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TEACHERS' PERCEPTION ON IMPLEMENTING HOTS IN SCIENCE EDUCATION

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The recent attempt of reformation of the Indian education system aims at assessing learners' abilities from all aspects. The concept of HOTS has lately been introduced in the evaluation and examination process (CBSE, 2010). The entire process of students' evaluation requires rigorous skills and training on the parts of teachers. Hence, it is of utmost importance to consider teachers' views regarding any new change. This paper is an attempt to study science teachers' perceptions towards implementation of HOTS in the evaluation process of science education. A survey was conducted to determine their perception about HOTS implementation with respect to four variables viz.; need, clarity, complexity and quality and practicality.

INTRODUCTION

The curriculum is decided based on the changing needs of the society. With the changing needs the evaluation patterns also should be reformed. Document of the National Policy on Education (MHRD, 1986) expressed an aspiration that science education would be strengthened so as to develop in the child well-defined abilities and skills such as spirit of inquiry, creativity and objectivity. Since examinations are an indispensable part of the educational process as some form of assessment is necessary to determine the effectiveness of teaching-learning process and their internalisation by learners (CBSE, 2010), use of varied modes of assessment are desired to shift the focus of the exams from testing memory to testing higher levels of competencies (NCERT, 2005). Reform in examination is need of the hour because the quality of question papers is low. They usually call for rote-memorisation and fail to test higher-order skills (NCERT, 2006). One such reformation is introduction of Higher Order Thinking Skills (HOTS) questions in secondary education. Central Board of Secondary Education (CBSE) took this remarkable step to shift the focus from assessing students' mere crammed information to developing their higher level competencies.

Implementation: a momentous coupler

Any new policy or a plan is put forward with an objective to propel the process of change. According to Fullan (2007) there are three broad phases of the change process:

Phase I—variously labelled initiation, mobilization, or adoption—consists of the process that leads up to and includes a decision to adopt or proceed with a change; Phase II—implementation or initial use (usually the first 2 or 3 years of use)—involves the first experiences of attempting to put an idea or reform into practice and; Phase III—called continuation, incorporation, routinization, or institutionalization—refers to whether the

change gets built in as an ongoing part of the system or disappears by way of a decision to discard or through attrition (Berman & McLaughlin, 1977; Huberman & Miles, 1984). (p. 65).

The following figure illustrates the change process explained by Fullan (2007):

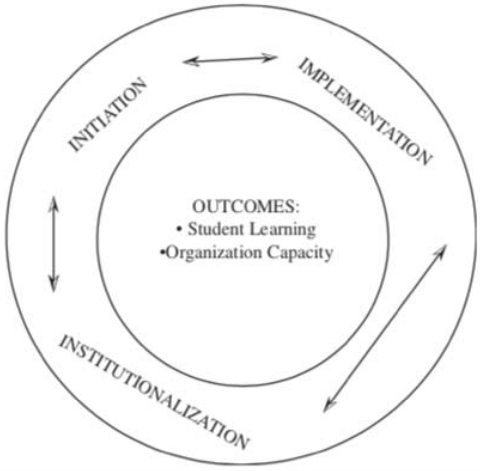

Figure 1: A simplified overview of the change process (Fullan, 2007)

It can be inferred from the above explanation that implementation is the momentous coupler of phase I i.e. initiation and phase III i.e. institutionalization. In Fullan's (2007) words, Implementation consists of the process of putting into practice an idea, program, or set of activities and structures new to the people attempting or expected to change. The change may be externally imposed or voluntarily sought; explicitly defined in detail in advance or developed and adapted incrementally through use; designed to be used uniformly or deliberately planned so that users can make modifications according to their perceptions of the needs of the situation (p.84).

Implementation, further, is characterised by four variables: "Need, Clarity, Complexity and; Quality and Practicality" [Fullan (2007), p. 87]. Huberman and Miles (1984) explain that people involved in the implementation stage must perceive the significance of the needs and must make some progress towards meeting those needs. Clarity, on the other hand, is crucial in the implementation phase since "lack of clarity - diffuse goals and unspecified means of implementation—represents a major problem at the implementation stage" [Fullan (2007), p. 89]. Complexity requires making change in one's self, carefully chosen set of activities and understanding of the big picture [Fullan (2007), p. 91]. Lastly, quality and practicality are affected by various factors such as materials and resources and; development in people's minds and actions count here [Fullan (2007), p. 92].

