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LOOKING FOR AN ALTERNATIVE STRATEGY FOR TEACHING AND TESTING: AN EXPERIMENT WITH CONCEPT MAPPING IN AN INCLUSIVE SCIENCE CLASSROOM

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He drew a circle that shut me out –
Heretic, rebel, a thing to flout.
But love and I had the wit to win:
We drew a circle that took him in.
EDWIN MARKHAM

1 Need for Inclusive Pedagogy

These beautiful lines express the whole philosophy of inclusive education and the place of concept mapping as a pedagogical option of educational setups in the near future. The last decade has seen many enormous changes in the philosophy of education. One of the greatest changes is the realization of the need for inclusive education and inclusive pedagogy. The concept of inclusion places emphasis on changing the system rather than the child. Inclusive schooling is often thought of as the inclusion of all students regardless of ability, into the same schools and classrooms with the peers who are not considered to have disabilities. Inclusive schooling extends far beyond mere physical proximity to providing students and adults the support required to belong and achieve in classrooms and school communities. Inclusion is both a process for and outcome of understanding, acceptance, and valuing of differences among today's school children and youth.

In response inclusive pedagogy is a term used to describe an emerging body of literature (Adams 1992; banks 19991; Darder 1996; Giroux & Mc Laren , 1996; hooks,1994) that advocates teaching practices that embrace the whole student in the learning process. Against this backdrop teachers are been called upon to teach students with a variety of needs and abilities.

2 The didactic role of concept maps in inclusive classrooms

During the process of learning, learning, learners construct a reality or an interpretation of reality based on their perceptions. Traditional conceptions of learning emphasize the object of our knowing rather than the process of coming to know what is actually learned. (Julio Valente da Costa Jr.) Constructivism, on the other hand, focuses on the mental processes inherent in the construction of meaning. These mental processes are highly dependent on the learner's prior knowledge, current mental structures, and existing beliefs (Jonassen et al. , 1993).

Adapting this to the process of learning in an inclusive classroom we, in our research wanted to help students with diverse abilities to get better control over the meanings of the surrounding that shapes their lives. We too, wanted the learning of science to be " conceptually opaque" (Novak 1991). For facilitating this type of learning, students need to see relationships and visualize the structure of content that they are studying.

Concept maps intend to represent meaningful relationships between concepts in the form of propositions. In order to provide opportunities for students to visualize the structure of content, we used concept maps as an instructional tool in an inclusive classroom.

Concept mapping is a technique for externalizing concepts and proposition (Novak 1990a). It exposes the concepts and the meanings that are hidden in the cognitive structure of students and it is of great importance since it helps the teacher and student to arrive at a shared understanding of content that is dealt with. It helps to clarify misconceptions and most often the superficial connections that are made in the teaching learning process. This is of much value in classrooms with a large number of students who vary in their abilities to make sense of the teaching learning experiences. Therefore while working with concept mapping technique, *one of the objectives*, was to

identify the difficulties, misconceptions and the superficial connections made by students while processing information from a given text matter.

There is a growing body of research that shows that when students work together in small groups and co-operate in striving to learn subject matter, positive cognitive and affective outcomes result (Johnson et al., 1981). In our attempt to understand how concept maps help students with diverse abilities to learn together we have tried to find out how working co operatively helps to bring together their own negotiations and construct their learning experiences. This is of great social value as it can help the students who are so differently abled to dialog, exchange, share and even sometimes compromise (Novak, 1984). *Secondly* this research paper is an attempt to see how students work together and negotiate while using concept maps as a tool for learning.

According to Novak and Gowin (1984), the process of teaching and learning has an emotional component too. Students when they construct new meanings and organize their own content, feel emotion. It is these emotions which will decide the course of the future learning (Dandekar 1999). The learner experiences this educative regularity called 'felt significance'. There are other emotions too like fear, which must be recognized and encouraged as an expression of 'felt significance' (Novak 1986). This brings us to the *third* objective of the research that is to understand the 'felt significance' experienced by students while they work together and construct new meanings and organize their own content.

3 Inspirational context for the use of Concept Mapping

A classroom of 75 students of standard VI participated in the study. The study comprised of a school that was located in the suburbs of the city of Mumbai. The students came from families that belonged to lower socio economic backgrounds, where they were the first generation learners with English not being their mother tongue but they were studying in schools where English was the medium of instruction. This could be due to the fact that English is considered as a ladder for social progress. These students were coming from socially, economically, educationally and linguistically deprived backgrounds. Apart from the above-mentioned deprivations a significant proportion of them also suffered from different kinds of disabilities like; speech impairment, visual impairment, besides there were twelve students who were recommended for certification as students with learning disabilities.

