ENHANCING PHILOSOPHICAL THINKING AMONG STUDENT-TEACHERS

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Abstract:

The important thing in science is not so much to obtain new facts, as to discover new ways of thinking about them.

- ***Sir William Bragg (1862-1942)***

For the studies in science education and scientific methods, philosophical thinking for science may function as a logical study and it leads to a unification of the sciences which has been an aim of all synthetic philosophical systems. It integrates to sciences by discovering interrelations of structure and terms among sciences.

In this context, this research paper focuses on student-teachers' perceptions about philosophical ideas about concept of science. These perceptions were collected in a written form before and after their philosophical orientation to science. The responses were qualitatively analyzed and finally findings and recommendations leads to more effective ways of teaching learning science.

Key words : Science, Philosophy of Science, Epistemology, Metaphysics, Axiology, Philosophical thinking, Perceptions.

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Science is a way of thinking much more than it is a body of knowledge.

- ***Carl Sagan (1934-1996)***

Introduction :

Science aims at obtaining knowledge of natural world. Albert Einstem in Verne H. Booth (1962:151) says, the object of all science is to coordinate our experience and bring them into a logical system of thinking.

Science is a human construct and a human activity. Science encourages humans to develop positive attitudes, including their powerful curiosity to constant new ways of investigating and understanding. Science consists of what humans learn- knowledge for practical learning and everyday living - the meaning humans construct for themselves. (Flick, 1993:3-4)

Whereas, Philosophy of Science is an inclusive and creative concept encompassing the fundamental trends in Science leading towards philosophical thinking of Science. As an applied discipline the philosophy of science helps to think about practical, behavioural and overt conclusions based on scientific data. Such conclusions can serve as a guideline to determine the rationality and logical thinking of human beliefs and values.

When student teachers enter at their pre-service practice, they identify Science as body of knowledge and information. They could not think of science beyond this context. Hence, they were oriented for broadening up their span of thinking about science. An Orientation programme on Philosophy of Science was implemented on the student teachers at pre-service level and after that their philosophical thinking for science was analyzed and the results are discussed in this research paper.

Rationale :

Science is an interconnected series of concepts and conceptual schemes that have developed as a result of experimentation and observations which can be better explained with help of this philosophic orientation.

Bertrand Ressell remarked that (Lucas:1960) Philosophy is to be studied not for the sake of any definite answers to its questions. But rather for the sake of questions themselves, because these questions enlarge our conception of what is possible, enrich our intellectual imagination and diminish the dogmatic assurance which closes the mind.

The science taught at school and college level is mostly theory oriented and lack practice of science. So, students could not gear up their thinking process for acquiring science as logic, reasoning, and other various aspects.

This study could help student-teachers in re-establishing their concepts of science, they could think beyond textual facts for making their students to understand science. They could think of philosophical process of analyzing context, could interrelate science with life, have connection of science with induction, cause and effect relationship, falsification, probability, analytical criticism and so on.

A person connected with science can have research based 'conviction' that 'science' does not mean information and formulas, but science is a disciplined inquiry for solving problems and arriving at logical rational conclusions.

Such philosophical perception of student teachers for science emphasizes the importance of a blend of imaginative and logical thinking in generation of new ideas.

Theoretical Perspectives:

Philosophical Dimension of Science:

Philosophical dimension of science would suggest a discussion of the place of scientific enterprise in the whole pattern of life. It would be concerned with providing an ultimate justification of doing science that is whether science was worth doing at all. Philosophical thinking of science could identify that philosophy is no alien subject but a necessary sequel to science.

Philosophy of science may be viewed as a science of science; its relation to science is that of science to experience. It may also be viewed as presupposition of scientific theory and can be made explicit by philosophical inquiry.

Philosophical aspect of science is between the frontiers of pure speculative philosophy and pure science. It is a rich subject full of promises and it is hoped that it will help its two adjoining disciplines to know themselves better and come closer to each other.