In the present paper, "the people attempting or expected to change" [Fullan (2007), p. 84] are the secondary school science teachers. The outcome from students' HOTS development can be achieved by the active role of teachers in planning, implementing, and evaluating HOTS-oriented learning. To be able to plan HOTS-

oriented learning, teachers need knowledge of ways, strategies and methods to train students about HOTS (Bartell, 2012). Therefore, teachers' role is pivotal in implementing any new change or reform. The question of concern here is how far the teachers, who are supposed to be the pillars of implementing the proposed plan, are well versed with the underpinnings of putting the proposal into action.

OBJECTIVE OF THE STUDY

To Study teachers' perception of implementation of HOTS in science education.

Research Questions

Following research questions were framed to study teachers' perception.

1. What is the need of implementing HOTS in science education?
2. What is the extent of clarity regarding implementation of HOTS in science education?
3. What complexities do they face during implementation?
4. What are their views about quality and practicality of implementing HOTS in science education?

Methodology

A semi-structured interview schedule was prepared based on the characteristics of change given by Fullan (2007) viz., Need, Clarity, Complexity and Quality and Practicality. There were 15 questions in the interview schedule. 10 science teachers (7 females and 3 males; 1 government school teacher and 9 private school teachers; 5 biology, 3 Physics and 2 Chemistry teachers) of secondary schools affiliated to Central Board of Secondary Education (CBSE) were interviewed. They all were in the age group of 27 - 47 years having qualification M. Sc., B. Ed. They all had teaching experience of 2.5 to 24 years. Seven teachers were interviewed in face-to-face mode whereas three teachers were interviewed in telephonic conversation. Their responses were noted down and later analysed to draw the findings. The teachers will be referred to as T1, T2,…,T10 from here onwards.

ANALYSIS AND FINDINGS

The responses of the teachers were analysed and the emerging themes for each research question are described below:

Need

The following three questions were asked to the teachers regarding the Need variable of implementation.

1. To what extent do you feel/perceive that the need of HOTS in science education is obvious?
2. Why do you feel it is needed to include HOTS in science education?
3. What progress are you making towards meeting the need of HOTS in science education?

On asked about their opinion whether HOTS implementation is needed or not, not a single teacher disagreed with it. All the teachers were in favour of need of implementing HOTS in science education stressing their responses with the words "really important", "definitely needed" and "highly required". However, one teacher

(T7) was of the opinion that "*HOTS is not everyone's cup of tea*".

Various reasons were given by teachers for their opinions. 40% teachers said it was due to application based nature of HOTS questions, 30% teachers had agreed upon HOTS implementation because it brought conceptual understanding in the students, 30% teachers considered need of HOTS obvious for cognitive aspects – increased analytical, logical and reasoning abilities; creative and imaginary thinking, thinking in a divergent way, 20% teachers stated that for widening the views of students and broadening the horizons of the child HOTS implementation was needed. Other reasons for the need of HOTS were: HOTS questions gave a sense of satisfaction to high achieving students since only highly intellectual students would be able to think to that level and; to help a child self-evaluate his performance.

In order to meet the need of HOTS implementation, the following progress was made by teachers: referring various books, identifying HOTS questions and asking those questions to the students (50% teachers), connecting the content to real life situations (30% teachers). T6, interestingly, responded that *applying* HOTS was the progress she made towards meeting the needs of HOTS implementation. T8, on the contrary, opined that nothing new was to be done as she felt that teachers had already been doing all the practices. T3 and T10 asked thought provoking questions and showed models and videos while teaching, respectively, as their progresses. On the other side, T3 twisted the routine questions and made them HOTS ones. For instance, instead of asking "what is resonance?" she asked "a molecule has double bond still it is stable so what is the reason behind it?".

Clarity

Under the umbrella term 'Clarity' following four questions were asked to the teachers.