The fundamental challenge that we faced as we interacted with these students was in changing the locus of control in the teaching learning process from the teacher to the student due to traditional teacher centered mode of instruction, over emphasis on rote memorization and mechanical drilling, overcrowded classrooms and frequent absenteeism among the students that act as impediments in designing and implementing innovative teaching learning strategies.

These seventy-five students were further divided into seventeen groups. Each group had randomly allotted four to five students comprising of high, average and low academic achievers (based on their previous academic performance in the school's periodical tests), learning disabilities and physical impairment. Each group was provided with a mentor who was called '*Didi*' and '*Bhaiyyas*' which means elder sister and elder brother respectively. These mentors were trainee teachers of a college of education in the city of Mumbai and were allotted to that school for their practical trainee period .The role of the 'Didis' and '*Bhaiyya*' was to direct, encourage, facilitate and act as a 'sounding board' at times for student s to express their feelings during the learning process.

This project was conducted at three phases; comprising of three training modules.

i) Training of the mentors (ii) Preparation of the school students for the concept mapping activity. (iii) Introducing concept maps as an teaching learning tool for learning science subject which included the following topics-'Water' and 'Classification of Living Things' as given in the sixth standard text book. The sub themes of the topic 'Water' were; sources of water, properties of water and uses of water. The second unit contained classification of plants on the basis of height, presence and absence of flowers and life span and classification of animals on the basis of presence or absence of vertebral column and type of procreation. After a series of ten sessions with the students, they were assessed on their mastery of the content as well as the technique of concept mapping.

4 Experiences with Concept Mapping Technique

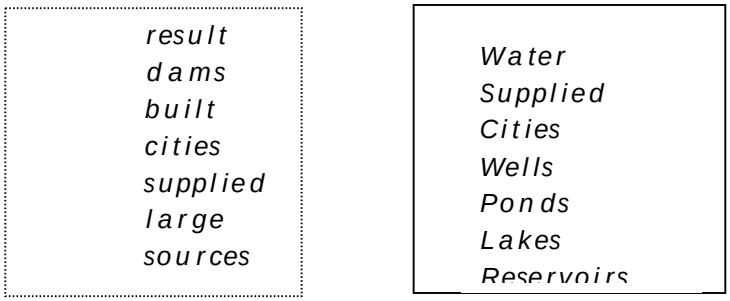
During our project with the students of standard VI at different sessions students had constructed various concept maps individually as well as in groups. The following are some of the maps and observations made by us at different stages in accordance with our research objectives that we set before us.

4.1 To identify the difficulties, the misconceptions an the superficial connections made by students while processing information from a given text matter while using the concept mapping technique.

During the second module ' Preparation of School Students for Concept Mapping Activity' and during the third module that is 'Using Concept Maps as a Teaching Learning Tool for Science Topics' the following difficulties were identified:

- Identifying the main concepts

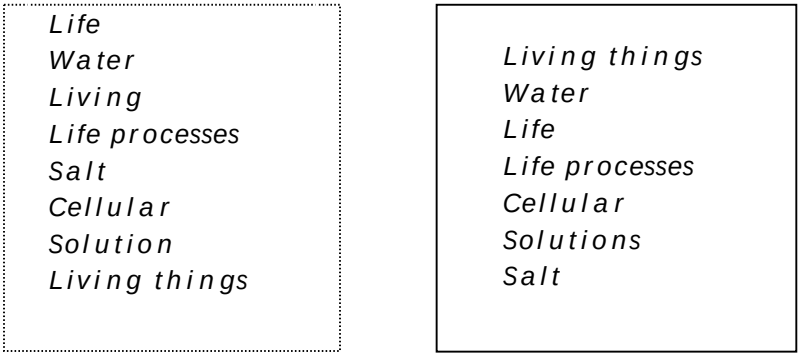
Based on a given content the students faced problems with identifying main concepts that the passage talked about. Here is an example of listed concept words for the content 'Sources of Water' by a student:



The words in the dotted outline boxes indicate the students responses while the other box indicates the desired responses. This was not only the problem with this particular student, but 48% of the students showed similar problems.

- Differentiating between the most general / most inclusive and most specific/less inclusive concepts.