Metaphysics of Science:

Metaphysics is aimed at achieving clarity of thought by a careful study of concepts. Kant (1961:76) argued that it is not possible for as to prove or disprove statements about real world by

reason alone. There are inevitable filters that stand between things as they really are and our perception and understanding of them.

Metaphysical questions in science usually arise after physical problems are considered and solved. Metaphysics attempts to supplement, evaluate, speculate about and interpret physical or scientific theories. It is a search for unity, for the one possible unifying principle that will render wherent and intelligible all the diversities evident in the universe and life.

Epistemology of Science:

Epistemology-known as theory of knowledge is concerned with the nature of evidence and the conditions of rational belief. Scientific beliefs, being the most complex and sophisticated, are perhaps the most philosophically challenging, which leads to a perennial debate. It is argued that if science agrees with common sense or theology, there is no problem. But if there is disagreement, the scientific belief is the one best supported by the evidence.

The epistemology of science overlaps with what is commonly called scientific method: How should we acquire scientific knowledge? How should we test theories? Are theories justified by observations alone, or do other factors like values, simplicity, social conditions play a role? Most philosophers of science accept the assumptions behind these questions that is they do assume that typical scientific theories are indeed justified, in the natural sciences. Then they try to answer the question: How was it done? What is the nature of evidence in science, in general? The discussions of such questions raise other questions which again deal with epistemology of science.

Axiology of Science:

As discussed by Brown Henry (1986:31) that science can tell only what we can do, but it does not help in telling as what we ought to do. Science is concerned only with facts and has nothing to say about values which are misleading and harmful.

Values can arise in the sciences in several different ways. Some of these are ethical, aesthetic, social and political and epistemic. Science and values is one of the more controversial areas of philosophy of science. Some maintain that good science must be "value free" while others claim that values are inevitable, even necessary, but they should be right values.

The perception of society or the angle of vision towards science and scientific research affects the values of science.

Objectives of the study:

- To conceptualize the philosophical dimension of science within the context of epistemology, metaphysics and axiology of science.
- To orient student - teachers for developing their philosophical thinking about concept of science.
- To analyze and interprete student-teachers' qualitative responses about their philosophical thinking of science.

Population and Sample:

For this study the pre-service student - teachers reading for their B.Ed. degree at Sardar Patel University as the students of science method made the population.

The group of 40 student teachers at M.B.Patel College of Education, Vallabh Vidyanagar was selected as a purposive sample for this study.

The Experiment:

For the experiment the main three dimensions of philosophy of science epistemology of science, metaphysics of science and axiology of science were selected. The researcher collected and developed material for orienting her pre service student - teachers.

In the beginning before orientation student - teachers' ideas about meaning of science were received. Then they were oriented in the context of philosophy of science, with its dimensions. After the experiment their perceptions were collected in the written form.

Analysis and Interpretation of the data:

The student teachers in the experimental group were asked an open ended question : what do you mean by science? What does it include? The responses were about to find out the intensity and expansion of student teachers' thinking and expansion of knowledge, understanding and perceptions towards important dimensions of science, philosophy of science and teaching learning process of science.

The analysis and interpretation of the descriptive data is presented here:

Table : 1

Student-teachers' Philosophical Thinking of Science before Orientation

Total No. of statements	Epistemology of Science	Metaphysics of Science	Axiology of Science
21	19	01	01

(a) Epistemology of Science

Nature	Form	Means
• Wide range of knowledge • detailed study • new inventions • technology	• Logic • Scientific aptitude	• reasoning • questioning • experiment • calculations • field studies

(b) Metaphysics of Science

Nature	Means
• Universe • human generation • Physics, chemistry, biology • living organs • environment	never known before

(c) Axiology of Science

Values	Direction
• reasoning • truth	• day to day life

Most of the student - teachers before orientation tend to believe that science was a rigid body of knowledge comprising of information, experiment, inventions, causal relationships and generalizations related to natural sciences. It had universal laws leading to ultimate truth. Science had a strong social usefulness in solving problems. Science should be taught through laboratory and field experiences. It is noteworthy that only one statement related to metaphysics and axiology each was found.

