Chapter 35

Touching the Sky: An Exploration of the Possibility of making Astronomy Accessible for the Visually Impaired Learners

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This chapter is a brief account of the research in progress funded by ICSSR, in which the researchers have proposed to investigate the impact of "Technology-based Inquiry Approach"(TBIA) on the conceptual understanding of the astronomy concepts among the visually impaired (VI) learners. The study also aims to find out the effect of the TBIA on the attitude of the VI learners towards Astronomy and curiosity about Science along with their achievement in Science. This study was carried out in the STD 6th Astronomy content with the 2 groups of VI learners from Kamala Mehta School for the Blind and Victoria Memorial School for the Blind (total of 22 students). Two hours a week instructional program was conducted for a period of 6 weeks. At present the researchers are in the process of data analysis and interpretations of the findings. The present paper focuses on discussing the challenges faced by the researchers in making the Astronomy content accessible for the experimental group with TBIA and Experiences of the VI learners about learning Astronomy through inquiry learning.

Introduction

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 (VI) 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. 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 indicatethat 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 also aims to find out the effect of the TBIA on the attitude of the VI learners towards Astronomy and curiosity about Science.

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 Mehata were in control group. Two instructional designs based on four major theme 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 5 E learning cycle for the TBIA. The duration of each design was 6 sessions of 2 hours each.

The pre and post test for conceptual understanding and preand post surveys for the attitude toward Astronomy and science curiosity

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. At present we are in the process of data analysis and interpretations of the findings.

Purpose

The purpose of this paper is to discuss the challenges faced by the researchers during implementing the TBIA approach for the experimental group and to describe the experiences of the VI learners about learning Astronomy through inquiry learning method.

Specifically we sought to answer the following research questions:

RQ1. What are some of the challenges in introducing the TBIA for transacting the Astronomy content for the VI learners?

RQ2. How do the VI learners evaluate their learning of Astronomy through the process of inquiry in this project?

Method

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 and the way VI learners perceived and experienced learning of Astronomy concepts through the process of inquiry.

As a qualitative research approach, IPA has its theoretical origins in phenomenology and hermeneutics. The framework was designed by Smith, Jarman and Osborn (1999). A researcher can deploy IPA if the aim of the study is to explore individuals' perceptions as well as understand how they (individuals) make sense of their experiences. IPA aids in the interpretation of perceptions, experiences, events and actions held for individuals in a study (Chapman & Smith, 2002). The framework helps in explanations that give insights to understand human experience better (Fade, 2004). IPA is both phenomenological and interpretative. It is phenomenological because it "seeks an insider perspective on the lived experiences of individuals," and is also

interpretive because it "acknowledges the researcher's personal beliefs and standpoint and embraces the view that understanding requires interpretation" (Fade, 2004).

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. There age ranged between 11 to 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.

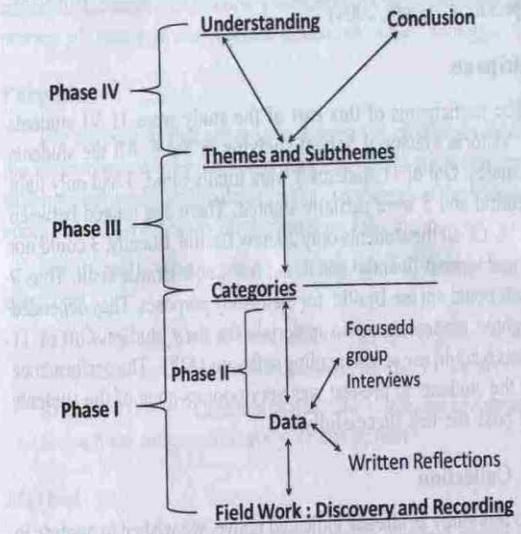
Data Collection

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 and the perceptions of the VI learners regarding learning Astronomy through inquiry process, we gathered data through the researchers reflections and field notes of the field workers. We also used the Focus group interviews of the VI learners to engage in a flexible dialogue with the participants in the study. Interviews were audio-recorded with the consent from the participants. The interviews were then transcribed verbatim. To establish trustworthiness of the findings, the interviews were conducted by two different researchers.