For the sub topic' Importance of Water for Living Things' the students were asked to arrange the concepts in an order of most general to most specific. Example of listing of the hierarchical order of concepts as given by a student from a content passage in the text is given below.



Students expressed difficulty in organizing the concepts in the order of hierarchy or specificity, nearly 32% of the students showed the lack of ability to differentiate between most general to most specific concepts. This could be the result of a tendency to blindly copy the matter from the textbook. Students with linguistic backwardness were found to make mistakes even while copying and listing concepts from the text matter in front of them. This tendency to copy the text unquestionably was particularly found when students worked alone rather than in groups. Figure 1 is a concept map of Athesham, a student who was rated as an average achiever.

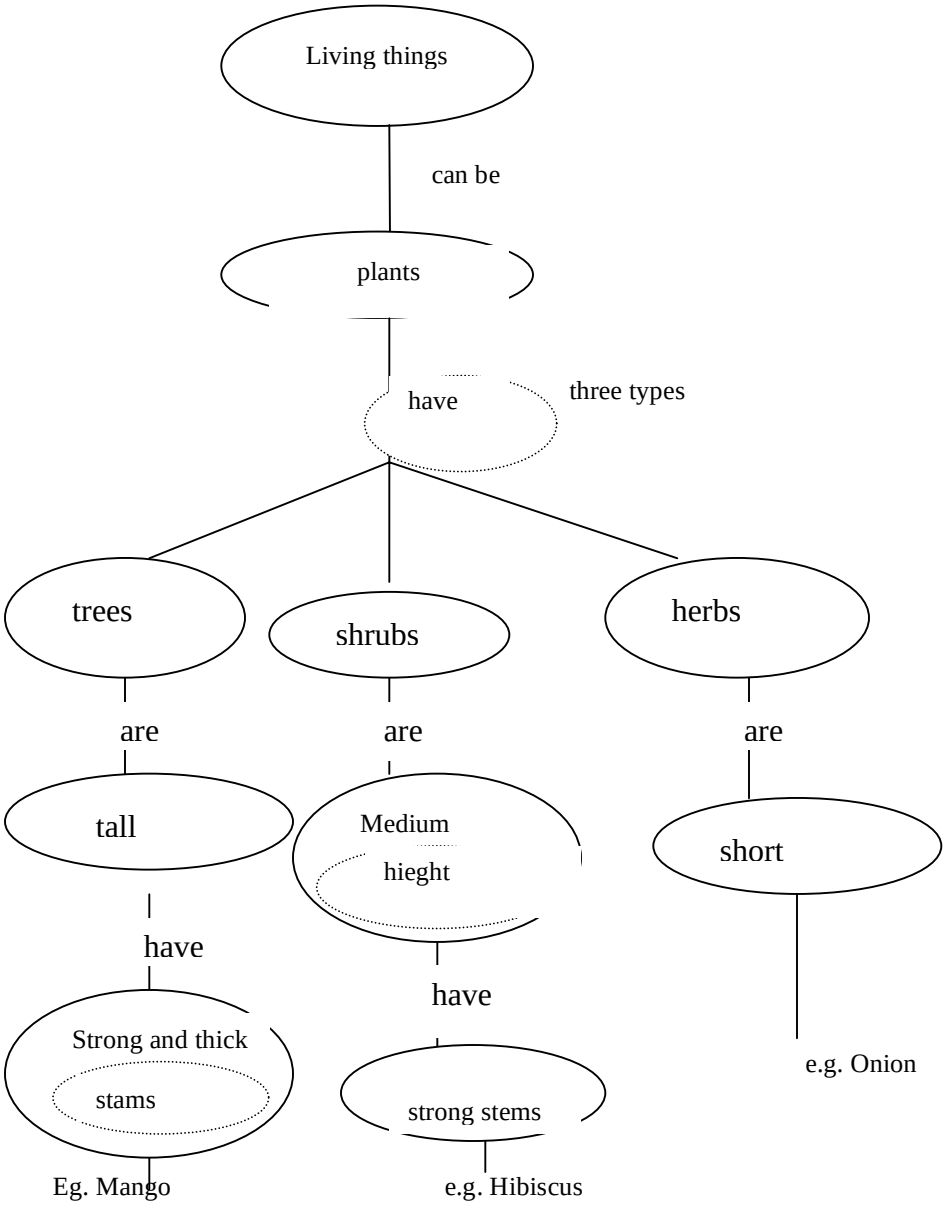


Figure 1 is a concept map of Athesham, a student who was rated as an average achiever by the schools. Words encircled in dotted lines indicate inappropriate language mastery or connections made by the student.

