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## ROLE OF REFLECTION IN SCIENCE EDUCATION

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### **ABSTRACT:**

*NCFTE 2009 came up with substantial changes in B.Ed. curriculum post the recommendations of Justice Verma Commission 2012. Longer duration of school internship program was one of the recommendations given. Reflection is important during pre-service training as the future teachers during their internship program think over their daily classroom processes and are able to introspect what are they doing in the classroom, why are they doing it and how can it be improved upon if faced with similar situations in future. Various models and frameworks have been proposed which guide a teacher and give them a direction for reflection. Science education mainly emphasises development of scientific attitude among learners and values such as objectivity, scepticism, open-mindedness, critical thinking, perseverance to name a few. Science teachers should be aware of the nature of science and the need of reflection in their pedagogy as well. This paper talks about the nature of science, goals of science education, ways of reflection and importance for reflection among science teachers.*

**Keywords:** reflection, nature of science, science teacher, science education

### **INTRODUCTION:**

With the recommendations of JVC 2012 there came changes in the duration and structure of B.Ed. curriculum. In B.Ed., students started having increased duration of school internship program. All the pre-service teachers maintain reflective journal where they record their daily experiences at school for the entire duration.

Science education helps in developing scientific attitude, critical thinking, process skills and rationality among students. The curriculum taught to students at school level along with the classroom experiences helps in fostering these skills among them. The teacher trainees who are enroute to becoming regular school teachers also learn various methods of teaching science at their teacher training institutions which they are able to apply during school internship program. Apart

from teaching, the pre-service teachers also reflect upon their teaching practices, biases, shortcomings etc. and try to improve upon them. They maintain reflective journal during their engagement with school and write down their daily experiences at school. Also, they discuss with their peer group, school teachers, college supervisors and get feedback to improve upon their classroom performance.

### **NATURE OF SCIENCE:**

As per Britannica Encyclopaedia (online), science is a system of knowledge that is concerned with the physical world and its phenomena and entails unbiased observations and systematic experimentation. Science involves observing, investigating and experimenting. It is a field of knowledge which depends on reasoning, critical thinking and valid evidences. When we talk of nature of science it is a way of investigating, a way of thinking and has a dual nature (process as well as product).

There are certain characteristics which make science different from other disciplines. The University of British Columbia (n.d.) states that science can be thought of as a discipline that requires a degree of evidence to build knowledge around phenomena, but it also blends logic with imagination. Science is built around facts, concepts, theories and laws. It is a way to understand the natural world based on experiential evidence, verifiable observations and mathematical reasoning (Hazen, 2021). Scientific knowledge is valid, reliable, objective, verifiable and replicable.

Building scientific attitude among school children is emphasised as it helps in developing qualities such as objectivity, scepticism, open-mindedness, respect for evidence, critical thinking, logical thinking, perseverance, truthfulness in reporting observations (NCERT, B.Ed. textbook). NCF 2005 lays emphasis on learning by doing which was the idea of great philosopher John Dewey. NCF 2005 elaborates that good science education should be true to child, true to life and true to science. Also, NCF 2005 gives the criteria of six types of validity in the formation of valid curriculum which includes- content, process, environmental, ethical, historical and cognitive validity. It is emphasised that the curriculum should be as per the cognitive level of child, content should be scientifically correct, learners should be given opportunities to engage in methods and processes of science, be able to appreciate how scientific concepts evolved over time, develop values such as honesty, cooperation and able to appreciate issues at wider context and understand interrelationship among interface of science, technology and society.

Position paper on Teaching of Science (NCERT, 2006) highlights the aims of science education as follows. Science education should enable the learners to-

- a. know the facts and principles of science and its applications (according to the stage of cognitive development),
- b. acquire the skills and understand the methods and processes that lead to generation and

validation of scientific knowledge,

- c. develop a historical and developmental perspective of science and to enable them to view science as a social enterprise,
- d. relate to the environment (natural environment, artifacts and people), local as well as global,
- e. appreciate the issues at the interface of science, technology and society,
- f. acquire the requisite theoretical knowledge and practical technological skills to enter the world of work,
- g. nurture the natural curiosity, aesthetic sense and creativity in science and technology,
- h. imbibe the values of honesty, integrity, cooperation, concern for life and preservation of environment,
- i. develop 'scientific temper'-objectivity, critical thinking and freedom from fear and prejudice.