Table : 2

Student-teachers' Philosophical Thinking of Science After Orientation

Total No. of statements	Epistemology of Science	Metaphysics of Science	Axiology of Science
75	40	23	12

(a) Epistemology of Science

Nature	Form	Means
• Specific and special knowledge • ever changing • never completely accepted • method of processing • rational • probable • logical • tentative	• observation • inquiry • hypothesis • generalization • logic • Mathematical	• direct experience • theory • experiment • observation • induction • questions

(b) Metaphysics of Science

Nature	Means
• Physical world • Universe • Space-time • unknown • earth • nature • mind • matter • organic • abstract • worldly • environment • events • micro cell to galaxies	• beyond reality • beyond knowledge • belief • never imagined but existed as ultimate truth • speculative thinking • search for unity

(c) Axiology of Science

Values	Direction
• spiritual • speculation • scientific attitude • faith • aesthetic • open-mindedness • truth • folsifiability	• psychology • beliefs • society • social science • humanities • day-to day life • culture

The list of key words state that the student - teachers were able to think of science from epistemological, metaphysical and axiological points of view. Now, after orientation, for them science was not only a school subject or a list of topics. They could describe the processes internal to science as knowledge. Along with observation and experimentation they also underlined probability, emerging, ever changing and never totally accepted knowledge as science. The key words like 'beyond reality and knowledge', 'physical and natural world', 'not imagined', 'beliefs,' and 'search for unity' show the metaphysical aspects of science as understood by student - teachers. Hence, they believe that science has to do with the physical as well as natural reality'. Science is a set of beliefs expressed through language available to a scientist. The student - teachers understood the pragmatic nature of science; they rated speculation, open

mindedness and even culture as scientific values. Scientific attitude was also reported as an integral part of science.

Thus, the answer to *'what is science'* encompasses ideas about a large number of concepts, processes and values. This thinking would have a direct influence on the perceptions of teaching learning science.

Findings of the study:

- The Orientation for philosophical thinking of science demonstrated significant effectiveness in generating, nurturing and grooming a philosophical interface to science.
- The experiment made it evident that the Meta knowledge of science would guide student-teachers to think beyond limited conception of science.
- Before the orientation programme they believed that science was a subject of information, formulas, experiments, rules and theories. There was a remarkable change after the programme regarding these beliefs.
- Students - teachers understood that science was a human venture to understand the nature and the physical world. It was not completely objective but a subjective, expression done through particular language.
- The personal attitudes of scientists and the culture in which the scientific activities took place affect the development of this subject.
- They could also appreciate the methods of scientists which included imagination, doubt, beauty, sense of wonder and mystery.
- They could think that science is a set of beliefs presented through the language available to a scientist.
- The student-teachers perceived that science is not only content or an organization body of knowledge and information. It emerges from everyday life. It proceeds through falsification and is tentative.

Recommendations:

On the basis of the whole experiment certain recommendations for the practitioners in this field are presented.

- The teachers should understand and believe that science is a method of inquiry. This would change their approach to deal with the facts, concepts and principles of science.

- The social and philosophical implications of science must be underlined by pre-service and in - service teachers.
- Scientific values, attitudes, imaginations and hypothesizing should be encouraged as against dry formulas and explanations.
- The lesson planning for teaching of science should include observation, probing, imaging, hypothesizing, establishing cause-effect relationship and attitude building.
- The textbooks should incorporate implicitly the metaphysics, epistemology and axiology of science. It can be recommended that some literary forms like short fiction, biographic, anecdotes, dialogist, debates and inter views should be utilized to add a taste of variation in the presentation. This would raise the interest level, as well as receptivity of the content.

Summing up:

The process of this research has sharpened and tinted my ways of thinking, believing and doing work. It has opened up a new avenue of knowledge, understanding and perceiving about philosophical thoughts in science. Also an attitude of critical thinking has set in into my academic work and life.

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