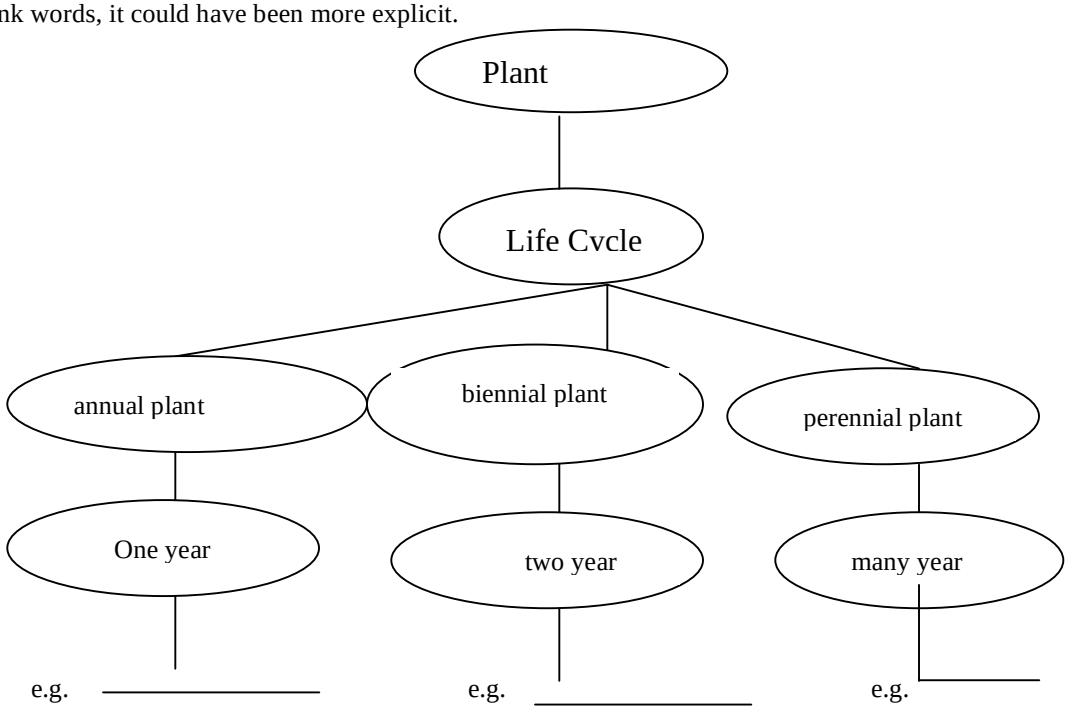
From the map it was evident that he associated the attribute tall with trees, medium height with shrubs and short with herbs. However the lack of an ability to subsume broader, more inclusive concepts with progressively more specific, less inclusive concepts below was evident .It was also evident that the lack of mastery over the language had come in the way of the organization of content.

- Identifying appropriate link words

The aspect of learning that is distinctly human is our remarkable capacity for using written or spoken symbols to represent perceived regularities in events and objects around us (Nowark & Gowin 1984). An awareness of the explicit role language plays in the exchange of information is central to understanding the value and purpose of concept mapping and educating. This was very much a part of our experiences in training students in concept mapping who were linguistically disadvantaged with regard to written and spoken English. The kind of link words that were often reflected in the connections made were*; is, an, as, has, have, the, of, on etc*. They found it difficult to

incorporate other verbs as link words. Besides sometimes student's concept maps were schematic representation of the content but were without any link words.

Figure 2 is an example of a map prepared by Devidas, an average achiever with speech impairment for the content based on the sub unit 'Classification of Plants on the Basis of Life Cycles'. This map was prepared individually. It is a reflection of content being classified, however with little more efforts in the use of appropriate link words, it could have been more explicit.



A shown in the above figures, and based on oral assessment, it was found that concept maps were not full reflections of their abilities to process and organize matter due to their lack of language mastery and learning habits. As stated earlier one of our challenges while working with these students was to help them to educate themselves and be responsible for their own learning. The technique had definitely contributed to self-study habits of the students as they were they were able to organize information even from unfamiliar content. The skill of organizing and presenting information was very evident in the high achievers. In figure 2 Devidas too, on oral questioning was able to present matter very logically but in different situations avoided the use of many words. This could be attributed to the speech impairment that he had.

