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Students' Views on Difficulties in Conceptual Understanding of Science at Secondary Stage

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Abstract: Present research investigates students' difficulties in conceptual understanding of science at the secondary stage (Class ninth and Class tenth) with a sample of 920 students spread over 23 schools in five States of India. Questionnaire and field notes were the tools of the study. Students' views and suggestions to overcome their difficulties have been sought through a semi-structured focus group interviews (n=222).The major findings of the study are – 70.22 percent students say that they have difficulties in understanding some science concepts.40 percent of class ninth and 49 percent of class tenth students are hesitant in asking questions in the class for the fear of being ridiculed. 31.11 percent say that they do not find any relevance of science concepts in their everyday life. Almost all students (97 percent) suggest that there should be more experiments and activities in the class and more interaction among students and with teachers so that they can be aware of each other's ideas about the science concept being transacted in the class. They want that classroom environment should be such that they can ask, pose and raise questions without any fear of being ridiculed. The paper gives an insight to the stakeholders for the enrichment of teaching-learning process. Students express that they want to be engaged in inquiry, field visit, projects, discussion, debate, group work and sharing of everyday life experiences. National Curriculum Framework (NCF)-2005 (NCERT,2005) says,"Child-centred pedagogy means giving primacy to children's experiences, their voices, and their active participation". As recommended by NCF-2005, it is imperative for the teachers and the teacher-educators to recognize and address students' difficulties and concerned ideas to familiarize themselves with students' perspectives of understanding science concepts. It is concluded that students' views and ideas regarding their difficulties must be valued and teaching-learning approaches and strategies must be adjusted according to students' learning needs and learning styles.

Keywords: Students' views, Conceptual understanding, Experiments, Activities, Child-centred pedagogy

Introduction

Many researchers have highlighted the importance of incorporating students' views for the enrichment of the teaching-learning process (Mitra, 2003; Kushman, 1997; Johnston,& Nicholls, 1995; Johnson,et al.,198l). Children's voices and experiences do not find expression in the classroom. Often the only voice heard is that of the teacher. When children speak, they are usually only answering the teacher's question or repeating the teacher's word (NCERT, 2005).Teachers spend most of their time teaching knowledge-based science in a learning environment that ignores their students' experiences. Students do not fully engage mentally in such classrooms, as they find a disconnect between teaching and their range of experiences (Rohandi, 2017).

Consulting with students on their views of teaching and learning has improved students' understanding of how they learn, helped students to gain a stronger sense of their own abilities, and improved teaching-learning so that teachers do a better job of meeting student needs (Johnson and Nicholls, 1995).In her research based on students' voices Mitra (2003) shows how listening to students can help in improving their learning experiences.Walker (2008) enlists many benefits for learners who are involved in shaping and leading their own learning.These benefits include: greater sense of ownership over their learning ; increased motivation; improved self-esteem ; greater achievement; improved relationships with peers and educators;increased self-efficacy.At the same time, failure to engage with learners in the education process risks increasing disengagement and disillusion amongst learners with their educational experiences.

According to Levin (2000), understanding students' perceptions and involving them in discussions about education can teach us a lot about changing classroom and school processes, and determine whether students are committed to learning. Study of Karanja and Oralado (2020) reveals that students can contribute to almost all aspects of learning. In some cases with some deep insights, well informed and, well-considered notions based on their personal, classroom experiences on what factors impacts their learning, those that help them learn as well as those that hinder them from learning. Seeking such contributions is one of the features of child-centred pedagogy.In child-centred pedagogy as recommended by National Curriculum Framework (NCF)-2005 (NCERT-2005),it is imperative for the teachers, teacher-educators and policy makers to recognize and address students' difficulties and concerned ideas to familiarize themselves with student's perspectives of understanding science concepts.Child-centred pedagogy means giving primacy to children's experiences, their voices, and their active participation. This kind of pedagogy requires us to plan learning in keeping with children's psychological development and interests. (NCERT,2005).Looking from this perspective,the present work has been conceived on two premises - students'views on difficulties in their conceptual understanding and the ideas they have to resolve those difficulties.We have taken students'views on the teaching-learning process of science only and difficulties they face in this process.Though there might be various dimensions of conceptual understanding, we have focused on students' perceptions on thier conceptual understanding of science.

