CONSTRUCTIVISM AND SCIENCE EDUCATION: REVISITING HOSHANGABAD SCIENCE TEACHING PROGRAMME

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CONSTRUCTIVISM AND THE HSTP EXPERIENCE

The Hoshangabad Science Teaching Programme (HSTP) was initiated in rural middle schools (class 6 to 8) of Madhya Pradesh in the seventies as a response to the dismal state of teaching of science in the country. The science classrooms were 'engulfed in a sea of meaninglessness' where alien terms, definitions, descriptions, formulae and equations were recited and learnt by rote but few knew what they meant (not that things are much different now).

The HSTP was based on the principle of learning science through experiments. Children learnt scientific concepts through intensive engagement – debates and discussions -- based on their observations. Experiment based learning enlivened the classrooms and successfully dislodged mindless mugging of definitions and facts with engagement of mind of the learner.

In the seventies, National Council for Educational Research and Training's (NCERT) major concern was the exponential growth in scientific knowledge and its incorporation in school science books. NCERT's way of keeping pace with this was by 'raising standards' of the science books, which merely meant stuffing more content and pushing difficult concepts down to lower classes. This was in the belief that if children are 'exposed' to them early they will pick them up faster eventually.

HSTP was envisaged as a small beginning to counter this. It was sought to bring experiment and observation to the centre stage of science learning. The experimental observations would provide the data for analysis and discussion leading to a gradual building of phenomenological and conceptual understanding. As opposed to behaviourist paradigm of learning, HSTP insisted on learning science through discovery by doing experiments. Given the rural setting, learning from the environment also became a core principle. The text-cum-workbooks evolved consisted of detailed guidelines to do experiments, record and analyse observations followed by a series of guiding questions whose answers were expected to emerge from a Socratic-like dialogue to be guided by the teacher in the classroom. It was a major curricular and pedagogic breakthrough in a stagnant and hierarchical government school system.

Possibilities, limitations and challenges

Apprehensions that direct transmission of knowledge encourages rote learning and subverts comprehension prevented inclusion of certain topics in HSTP for which experiments/activities were not feasible. It created major hurdles in teaching of concepts of astronomy, microbiology, atomic structure, evolution, chemical structure, etc. It is not easy to arrive at a very consistent approach to curricular choices in HSTP. Often, it was the feasibility of experiments/activities and not the hierarchy of concepts that determined the inclusion or exclusion of topics in HSTP curricula.

Thus in the earlier phase, direct transmission of knowledge was not considered pedagogically correct way of learning science at the middle school level. In the later phase however history of science/scientists was grudgingly incorporated in a few chapters of *Bal Vagyaniks* –the HSTP workbooks. The primary motivation for doing so was to enhance the readability of the books and make them interesting for the children. At the policy level, therefore, there has been ambivalence regarding transmission of knowledge as a legitimate way of learning science at the middle school level, despite limitations of the experiment based approach.

Thus some of the challenging questions thrown up by HSTP approach are:

- Science and critical thinking are concerned in part with producing correct accounts of practices and relations in which people are engaged with. This will involve displacing everyday common sense, immediate intuitions and conceptualisations. In the frame work of learning science through experiments and experiences, how to deal with counter intuition, that is, clash between observations and scientific truth?
- Does each individual experience constitute scientific knowledge and is knowledge a mere recollection of something already known? Both ambivalence and silence on transmission of knowledge have to be resolved in context of the philosophical debates on theory of knowledge – epistemology. How could this be incorporated in school science education?
- Are all answers right answers or they have to be judged against certain standardized norms of knowledge construction? How are those norms arrived at?
- Does science progress only through experiments? Do experiments and observations, and generalisations based on observations, known as inductivism, produces theory or theory precedes experiments and observations?
- Is any engagement with knowledge, without experiments or sensory experience (empiricism), necessarily didactic and behaviourist?

- Does engaging with concepts, construction and understanding of concepts in a child's mind (as described in the constructivist approach) also constitutes transmission of knowledge, at least in sciences?
- What is the role of Philosophy and history of science in science education? Is there any need to understand the major paradigmatic shift in sciences in the context of these (history and philosophy of science) at the school levels?
- In sciences, especially in physics, what is the role of idealisation and thought experiments? What are alternative perceptions and misconceptions? How do theories emerge? Why we can't arrive at exact theoretical equations through lab experiments?

At a much deeper level the teacher educator's dilemma of experiment based discovery method, has emerged out of these yet incomplete dimensions that HSTP in particular and science education practice in general have yet to deal with. The difficulty is that not dealing with the historical and philosophical aspects of knowledge construction and basing science education on experiments on the one hand prevents a richer understanding of science and scientific method. And on another level, perhaps inadvertently, leads the educators in an even more problematic arena of confusing successful pedagogic practices with epistemological claims.

HSTP's initial thrust on empirical method as the only desirable way of learning science failed to encompass major debates of knowledge construction in science and role of philosophy in major breakthroughs. Was that because of burden of undoing very didactic and meaningless mode of teaching in schools that existed (and still exist!) in early seventies? Or rather than a practical issue it is a deeper fundamental hesitation in treading the arena of philosophy of science? Or lack of appreciation of the fact that sciences especially Physics cannot be understood without understanding the philosophical basis of the terms of the discipline—'cause', 'law', 'theory' 'fact', 'belief', explanation', 'evidence' and so on ? Guided discovery and experimental method became a mantra as opposed to rote learning. This in a way set limits to what could be included or not included in the science syllabus/ workbooks, not necessarily guided by the principle of hierarchy of concepts or based on understanding derived from theories of cognition and learning. In this paper authors would discuss these crucial issues in the context HSTP and argue that the dogma of 'learning by doing' may have hampered the theorizing process in children.