4.2 To understand how students work together and negotiate while using concept maps as a tool for learning.

Over a period of years, in our experiences both at school and post graduate level, we have seen that in large class rooms it becomes very difficult to provide learning environments where students work together with peers in the social construction of personally significant meanings. The students in groups with their roles of facilitator, time keeper, recorder, material manager and spokesperson were more confident while working together rather than while working alone. Especially session 3 to 7 provided lot of opportunities for students to construct and build their understanding on topics like' Water' and 'Classification of Living Things'. Focusing on how different students process the information differently based on their abilities and disabilities we would like to present the map prepared by Khan Mohd. Aquib a student with vision impairment. This map was prepared by him on a small piece of content on the sub topic 'Uses of Water'

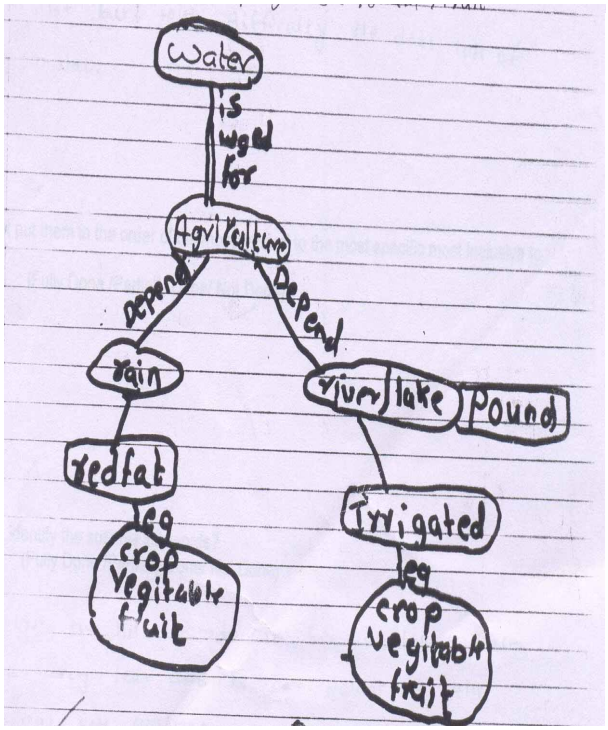


Figure 3- Concept Map prepared by Khan Mohd. Aquib on the sub topic 'Uses of Water'

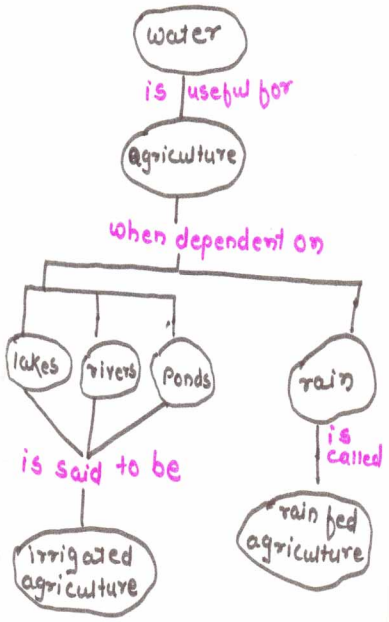


Figure 4- Concept Map presented by Khan Mohd. Aquib as a spokesperson for the group

The inability to express the ideas in a lexical form is evident. This however had not come in the way in which he processed and organized information. When Khan Mohd. Aquib worked with his peers in the group and then as the spokes person of the group, he was asked to present the concept map before the class. He presented the concept map as shown in figure 4, only due to the support and encouragement that he received from his group members.

Similarly, Figure 1 and 2 were combined as two groups dialoged, negotiated and shared their own understanding; they came up the following concept map that is given in Figure 5.