What do we actually mean when we say students have conceptual understanding? According to Moran & Page (2015),'when students have an understanding of a concept, they can (a) think with it, (b) use it in areas other than that in which they learned it, (c) state it in their own words, (d) find a metaphor or an analogy for it, or (e) build a mental or physical model of it. In other words, the students have made the concept their own. This is what we call conceptual understanding.'

Teaching-learning of science empowers students to make sense of natural and physical world. It is about engaging them in practices of science and facilitating them to apply their understanding in novel situations.It is to communicate in their own ways, not just reproducing crammed version of the textbook . In a formal set -up, one of the evidences of conceptual understanding can be through students' achievement in the examination.If students are not able to apply their understanding in novel situations,it can be presumed to have difficulties in conceptual understanding as one of the impeding factors of low achievement.

Backdrop

The National Achievement Survey (NAS) class X (NCERT, 2015), that was conducted on a sample comprising of 2, 77,416 students in 7,216 schools across 33 States /Union Territories (presently, India has 28 states and 8 Union Territories)) and Examination Boards of India, reveals that only two percent of students could achieve above seventy-five percent marks. The Ministry of Human Resource Development, Government of India has entrusted the National Council of Educational Research and Training (NCERT) to conduct a nationwide achievement survey of students at the end of Class X, on a sample basis. NAS is a large-scale national study. The survey reveals that there is a need for significant improvement in the teaching-learning of science at the secondary stage. Various reasons may be attributed for the low achievement of students. One of the reasons might be that students face difficultiesin conceptual understanding of science.

Secondary stage education is a link between the elementary (class 1- class 8) and higher secondary (class11-class 12) stage. If students' difficulties in conceptual understanding of science are not resolved at this stage, generating interest and establishing a strong foundation to cultivate scientific temper in them will be adversely affected. It is in the above backdrop, an attempt has been made in the present study to investigate what difficulties students face in conceptual understanding of science and how can teacher facilitate them to soften such difficulties. Though there might be various dimensions of students' views, this paper aims to examine students' views on the conceptual understanding of science so as to improve learning outcomes.

Research questions

Our study is guided by the following questions-

- What difficulties do students face in conceptual understanding of science at secondary stage?
- What are the reasons of the difficulties faced by students in conceptual understanding of science at secondary stage and what should science teacher do to make those difficult concepts easy?

Method, Sample and tools

Mixed method approach was followed in the study in which quantitative and qualitative methods were combined. The study covered twenty-three schools spread over five States / Union Territories of India. The schools selected were affiliated to the Central Board of Secondary Education (CBSE) which is a national level board of education in India. The sample comprised 920 students of Secondary Stage. Out of these, 461 students were studying in class ninth and 459 students in class tenth. A questionnaire was administered to all of them. In addition to the questionnaire, semi-structured focus group interview was also conducted with 222 students. Number of students in the focus group was five for each of the classes. Participants were assured of complete confidentiality. Medium of teaching-learning was English in all the schools. The researcher recorded many contextual observations in her field notes. For qualitative analysis, field notes and responses of focus group interview were coded and analysed. Observing the emerging patterns, the responses were categorized into different themes for discussion.

Findings and discussion

Quantitative analysis: findings

70.22 percent of students say that they have difficulties in understanding some or other concepts of science. This was the warm-up item of the questionnaire in the beginning .It seems remaining 29.88 percent students could not recall or think about any difficulties at the beginning of the administration of the tool, because later, all students mentioned some or other suggestions and views on improvement of teaching-learning of science which is discussed in the next section. This is one of the very significant findings.

Quantitative analysis of students' views was done item-wise, as given below. Table: 1 shows class ninth and class tenth students' affirmative responses in percentage to the items related to the difficulties they face in conceptual understanding of science.

For some of the questions, (items no 3, 4, 5, 8, and 10) responses in percentage were found to be approximately the same for both the classes. About 48 percent of students accept that they have forgotten the concepts of their previous classes. They are not able to link the concepts being transacted in the class with their previous experiences, which is one of paramount importance for construction of knowledge. Other reasons attributed by 37 percent of students were that the pace of teaching in the class was too fast to understand. However, it was verified by the researcher that the teachers follow the academic calendar provided to them. Answering to item number 5, about 60 percent of students said that they perform activities and experiments in the class. On further probing, it came out that hardly six-seven activities were conducted, that too in an isolated way. Experiments were not integrated with the theoretical concepts. The response of item number 8 brings the science teachers in very good limelight.