In the process of analysis, we did a detailed systematic qualitative analysis of the transcripts. Then we extracted and listed the themes. The themes were then clustered in a meaningful way by looking for connections between them to develop super ordinate themes. We also had obtained permission from the institution to interview the VI learners before the study commenced.

Privacy and confidentiality were adhered to throughout the research process.

Different phases of data analysis are shown in the following diagram.



Findings and Discussion

This section presents the Major findings and answers the research questions.

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

RQ1. 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 a 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 introducing the TBIA for teaching Astronomy to the VI learners, but with little flexibility, optimum use of assistive technology and to some extend sighted help we can teach Astronomical concepts successfully to theVI learners.

RQ2: How do the VI learners evaluate their learning of Astronomy through the process of inquiry in this project?

To answer this question we conducted a focus group interview of the participants.

Following super ordinate themes became evident after the qualitative data analysis:

1. Unquestioned trust in the learners – This was a very prominent theme which immerged from the interview. All the participants unanimously felt that the research team showed lot of trust in them.

   For the sake of confidentiality we are giving the comments of the participants with the beginning letter of their names. Students with the same beginning letter are given additional numerical identity like S1 and S2.

   S1 said "For the first time someone has allowed us to touch the models, apparatus independently. Earlier we were never touched the things on our own. S2 said" We were not scared to touch things as we knew all the team members are supportive and if anything would go wrong no one would scold us".

   Several of the students mentioned how surprised they were that the research team allowed them to actually work,

hands-on, with the models, graphics etc. As with all young people, there exists a strong desire among these students to try things on their own without someone stepping in and doing things for them.

A said" People do not let me do things myself. They would either put their hands over mine and show me, or they would just do it themselves and not let me do it at all. So, I think this was great".

By allowing the students to work on their own and develop confidence with some expensive and delicate equipment, the research team showed the group that they were genuinely interested in their learning experience. This fostered an atmosphere in which the students felt comfortable to show what they didn't know by asking questions of the research team.R specifically found the collaborative grouping quite helpful to his learning experience." You felt like you could ask anything, and you wouldn't be made fun of by anyone.

In classroom you still feel uncomfortable, and the teachers don't have a lot of time to answer all the questions you have!" He said.

Because each of the students was at a different age, degree of vision impairment, and knowledge level in Astronomy, the project could have easily fallen into the trap of teaching to the so-called lowest common denominator. This would have had the advantage that no student gets left behind or confused by any of the activities, but it certainly would have also limited or constrained the learning experience of those students who had a stronger base in Astronomy prior to the project . S3 talked about how well the project team dealt with this issue of students' learning process. He said " I was pretty familiar with astronomical topics,

But I wanted to know more and more interesting things about the motion of the Earth, different planets which is not there in the textbook. But the team members gave me all the information what I asked for"

2. Enriching moments of learning - All the participants found the learning experiences during the project very enriching. B said" It was great to touch the sky and feel the stars." V added" Whatever I could see in movie it was very exciting." N also agreed with his friends and said " It was interesting to touch each planet in the model and feel their surface in the tactile diagrams.
3. Willing attitude of the team – The participants appreciated that the research team members were very willing to know the problems faced by the students and very prompt to bring changes in the activities. M said " The team members asked me whether I could understand the concepts, what changes I need in the diagrams or models. Nobody has asked me like this before" N also felt the same and said" The project teachers were always ready to know about my problems and they always asked me how I would have liked to be taught. Who does so much for us?"

All in all, every participant rated the project a huge success. Clearly, partnering young students eager to learn with experts in a particular field is no easy task. The funds made available by the ICSSR for our research project provided a much needed financial base. At the same time it was the energy, creativity, and open mindedness of both team members and students that allowed this experience to become a model and an inspiration for future endeavors of this kind.

4. 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 asumssion 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.

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