"We Want the Moon": An Exploration of the Possibility of making Astronomy Accessible for the Visually Impaired Learners

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ABSTRACT

1. **The Central Theme**

Astronomy occurred as a result of curiosity of unknown which placed in human nature and depend on observation that is inseparable part of science. But the same field of knowledge remains largely inaccessible for the visually impaired (V I) learners due to societal misconceptions about their abilities on one hand as well as an abstract nature of the subject and high focus on visual representations for its transaction on the other.

2. **A Brief Baseline of Literature**

Students with visual impairments have a challenging time with most Astronomical phenomena because, they are frequently left out of critical experiences in the classroom (Beck-Winchatz & Riccobono, 2008). Wild, Paul, and Kurz (2008) reported that the students with visual impairments in their study learned astronomy through memorization, the Internet, audio descriptions, and tactile diagrams or manipulative. Research in the general field of disabilities seems to indicate that inquiry-based methodologies are beneficial for the disabled students (Mastropieri, 2005). Several researchers abroad have also pointed out the superiority of technology based inquiry approach (TBIA) over inquiry approach alone, for the disabled students (Krajcik et al,2000; Tapscott, 1996). But the field of effect of research based instructional strategies on the Education of the disabled students in general and the VI learners in particular have largely remained neglected in educational researches in India. Hence the purpose of this study was to design an instructional strategy based on TBIA for teaching Astronomical concepts and study its impact on the conceptual understanding among the VI learners from Std 6.

The study was based on a quasi-experimental research design and took a mixed method research paradigm. 22 VI students of Std 6 from 2 special schools for the students with vision impairment in Mumbai (Kamala Mehta School for the Blind girls and Victoria Memorial School for the Blind) were the participants of the study. The students from Victoria Memorial were in experimental group while the students from Kamala Mehta were in control group. Two instructional designs based on four major themes namely: Solar system and the Galaxy, motion of Earth and its types, occurrence of day and night and reasons for the seasons were developed. The experimental group was chosen for the instructional design based on TBIA while the content for the control group was transacted by the traditional method. We chose the 5 E learning cycles for the TBIA. The duration of each design was 6 sessions of 2 hours each.

The pre and posttest for conceptual understanding were administered to find out the effect of the treatment. Pre and post oral test was administered to examine the emergence of conceptual change in Astronomy concepts.

3. **Focus**

This brief paper is based on a small part of a major research project funded by ICSSR. Hence the scope of it is very limited.

The purpose of this paper is to discuss the challenges faced by the researchers during implementing the TBIA approach for the experimental group. Specifically we sought to answer the following research question in this paper:

RQ. What are some of the challenges in introducing the TBIA for transacting the Astronomy content for the VI learners?

4. Method and Theoretical Foundation

We adopted an interpretative qualitative research approach to gather and analyse the data collected through students' comments, researchers' and field workers' experiences and course material. We used an Interpretative Phenomenological Analysis approach to gain insights in to the pedagogical issues associated with the use of TBIA for the VI learners.

As a qualitative research approach, IPA has its theoretical origins in phenomenology and hermeneutics. The framework was designed by Smith, Jarman and Osborn (1999).

Participants

The participants of this part of the study were 11 VI students from Victoria Memorial School studying in Std 6. All the students were males. Out of 11 students, 3 were totally blind, 3 had only light perception and 5 were partially sighted. Their age ranged between 11 and 16. Of all the students only 2 knew Braille fluently, 3 could not read and write it fluently and 6 did not know Braille at all. Thus 9 students could not use Braille for their study purposes. They depended on sighted readers or audio materials for their studies. Out of 11 students 6 could use screen reading software JAWS. The performance of all the students in pre-test was very poor as none of the students could pass the test successfully.

Data Collection

In this study as already indicated above, we wished to analyse in detail the experiences of the researchers about using TBIA for teaching Astronomy to the VI learners, we gathered data through the researchers reflections and field notes of the field workers.

5. Findings and Discussion

This section presents the major findings and answers the research question.

For this the IPA framework helped us to arrive at the super ordinate themes.

RQ. What are some of the challenges in introducing the TBIA for transacting the Astronomy content for the VI learners?

To answer this question we used data from our reflections and the field notes of the field workers. Following were some of the major challenges faced and solutions sought by us while using TBIA for teaching Astronomy to the VI learners:

- ✓ **Challenges and Solutions**

1. Non accommodative course content

It was noticed that the special schools for the VI students are using the same textbooks only they are made available in Braille print. As a result these books not only lack in appropriate graphical presentations but even the content as well as the vocabulary used in the content is not at all accommodative. Hence, the content largely remains out of reach for the VI learners.

Solution

To solve this issue we did a thorough content analysis of the Astronomy content; identified the complex areas and provided textual and linguistic scaffolds by creating new learning material. We used the latest technology to introduce the graphics in tactile form.

2. Inaccessibility of information

In spite of making new learning resources it was found that more than 50% students could not access the learning material in Braille. For this they expected the reader's help which was difficult to provide all the time.

Solution

To combat this challenge we converted the material in DAISY format with audio input. In the DAISY format, too the diagrams were audio described. Separate audio content was also made available for the learners. The models used did not only have Braille labels but even they too were given audio inputs. Since the simple short video clipping downloaded from net could not be used for them we created a small film with audio description. All this helped the learners to access the required information for their inquiry learning.

3. Lack of resources

The school chosen for the experimental group did not have sufficient learning resources like models, charts etc. Whatever they had also was not in a good shape.