Table 1.Class ninth (n= 461) and Class tenth (n= 459) students' response

Item No.	Students' response to the difficulties they face in conceptual understanding	Response in YES % Class ninth	Response in YES % Class tenth
1.	The course is too vast in the Science syllabus to learn.	50.66	43.58
2.	The lesson is taught in English and I have difficulty in understanding English.	10.00	5.08
3.	I have forgotten the concepts of the previous classes, so I find it difficult to connect the concepts.	48.88	47.12
4.	The pace of teaching in the class is too fast to understand.	36.22	37.39
5.	I perform experiments/activities during teaching-learning.	59.77	59.95
6.	My participation in all teaching- learning process is encouraged in the class.	77.33	73.45
7.	I have many questions but do not ask questions in the class for the fear that class will laugh at me / for the fear of being ridiculed.	40.00	49.34

8.	The teacher is accessible for discussion/ clearing doubts during or after the class.	88.88	87.67
9.	I feel that number of periods allotted for science teaching is less, so I do not get sufficient time to learn the concepts.	37.33	21.02
10.	I do not find the relevance of the classroom teaching with my everyday life.	31.11	29.20

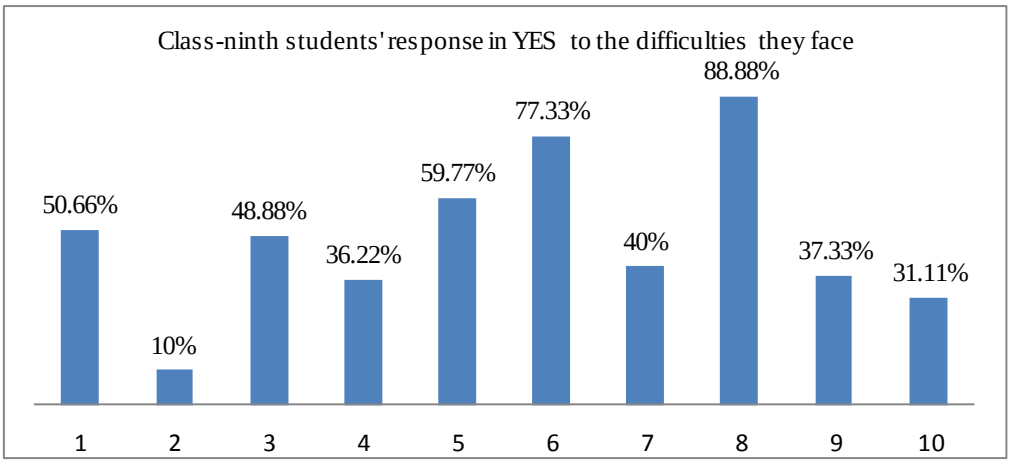

Fig. 1.Class-ninth students' response in % to the difficulties in conceptual understanding

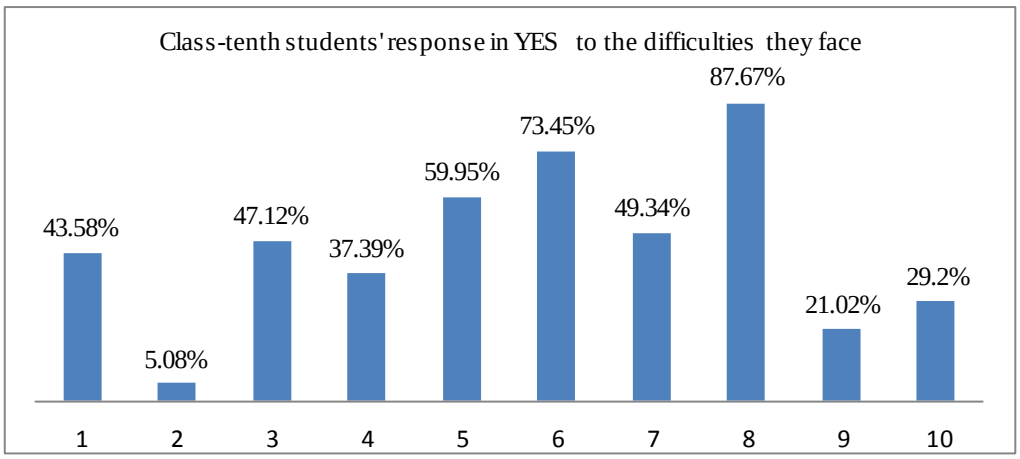

Fig. 2.Class-tenth students' response in % to the difficulties in conceptual understanding