At school level students are engaged in different activities apart from syllabus such as experimentation, project work, poster making, debate, club activities, exhibition, field trips, craft work etc. which helps in their knowledge building as well as developing scientific skills.

Science teachers should be aware of the nature of science and process skills and give students opportunities for active involvement. Science teaching is not merely restricted to studying content in textbook but being able to provide opportunities beyond the classroom where the students are able to explore the natural surroundings and utilise the resources of community for their learning. Efforts should be made by science teacher in the classroom to develop qualities such as curiosity, questioning, problem identification, formulating tentative solutions, investigating skill, among learners (Handbook, NCERT, 2021).

#### **WAYS OF REFLECTION:**

Reflection is not necessarily done at a specific time or in a specific way by the teachers, but it can be done while being in the class (during in-action, as said by Schon) or outside the classroom post teaching (on-action) to plan for the future situations (for-action). Reflection is a way of thinking and many frameworks and models have been proposed which can be followed to begin with reflective writing. Some of the famous models include Schon's model, Kolb's model, Gibb's model, Korthagen model (ALACT and onion model). Reflection should be able to bring a change in the way a teacher looks at a situation and think over it.

One can reflect upon after discussing with other teachers (peer observation), by feedback from students(who are being taught), by video-recording their class teaching (and looking minutely at each and every aspect of their teaching), by taking up action research (the teacher takes up their classroom problems and come up with solution by using a systematic method), discussion with others, writing journal at the end of the day (jotting down day's experiences, mistakes, problems faced and learning from it) etc.

## REFLECTION AMONG SCIENCE TEACHERS:

Science teachers need to be aware of nature of science, methods and techniques of science teaching in order to learn the nuances of science pedagogy. Reflection by teachers help in changing their teaching methods, activities etc. planned for their students and thus coming up with what is the best suited for their learners. Science emphasises construction of knowledge by learners by using experimentation, problem-solving approach, heuristic approach, activity method to name a few and the role of teachers being that of a facilitator who is helping in this entire process and not imposing much on them (Handbook, NCERT, 2021).

Let's understand how reflection can be useful for a science teacher with an example.

A science teacher went to her class to teach the chapter on physical and chemical changes in Class VII. She used various real objects to discuss physical changes such as paper, water, ice, chalk and did activities based on that. It was observed that students were very active and responded to all the questions posed post activity. She used pictures of chemical changes to teach it and observed that only some students were answering. Most of the students looked distracted and uninterested. She reflected and introspected of her classroom experience that when demonstration or activity was conducted the students were participating well while when the images were used then the students' interaction and interest decreased and they were quieter. She reflected that she needs to conduct more activities to increase students' participation in the class and for her later classes, she planned to use child centred and engaging methods of teaching. Also, to bring in some novelty she thought of using ICT tools which are interactive (such as Pear Deck, Kahoot) and help them visualise, learn concepts that are difficult to perform because of paucity of resources (such as Olabs). A teacher should make an effort to increase the engagement of his/her learners in the class.

A study was undertaken by Rifat (2009) in Turkey to determine science student teachers' attitude towards reflective practice and it was observed that experience and knowledge of teaching influenced their way of looking at the teaching profession and also those who had more experience of teaching, teaching practice and awareness of school life had a positive view of reflective practice. It was also felt that more attention to be paid to critical level of reflection in teacher education programmes and in order to improve reflective skills the science student teachers should be encouraged to reflect ethically, socially and politically.

Aldahmash et.al (2017) surveyed secondary school science teachers pertaining to their reflective practice and found out that the secondary school teachers were consciously reflecting in different ways such as doing mind reflection on their own as well as with other persons within and outside the school; by writing, with group of teachers within and outside the school etc. Also, it was recommended that reflective practice should be made a part of CPD (continuous professional development) to help teachers acquire reflective abilities (Aldahmash, 2017).

## CONCLUSION:

Reflection is essential for professional development of every pedagogy teacher. In order to develop teaching skills and professional development of teachers, reflection is considered important. School teachers regularly maintain reflective journal and also take feedback from their peer teachers, record their classroom teaching in order to grow and improvise their teaching methods and skills. Reflection can bring a change in a teacher. It helps in their personal growth by which they can improve upon their skills as well as constantly amend themselves with the changing needs of their learners and also work upon their beliefs. Science education is about developing skills such as observation, critical thinking, rationality, truthfulness to name a few in the future citizens. So, in order to realise this, it is important that science teachers understand nature of science, regularly reflect on the way they teach science and help their students to develop a keen interest in it.

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