the data collected from informal discussions and semi-structured interviews too (Table 3). Besides these ideas, all prospective teachers have learnt science as a core subject in the secondary level classes, but 17% of them were not interested in the subject. All of them emphasized the scientific method as a way of solving problems. The majority of them (81%) viewed science as a body of knowledge and processes and scientific knowledge is based on observations.



Table 3 *Prospective teachers' most common responses about the nature of science*

Response	semi-stru. int.		infor.dis.	
	No. of PTs	%	No. of PTs	%
Science is a core subject in the secondary level	77	100%	77	100%
Science is not an interesting subject	13	17%	13	17%
Science is a body of knowledge and processes	62	81%	63	81%
Science explains natural phenomena	69	89%	71	92%
scientific knowledge is based on observations.	63	81%	63	81%
Scientific method is a way of solving problems	70	91%	72	93%
Science consists of fact-dominated information	68	89%	71	92%
Science content is not inter-related	77	100%	77	100%
Science uses in our everyday life	77	100%	77	100%
Science includes theory and laws	71	92%	73	95%

The data from three techniques showed that all of them (100%) focused on science content knowledge rather than on the nature of science itself and have traditional science views. Another common misconception is that science consists of fact-dominated information. Nearly 100% of them viewed science content as separate entities because they have learnt science under different topics without inter-connectedness. They did not have any idea about the connection between these facts/topics. None of them were able to identify the structural relationships found in it. As a result, prospective teachers typically have only a partial understanding of the nature of science. It seemed that at the beginning, they had difficulty in conceptualizing the overview of the nature of science. Hence, there were no observable changes in their perception of the nature of science until the end of Phase I.

A combination of all these facts proves that they did not learn science meaningfully at the secondary level. In Sri Lanka, science textbooks are the main teaching-learning resource for teachers and students in schools. Content of the textbooks mainly focused on science content knowledge rather than the nature of science. Therefore, teachers are strictly committed to the syllabus content and they do not consider the instruction on the nature of science. According to Lederman (2007), teachers do not consider teaching the nature of science as important as teaching traditional subject matter knowledge. It gives evidence that teachers tend to focus on content knowledge of science in their teaching-learning process without fostering students' understanding of the nature of science. Presently, what is expected in the classroom is that teachers should facilitate students to construct science concepts by themselves through their models. Teachers who did not possess an inadequate understanding of the nature of science are less equipped to help students to construct these concepts. Therefore, teaching-learning recommended to be used in today's classroom can directly conflict with prospective teachers' present conceived perceptions of the nature of science. Pre-service teacher education provides frequent opportunities throughout the programme for prospective science teachers to develop their nature of science knowledge and avoid misconceptions. When course work is going on together with teaching practice during Phase II, and Phase III, it allowed prospective teachers to engage in interactive experiences and think about the nature of science. As a result prospective teachers gradually developed their knowledge of relevant pedagogy and reviewed and clarified their science views. They valued their own skills development and built positive attitudes towards their teaching. The data from three techniques showed that there was no significant perceptual change except a few shifts in prospective teachers' view of the nature of science during Phase II.

At the end of Phase III, prospective teachers recognized the need for expert knowledge base on the nature of science before attempting to construct their lessons. Responses for three instruments from the sample about the nature of science illustrated the comprehensive knowledge they have acquired throughout the pre-service education. 83% of the sample agreed that science is a discipline different than other disciplines. The science discipline provides explanations about natural phenomena. 79% of them believed that scientific knowledge is based on observations and inferences. It is socially and culturally embedded. Nearly 100% of them viewed science as a set



of separate entities at the beginning of their training, yet towards the end of the programme they saw it as a “system with interrelated concepts”. These ideas give evidence that prospective teachers’ views on the nature of science were vague and still they were unable to give a comprehensive definition for the nature of science relating to other disciplines. It seemed that they had not acquired a proper understanding of the nature of science by the end of the programme. Therefore, further explicit instruction on the nature of science is necessary to improve prospective teachers’ deep understanding of the nature of science. This evidence suggests that prospective teachers’ initial perceptions about the nature of science inclined to change at the end of Phase III. This could be used as an analytical device for understanding the complex relationships between prospective teachers’ conceptions of the nature of science. When they are equipped with theoretical and practical knowledge of science process skills they understood science teaching requires these science process skills. They strictly believe that science teachers must build up these skills and become aware of the deep understanding of the nature of science for effective science teaching.

CONCLUSIONS AND RECOMMENDATIONS

The findings of this study indicate that initially, prospective science teachers did not have a clear perception of the nature of science. Even after six months (end of Phase I), there were no observable changes that took place in their perception of the nature of science. During Phase II, the significant perceptual change could not be seen except a few shifts in prospective teachers’ view of the nature of science. At the end of the two-year institutional training period (end of Phase III), their responses illustrated the comprehensive knowledge they have acquired throughout the pre-service education programme. Finally, it could be concluded that changing prospective teacher perceptions should and can occur during their pre-service education period. The procedures employed and explicit instruction given during the pre-service education facilitated prospective teachers to change their perceptions of the nature of science.

It is recommended that the pre-service teacher education programme needs to make a concerted effort to help prospective teachers improve their ability to understand the nature of science as well as improve students’ understanding of the nature of science. Lecturers who implement the science curriculum need to be prepared with strategies designed specifically for teaching the nature of science. It is prospective teachers’ responsibility to gain a vast and complex body of scientific knowledge, pedagogical knowledge associated with different content to acquire exact perceptions of the nature of science.

REFERENCES

- Bell, R. L., Lederman, N. G. and Abd-El-Khalick, F. (2000). Developing and acting upon one’s conceptions of the nature of science. a follow-up study. *Journal of Research in Science Teaching*, 37(6), 563-581
- Dickinson, V. L., Abd-El-Khalick, F. S., & Lederman, N. G. (2000). Changing elementary teachers’ views of the NOS: Effective strategies for science methods courses. *ERIC Document Reproduction Service No. ED, 441, 680.*
- Lederman, N. G. (2007). Nature of science: Past, present, and future. In S. K. Abell & N. G. Lederman (Eds.), *Handbook of research on science education* (pp. 831–879). Mahwah, NJ: Lawrence Erlbaum Associates.
- Lederman, N. G. (1992). Students’ and teachers’ conceptions of the nature of science: a review of the research. *Journal of Research in Science Teaching*, 29, 331-359.
- Liang, L. L., Chen, S., Chen, X., Kaya, O. N., Adams, A. D., Macklin, M., & Ebenezer, J. (2009). Preservice teachers’ views about nature of scientific knowledge development: An international collaborative study. *International Journal of Science and Mathematics Education*, 7, 987–1012.10.1007/s10763-008-9140-0.
- McComas, W. F., Clough, M. P., & Almazroa, H. (1998). The role and character of the nature of science in science education. In W. F. McComas (Ed.), *The nature of science in science education: Rationales and strategies* (pp. 3–39). Dordrecht: Kluwer Academic Publishers.