88 percent of students say that teacher is accessible for discussion / clearing doubts during or after the class. The answer of item no 10 is a matter of great concern, as about 30 percent students do not find the concepts being transacted to be relevant to their everyday life.

It was found that 50.66 percent of class ninth and 43.58 percent of class tenth students feel that the course of science is too vast to learn. Though, English was the second language of the sample students, few students expressed their difficulties with the language problem. About 77 percent students of class ninth and 73 percent students of class tenth say that their participation is encouraged in the class. The percentage of responses to item number 7 is 40 percent and 49 percent respectively. 40 percent of students of class ninth and 49 percent of class tenth have many questions but they are hesitant to ask in the class for the fear of being ridiculed. 37.33 percent of students of class ninth feel that number of periods allotted to the class is less, so they do not get sufficient time to learn the concept, while this percentage is comparatively low (21.02 percent) for the students of class tenth.

Discussion

Each student is unique and learns with her/his own pace. Paying attention to the learning needs and learning styles of students is an essential part of teaching-learning process. One framework of the academic calendar

prepared cannot suit all students. Teachers are hard pressed for time to cover the syllabus. Their capacity of uncovering, rather than covering the syllabus with a child-centred approach should be developed. A large majority of students feel that the syllabus is vast, though experts develop it after long deliberation. It implies that how to transact the concepts in the allotted time framework with students' friendly pace should also be part of the capacity building programme of the teachers. Each learner is valuable, hence, view of a few students that using their mother -tongue along with English can facilitate them in conceptual understanding is important.

Response to item no 3 (they have forgotten concepts of their previous classes) implies that 48 percent of students know – what they do not know. This awareness of their learning needs to be addressed. It is of paramount importance to link the concepts being transacted with students' existing ideas and the relevant concepts they have. New concepts need to be anchored on those concepts. This need has been mentioned in NCF-2005 (NCERT, 2005) as, 'learners actively construct their own knowledge by connecting new ideas to existing ideas on the basis of materials/activities presented to them (experiences).' One of the ways to find their existing ideas can be relating the concepts through their daily life experiences. This can make students find its relevance to their daily life and hence facilitate understanding. It is important to link within the classroom and beyond the classroom experiences to help students in making meaning of the concept.

Experiments and activities need to be carried out with an inquiry approach integrating them with the science concepts being transacted. Performing experiments with a spirit of inquiry and thinking critically about various aspects of the material and apparatus as well as concepts of the experiment can lead students towards meaningful understanding of science (Prabha,2016).Number of experiments is not of much importance, how these experiments are performed so as to spark curiosity and reativity is more important. NCERT (2010) recommends that there is a need for providing a few longer periods lasting an hour, or one and a half hours, in the school time table that allows for other kinds of activities, such as laboratory work, projects, etc. This can facilitate teachers to better integrate experimental work with concepts being transacted as well as recognize and address the concepts that students find difficult.

Though, most of the students say that teachers are available for clearing their doubts and their participation in the class is encouraged, still 40 percent of class nineth and 49 percent of class tenth students express hesitation in asking questions in the class for the fear of being ridiculed. This response was further clarified from the researcher's field notes. It seems there is only formal interaction among students and teachers. Students do not find classroom environment conducive to interact on the basis of their out of the box thinking. Teachers need to create an emotionally safe learning environment in the class to encourage students to ask questions.

Qualitative analysis of students' views

Students' response to the open-ended question, 'What should science teacher do to make the difficult concept easy?' was analysed. The data provides an insight into multiple factors that cause learning difficulties in conceptual understanding. Almost all students (97 percent) suggest that there should be more experiments and activities in the class and more interaction among students and with teachers so that they can be aware of each other's idea about the science concept being transacted in the class. They want that classroom environment should be such that they can ask, pose and raise questions without any fear of being ridiculed.