Solution

For the problem of lack of resources we ourselves developed theme wise models, material in 2D form. That too was made in multiple copies as each VI child needs separate time to explore the material. Only one set of learning resources would have created a big chaos in the classroom. Sometimes we used waste material to create learning resources as well. For example a dome like structure for the concept of night sky was developed out of empty boxes of cardboards.

4. Class management

Inquiry required the self-exploration of the materials in Braille or in digital form, models or audio form which was many a times difficult for 5/6 students. It was risky to make them touch the electric bulbs in the models as well.

Solution

We made the groups of totally blind and partially sighted students and gave each group one field worker as a sighted assistant. We also saw to it each group at least one person could read Braille or could access digital material.

5. Lack of time

Inquiry learning required time for explorations and analysis, which could not be fitted in a regular class period of 30 minutes.

Solution

We decided to take classes on Sundays for a longer duration. It was possible as the school is a residential one and students could sit with us for a longer time.

6. Classroom setting

The TBIA required constant interaction between the group members and the field assistants. The students required to touch the models, access the materials and take part in the discussions. All this was difficult in a regular classroom setting with benches and tables with chairs.

Solution

We requested the school to provide us with empty room with minimum furniture to put the models and other things so that the students could move freely with their group members and the field assistants in the room for working on the problems.

7. Inquiry overtaken by technology

During few initial sessions the students used to engrossed in technology and shift their attention from inquiry into problem.

Solution

The field assistants were allotted to the groups who could time to time keep the track of the inquiry process.

8. Lack of inquiry skills

According to research findings, students learn content best when: they are involved in firsthand exploration and investigation and inquiry/process skills are nurtured; instruction builds directly on the student's conceptual framework.

When engaging in inquiry, students are expected to describe objects and events, ask questions, construct explanations, test those explanations against current scientific knowledge, and communicate their ideas to others. They identify their assumptions, use critical and logical thinking, and consider alternative explanations.

Despite widespread agreement on the importance of inquiry-based learning, it was difficult to adopt this pedagogical approach in classrooms. Initially we found that students were getting disruptive, paying less or no attention, or simply not participating.

Solution

We adopted easy step by step guided inquiry strategy in which students were guided from one stage to another with the help of structured observations , interpretations and conclusions.

9. Equality of Learning Experience

The main challenge before us was how the totally blind students could get a comparable learning experience to partially sighted students. Out of 11 learners, 6 did not have any functional vision.

The stated aims of the TBIA module stress the importance of inquiry. It was, therefore, important that all the students irrespective of their vision condition got engaged in the process of inquiry rather than simply being present. The

obvious problem was the visual nature of Astronomy concepts.

It required that observations are to be made and conclusions are to be drawn on the bases of analysis of the observations.

Solution

In this situation, having a sighted assistant to describe the visual elements was an obvious solution. Hands-on experience depended to a large degree on the nature of the models and instructional material. In a two hour session there was time for the students to explore the models and other materials. Where it was impossible for the totally blind students to manually do the activity they instructed the sighted assistant to do it for them. In some situation the use of talking models or audio description of the graphics and movie made the totally blind learners enthusiastic and actively engaged them in the inquiry process. Thus the sighted assistance, little flexibility and assistive technology helped us to meet this challenge.

10. Assessment

The challenge here was how to assess the inquiry learning among VI learners, how would the marking criteria be applied in the same way as for other students when some of the student had a sighted assistant, how strictly to follow the marking criteria .

Solution

We decided to mark the students based on the three criteria:

1. Inquiry skills,
2. Conceptual understanding
3. Group presentations

Inquiry skills are marked on whether the student has participated in the following activities:

- Asking questions
- Accessing information
- Sorting information
- Reporting finding

The totally as well as partially sighted students tended to score well on this.

- Conceptual understanding was to assessed by marking them on understanding of the Astronomy content and performing certain practical activities. Initially the students were presenting very sketchy notes on the assigned tasks. Some leeway was given here as it was felt to be unreasonable to expect such a comprehensive written account. However, when it came to writing up test paper no such leeway was given.

- Group Presentation skills were also straightforward to mark. We marked the students against certain dimensions like content clarity, logical organization of the content and group coordination.

To sum up,

- There are several pedagogical issues and challenges in using TBIA for introducing the Astronomical concepts to the VI learners, but with little flexibility in designing teaching –learning strategy , optimum use of assistive technology and to some extend sighted help we can teach Astronomical concepts successfully to the VI learners.

  a. The TBIA helped in engaging the VI learners in the process of inquiry meaningfully.

  b. Assistive technology used in this study namely: multiple representations of content in audio, Braille and DAISY formats, tactile models and diagrams, talking models, audio described movie contributed to the conceptual understanding of astronomical concepts of the VI learners.

  c. Sighted help assisted the VI learners to explore the phenomenon and remove the visual obstacles in the way of inquiry and exploration.

6. Key Learning: Despite of the pedagogical issues and challenges the project was a great success. Never the less we learn several lessons through experiences.

1. **Partnering with the learners**

   We the educators should not work with our rigid assumption about the disabled learners , in staid we need to ask them about their concerns and make them partners in the voyage of making the education accessible.

2. **Designing learning with Accessibility in the centre** - The entire teacher fraternity need to put the accessibility concerns in the centre of each learning experience. The teacher education institutions should take a lead to make the prospective teachers as champions of the inclusive learning.

7. Contribution of this study to the literature

The current study proves the effectiveness of Constructivist instructional strategy TBIA for teaching Science in general and Astronomy in particular to the VI learners.

This study provides significant results showing that assistive technology used for the visually impaired learners aided their conceptual understanding and that it facilitated the teaching and learning processes .

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