4. What are the goals of HOTS in science education?
5. What do you do differently to achieve the goals of HOTS in science education? And through what means?
6. How does it help you address the goals of HOTS?
7. What are the prescriptions/ guidelines provided to you for implementing HOTS in science education? In what manner do you follow them? (As it is? Or make changes on your own?)

When asked about clarity of goals following were the responses of the teachers. According to 30% teachers, the goal of HOTS was to improve the creative thinking and improve mathematical applications, understand interrelationship between topics to topics and subject to subject of science, for instance relationship of electromagnetism to optics; HOTS implementation leads to deeper understanding of knowledge and better thinking ability and; it was to make them think because *we need thinkers who can make a difference*. In the view of 50% teachers, the goal of HOTS was application-based problem solving skills, apply the knowledge into real life situations so that the child does not get panicked and; develop higher levels of cognition such as synthesise the knowledge and increase analytical and reasoning abilities. In-depth understanding of concepts was also stated the goal of HOTS by 40% teachers whereas avoiding rote learning and developing interest among students for learning science were stated goals by T8 and T10.

When asked further what they needed to do differently to achieve those goals, the responses given by teachers were more or less the same as stated in response of the previous questions. T1, T2, T6, T9 said they used to read different books and various other material. However, T1 used to frame HOTS questions on his own whereas other three teachers used readily available questions in the reference books. T8 also said that she framed HOTS questions on her own but did not clearly mention about any source of reading material. 30% teachers mentioned about giving multi-sensory experiences using teaching aids such as demonstration method, concept map and practical observations.

To the response of how exactly these practices helped them achieve the goals of HOTS, teachers had diverse views. 50% teachers said that it led to better and deeper understanding of the concepts and deeper interest in science' for T3 it lead to "more interactive class", and for T7 "better involvement in the classroom activities". 20% teachers viewed its utility in preparing students for various exams such as board exams and other competitive exams such as NEET, JEE, NTSE, Olympiad. 20% teachers believed that students got ready to face challenging and thought provoking questions in the class whereas T2 observed better problem solving ability in the students.

When asked about the clarity of guidelines all the 10 teachers had similarity in their responses. They did not have any specific guidelines regarding HOTS. T4, T5, T7 mentioned of CBSE circular which is generic in nature for providing guidelines but no unique document for HOTS is available. The various sources of information about HOTS are NCERT textbooks and private publishers' books. Nevertheless, they do follow the prescriptions given by CBSE for preparing the question papers by differential allotment of weightage to questions of varying difficulties.

Complexity

There were three questions asked to the teachers to determine the complexities faced by them.

8. What changes you have had to make in *yourself* in order to implement HOTS in science education? (in terms of skills required, difficulties faced, alterations in beliefs, teaching strategies, and use of materials.)
9. According to you what series of activities is required to implement HOTS? (is it different than for the previous practices or the same?)
10. So what is the "larger picture" and what is your role in it?

When asked about the changes they had to make in themselves in order to implement HOTS, 50% teachers stated that they had to update their selves from time to time about the news, innovations and latest discoveries in the field of science. T1 had to shift from traditional ways and adopt different skilful ways of teaching, spend more time in framing HOTS questions; T2 had to come out of the textbook and look into surrounding to give real life examples to the students; T3 brought change in teaching strategy and mode of discussion. However, 20% teachers did not see it as something new and hence did not have to change anything in themselves. T10 said that he went through curricula of different countries, their classroom activities, teaching strategies and tried to follow it during teaching.

When probed further regarding the series of activities required to implement HOTS, 40% teachers said change in strategies and use of teaching aids was required whereas 30% teachers considered change in type of questions essential. On the contrary T1 said that not much had changed as previously known as 'tough' questions were termed as 'HOTS' now. 20% teachers considered that giving varied experiences to students had changed.

Ultimately, when asked about the larger picture and role of teachers in it, all the teachers stated that children were getting prepared to perform better in their future. Through HOTS activities, they could perform better in higher secondary examination, in competitive examinations, could tackle the situations better and could apply their knowledge to real life situation; survive in the competitive world, become good citizens of the nation. All the teachers opined that they played the role of a resource provider and a facilitator to the students. "*Secondary school stage is the training phase for the students*".

Quality and Practicality

Following five questions were asked to teachers to study their perception about quality and practicality.