Findings

Observing the response patterns of students' of class ninth and tenth both on reasons of difficulties in conceptual understanding of science, it was categorized into following eight themes. Their views are mentioned below.it is very interesting that all students have some or other views on reasons of difficulties in conceptual understanding of science.

1. *More experiments and activities*
2. *Pedagogy*
3. *Interactive classroom*
4. *Examples from everyday life*
5. *Use of technology*
6. *Medium of instruction*
7. *Textbook*
8. *Infrastructure*

1. *More experiments and activities:* 'Conduct more experiments and activities.' 'Explain the concepts showing many experiments and activities.' 'Let students do experiments individually.' 'Perform practical more frequently.' 'Make students perform practical.' 'Relate experiments with each chapter.' 'Practical based teaching so that we can understand easily.' 'Take us to the laboratory. '

2. *Pedagogy*: 'Make us do group activities.' 'Teach through flowchart/more diagrams/mind map.' 'Explain the concepts two-three times.' 'Allow students to ask questions, why only teacher asks questions?' 'Clear our doubt; solve our difficulties.' 'Ask with students, whether they have understood.' 'Ask questions in between teaching.' 'Think positively about the questions asked by the student.' 'Take us to field visit /take an outdoor class.' Ask logical questions, not only memory type questions.' 'Take us outside the class and make us interact with nature and society.' 'Give equal attention to each student. 'Teacher should continuously take feedback regarding the concepts from the students to check their understanding.' 'Explain the concepts in easy words/easy language.' 'Tell stories related to science.' 'Respect each student-good or bad.' 'Give difficult numerical problems.' 'Make teaching enjoyable /funny/make us laugh during teaching.' 'Seminar should be conducted for some topics.' 'Do not tell us only conclusion, explain how do we get the conclusion.' 'Take test after each topic.' 'Teach us slowly /take more time to teach.' 'Ask students to explain the concept after teaching.' 'Put less pressure on students.' 'Take revision classes and give individual attention.' 'Teach for understanding, not for completing the syllabus. 'Do not talk about examination, it puts pressure on us.' 'Teacher should teach in a friendly manner.' 'Teach through the advanced book, not only from a textbook.' 'I want to know the genesis of ideas, teach from the root, how people got the ideas (Science facts and principles).' 'Give more explanation of the term used or the first time.' 'Teacher should teach in a way which students find interesting. ' 'Teacher should pay attention to average students also, not only to weak students.'

3. *Interactive classroom***: '**There should be more exchange of ideas in the class.' 'Just sitting and listening in the class is boring, make it interactive.' 'Each student should get chance to express her/his opinion so that we can know which book s/he is studying.' 'Students should be given opportunities to make presentations in front of the class and the teacher should be friendly and open.' 'Make good interaction with us.'

4. *Example from everyday life***:** 'Relate the topics to our daily life/real life.' 'Give many examples to explain a concept.' 'Link the topic with day-to-day examples.' 'Give highly relatable examples which help to understand difficult concepts.' 'Connect the topic with our everyday life experiences.' 'Add everyday ideas about the topic in all chapters.'

5. *Technology:* **'**Show us videos related to chapter/concepts.' 'Explain pointwise using ppt (PowerPoint Presentation).' 'Show concepts in a digitized way.' 'Show videos of experiments.' 'We want more video class/smart class as the brain receives visual picture better than audio presentation.' 'Use smart board in teaching.' 'Use video, animation, ppt in teaching, digital illustrations of practical. 'Show us audio-video examples.'

6. *Medium of instruction*: 'Teaching in the mother tongue will make our understanding easy. 'Teach in Hindi and English both.' 'First teach in our mother tongue, then in English.'

7. *Textbook***: '**Make language simple.' 'Add more illustrations and figures in the chapters.' 'Technical terms should be printed in bold.' 'Add more numerical questions.' 'Write in small paragraphs.' 'Add explanations of basic concepts in a separate column on each page.' 'Include more examples for difficult concepts.'

8. *Infrastructure***: '**Seating arrangement should be flexible, not of the traditional type.' 'Classroom should have Laboratory corners.' 'There should be a smart board in the class.' 'There should be a cupboard for each student so that they need not carry books every day. 'There should be a separate seat for each student, not a bench.' 'There should be an air conditioner in each class.'