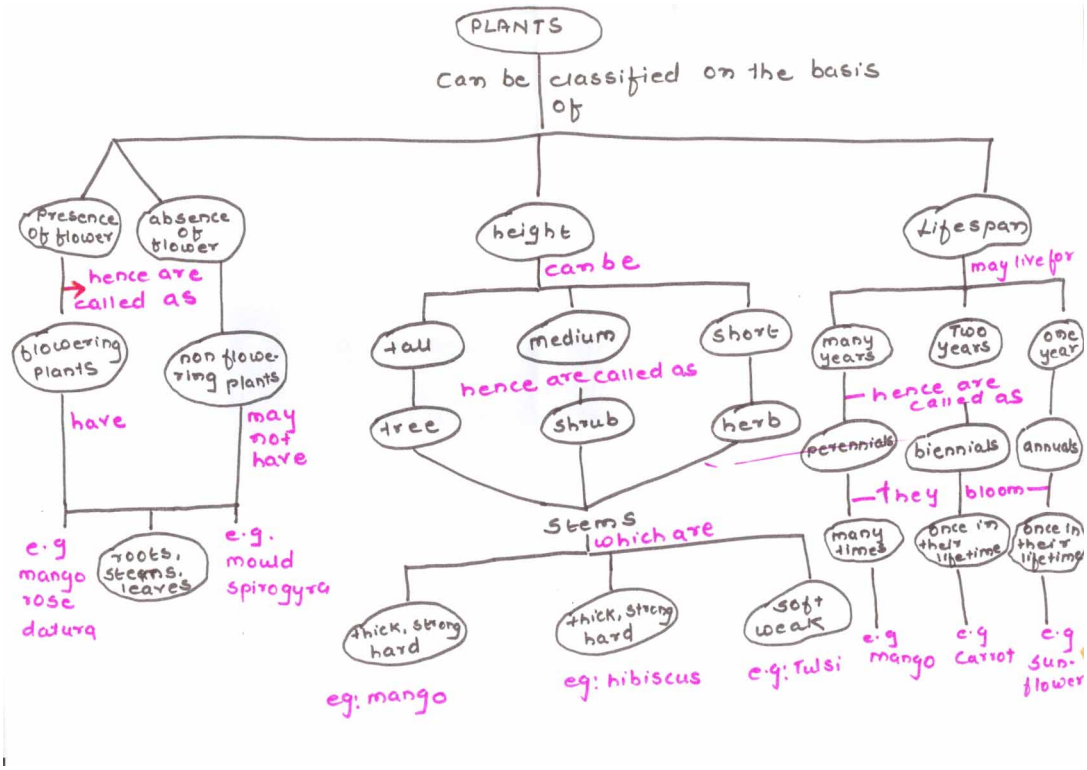


Figure 5. Concept Map prepared by two groups together on the topic 'Classification of Plants'.

As seventeen different groups worked together and co operated in striving to learn the subject matter, a positive cognitive and affective outcome was observed. There were evident features of affective outcomes that were visible in the group work and group presentations. Based on the daily observations and reflections of the mentors along with the unstructured interviews of the learners, the following are some of the affective and cognitive outcomes of learning.

There was a strong sense of bonding and "we feeling" among members of the same group. The above average student found fulfillment in providing suggestions for the organization of content in the concept maps. The below average students felt a sense of "equality" which made them feel responsible for their contribution to the group. It provided scope for a lot of creativity and diversity in the style of presentation both in the written and oral form. It developed a sense of confidence for oral presentation even though mastery over written mode of communication was lacking. It helped the average achiever to sharpen their cognitive competencies and information processing skills. The higher achievers morale was boosted and it gave them an opportunity to respect students who were differently abled in their group. This is how the concept mapping activity facilitated co operative learning essential for creating inclusive environment in the classroom .

4.3 To understand the 'felt significance' experienced by students while they worked together and constructed new meanings and organized their own content.

Based on the daily observations and reflections along with the unstructured interviews of the learners the following are some of the feelings of the students at different points of time while learning the technique and working in groups for the project.

I feel it helped me in learning how to make summaries for the lesson that I learn, I feel it help me in developing relationship between concepts, I feel I need not be worried about so many words and spellings while presenting my ideas, I feel confident of learning independently, I feel that I too am capable of understanding and learning science	I feel scared of making big maps, I feel confused when I am asked to make cross links, I feel one needs good command over the language to use concept mapping as a tool for learning, I feel lost when I am to make maps for large content matter.

These valuable feelings are representative of the entire class irrespective of diverse abilities among the students. These experiences give us a reason to celebrate a sense of achievement that results when students and teachers share meanings and give emotional support to one another leading to appreciate the diversity that exist within any classroom

5 Conclusion

This research project has left a deep impact on the researchers as well as the mentors involved in it. Along with the significant impact on the scholastic profile of the learners, concept mapping technique proved to be an effective alternative teaching and testing strategy for the inclusive science classroom. Though the experiences were varied and all could not be captured in this paper but this technique has provided and will provide a promise for making inclusion a reality. 'A road is made by walking' and so in our journey towards inclusion, concept mapping has helped us to cherish, appreciate and celebrate the diversities among the learners.

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