11. To what extent do you think that the time given to prepare yourselves for initiation of implementing HOTS was adequate? (the time-line between the decision of implementation and the initiation of implementation)
12. What sort of materials and resources are you provided for implementing HOTS? (high quality teaching and training materials (print, video, electronic))
13. Are you given training for using those materials and resources? By whom?
14. Despite of the materials provided do you make judgements on your own based on students' performances?
15. What changes has it led to change your *mind* and *action*?

Teachers were asked if the time given to prepare themselves for initiation of implementing HOTS was adequate (the time line between the decision of implementation and the initiation of implementation). In response only one teacher said that it was inadequate and more time was needed to prepare for implementation of HOTS. Rest of the teachers responded that it was adequate. The reasons quoted by them were: "we have been doing it so nothing new is there", "a teacher has to be ready always and change can come within a fraction of second".

In the reference of materials and resources provided, 70% teachers replied that nothing from the government was provided to them. Major resources being availed to them were books and laboratory equipment which were supplied by the schools through collaboration with private publishers and suppliers. In addition to that, 20% teachers also mentioned about smart class as a resource being provided by the schools. However, one teacher responded that everything was provided by the government like online lectures uploaded by IIT, books, multimedia resources.

About training for using those materials and resources, 70% teachers were given such training in schools

through workshops by private publishers and suppliers. 20% said no training was given to them. One teacher T1 mentioned about workshops, subject enrichment programmes by the government saying that faculties from IIT or other engineering colleges used to come for training.

Despite the materials provided, 90% teachers made judgements on their own. They did make their own judgements while using the materials for teaching, the reasons were: difficult language of the print materials, students' demands, classroom observations, students' performance; continuous assessment and; availability of materials. On the contrary, T10 was of the opinion that not much was needed since whatever is brought to the class, children always like it "They are relaxed that today they don't have to study in routine boring manner."

In the response of changing their minds and actions, all the teachers talked about their changed thoughts, style of working and enrichment attained so far. 30% teachers said that they have become empathetic; competent and a better teacher. 30% teachers said that now they try to make their classes more interactive. T8 was inclined towards including more and more HOTS questions and now focused more on training other teachers as a Head of the Department. T7 felt that she needed to do more and more reading. T9 elaborated the change in his personality. He said that, *"I am ready to face any challenge now. My mind-set is always problem solving based. I don't look at the problem now. I look at the solution"*.

SUMMARY AND CONCLUSION

The major responses coming forward again and again are that the teachers strongly agree upon the need to include HOTS in science education and they are making some progress for it. It is to be noted here that all the teachers, in response of one or other question, stated that HOTS implementation is nothing new. They have been practicing it since long in the name of 'tough' or 'application based' questions and hence they do not need to undergo a structural change. Moreover, there is a difference in the opinions of one government school teacher and nine private school teachers regarding trainings and resources. However, the similarity is that all of them do practice HOTS questions during classroom teaching – learning practices.

It can be concluded that teachers possess a "false clarity" (Fullan, 2007, p.89) in their perception about implementing HOTS since they feel that HOTS is nothing new for them. The underlying reasons might be: lack of clear guidelines and of proper trainings and availability of high quality teaching-learning materials other than printed materials. There was a phenomenal convergence in their responses with regard to (i) need of HOTS inclusion, (ii) proper guidelines and (iii) their roles in the entire picture. It is a prominent point to be noted here that the teachers are now well aware about their changing roles. They all stated their roles as facilitators or resource providers. This implies that the aspired reform in the Indian education system of shifting from teacher-centred system to the child centred one is being realised.

On the other hand, there was a huge divergence when they were asked about the change in their minds and actions. It is also prominent that all the teachers have undergone some sort of changes while implementing HOTS in science education though not structural change or change in terms of conceptual understanding of

the underpinnings of HOTS. Since implementation is followed by institutionalisation, there has to be a smooth transition of outcomes and ideas attained in the present phase so as to ensure the sustainability of the proposed plan of change. Therefore, it is suggested that teachers do require well-organised trainings in order to understand the significance of the concept of HOTS and implement it in its true sense. Then only it will yield a routinised practice to serve its essential aim of reforming the system.

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