Discussion

It is found that students' views on reasons of difficulties in conceptual understanding of science are closely aligned with some of the theoretical aspects of science pedagogy i.e. integrating experiments and activities with science concepts in teaching-learning of science; integrating assessment with teaching-learning; connecting science concepts with students' everyday life experiences; making the class more interactive; providing challenging learning opportunities to students; making each student feel valuable; use of Information and Communication Technology (ICT) to reinforce the concepts. Hence, their views are worth paying attention to.

Analysing students' views, it can be realised that their expectations are not beyond the realm of classroom process. They are expecting something that is achievable. Pre-service as well as practising teachers are trained to address these aspects of pedagogy of science. Why do teachers not able to implement them can be a matter for further research.

Students feel that conducting more experiments and integrating science concepts with laboratory work can ease their difficulties in conceptual understanding. This finding is also supported by earlier researches Lunetta, Hofstein & Clough, (2007) have found that laboratory work helps students to have meaningful understanding about scientific concepts and enhances students' motivation to learn science. In a study on Junior High School students of Indonesia (Rohandi (2017) it emerges that 89% of 107 students preferred to learn science through hands-on activities.Present study finds 97% of high school students prefer more experiments and activities in teaching-learning of science. Developing conceptual understanding through engaging in the practices of science is more productive for future learning than simply memorizing lists of facts (Clark, 2006; Driver et al., 1996). Analysis of students' views show that they like to make conclusion about science concept based on their own observations and experimentation, not on the basis of what is just transmitted to them verbally in the classroom.

Students express that they want to be engaged in inquiry, field visit, projects, discussion, debate, group work and sharing of everyday life experiences.They want interactive classrooms because they can know what other students are reading,what learning resources they are using . Interactive classroom with teacher's mediation can provide them opportunities to reflect on each other ideas in the process of construction of their knowledge. Driver et al. (1996)argues that students benefit from considering the range of ideas that, their classmates may have to describe the same phenomenon and developing ways of evaluating these explanations. Through such interactions, students can come to appreciate the criteria on which judgments in science are made. There is a growing body of research that shows that when students work in small groups and cooperate in striving to learn subject matter, positive cognitive and affective outcomes result (Johnson et al., 1981). Research has shown that learning is enhanced in a community setting when students and teachers share norms that value knowledge and participation (Cobb et.al, 2001).

Students view that one of the ways of softening their difficulties can be connecting concepts being transacted in the class with their everyday life experiences. Rohandi(2017) shows similar findings, that, students expect the learning of science to be more relevant to their everyday life, to include more practical/hands -on activities, and to provide greater opportunity for discussion and participation. Relating, linking, integrating and sharing their knowledge with science concepts can make students feel that their experiences and voice are important to the class. When science learning does not make connections to learners' interests and experiences, students may have pervasive negative views of science (Basu & Barton, 2007). To be effective, science teachers need to possess the ability to represent important ideas and abstract concepts in a way that makes them understandable to students. The ability to make this connection is the root of effective teaching; effective teachers possess content knowledge and the pedagogy skills most effective to teach the subject matter (Dewey, 1939).

For an enriched pedagogy, students have plenty of ideas. It shows that different students learn differently and they value different issues for making their understanding easier. Design of teaching- learning experiences must respond to students interset, their learning preferences and learning needs. Assessment must be integrated with the teaching-learning processes without putting pressure on students. Field visits should be its essential comopent. Teacher should maintain a friendly environment in the class so that students do not fear to express their ideas and ask any question.All students should be treated equally. It is of utmost importance for science teachers to engage students actively in the process of inquiry and diversify their strategies. Students feel that some challenging learning situations can make science interesting and easier. Science teachers should remain open to bring variety, diversity and flexibility in the choice of her/his pedagogical approaches so as to cater multiple learning needs of different students.

Numerical problems play a vital role to understand various concepts of science. It facilitates students to make connection between physical situations and mathematical equations. In the present study students feel that many times the conceptual terms appearing in the numerical problems in Physics are difficult and more practice of solving difficult problems should be done in the class for conceptual clarity.This finding is congruent with one of the findings of Phonapichat, et al.(2014), 'students have difficulties in understanding the keywords appearing in problems, thus cannot interpret them into mathematical sentences, in the context of mathematical problem solving difficulties of elementary school students.

Based on the positive effect of science teaching enriched with technological applications in the research, it can be said that teaching should be supported with technology to enrich the learning-teaching process and technological applications should be included in education. (Yildirim & Sensoy 2018). Their findings are in line with students' perception that their difficulties in conceptual understanding will ease with the use of more video, animation, digital illustrations, PowerPoint Presentations and smart boards. Creative and interactive use of Information and Communication Technology (ICT) facilitating contributions of students for its development should be part of teaching-learning in today's scenario. It can be helpful to all, especially visual learners.

Language is one of the fundamental competencies that provides the foundation to all educational activities. Teachers need to interact with students giving due attention to students' preferences to the medium of instruction. Many students expressed conceptual understanding will be easier if science concepts are first explained in their mother tongue, then in English.

Students have their suggestions for the science textbook also. A significant suggestion is to include basic, previous, and related concepts in a separate column on the relevant page. Though textbook is a tool for teaching-learning, and teacher is expected to link the present concept with the previous concepts; incorporating the above suggestion can be helpful to students in managing their own learning and removing one of the hurdles in conceptual understanding. Though difficulties related to infrastructure were not part of the study, some students expressed the issues, as the item of the questionnaire was open-ended. No doubt, a good infrastructure provides an enabling learning environment.

It emerges from the findings that if a conducive environment is created to express their views and learning preferences, students can provide very valuable feedback to enrich teaching-learning process. This is in line with the observation of Thomas (2012) that teacher education courses and professional development activities should make it obvious to prospective and practising teachers that there is need for them to set aside time so that students can reflect on their learning processes, how they might be improved and what it might mean to be an effective science learner.

We should never lose sight of the fact that children and teachers in classrooms are conscious, sentient, and purposive human beings, so no scientific explanation of human behavior could ever be complete (Berliner ,2002). There is a remarkable scope for further studies in the area of students' learning difficulties in conceptual understanding of science. Similar studies can be taken for higher secondary classes (class eleventh - class twelfth). Studies can be taken on correlation between students' difficulties in conceptual understanding of science and teachers' difficulties in transacting those concepts. It would be interesting to investigate the efficacy of pedagogical interventions to address students' difficulties in conceptual understanding of science and find answers of the question, 'what difficulties teachers face in implementing those pedagogical practices in science.' The study was limited to only five states of India and CBSE (Central Board of Secondary Education) schools . Status and limitations of infrastructures in schools were beyond the scope of the study. However, many students expressed their views on this issue in open- ended item of the questionnaire.

Conclusion

In the present work, secondary stage students' views on difficulties of conceptual understanding of science were investigated. Two key conclusions emerge from the research. Firstly, it provides valuable insights to educators and policymakers for reinforcement of learner- centred pedagogy of science. The findings of the study provide useful information regarding pedagogical aspects of science and design of teacher-education programmes for prospective as well as practising teachers. Students' views also provide hints to develop various teaching - learning materials including e-resources on the concepts students find difficult at the secondary stage.

Secondly, the research throws some light on the metacognitive aspects of students. It is clear that students are conscious of difficulties in their conceptual understanding of science; they can identify the reason for their

difficulties and express informed views to address and resolve them. They know how they can learn best. It offers a very optimistic framework to educators and policymakers.

However, at the first place, making students aware that they can also express their views on teaching - learning of science and their views are important to modify classroom processes and soften their difficulties, is important.Students can develop a better sense of belongingness to school and learn meaningfully if they find their voices are heard. Giving primacy to students' views in teaching-learning can develop a greater interest and greater realisation of learning outcomes and hence greater academic achievement.This aspect is vital to enrich their learning and to achieve excellence in education.

Recommendations

It is recommended that science teachers invite, ponder and use students' views on their difficulties in conceptual understanding and the reasons thereof as a continuing process to enrich teaching-learning of science. Their views must be valued and teaching-learning approaches and strategies must be adjusted according to their learning needs and learning preferences. Issues and concerns expressed in students' views need to be addressed in capacity building programmes for science teachers.

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