



THE SKY IS NOT THE LIMIT": AN EXPLORATION OF THE FEASIBILITY OF MAKING ASTRONOMY LEARNING ACCESSIBLE FOR THE VISUALLY IMPAIRED LEARNERS

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Abstract:

The visually impaired learners have to face many access challenges in getting education with respect to content, teaching-learning and assessment. Astronomy is one of such fields which is highly inaccessible for the VI learners due to its abstract and visual nature. But if appropriate instructional interventions are made then even the VI learners can also access the astronomy content effectively. This study presents such an experiment in which the VI learners were given exposure to astronomy learning through the instructional intervention based on technology based inquiry learning approach (TBIA). The statistical analysis proved the usefulness of TBIA approach over traditional approach of teaching astronomy to VI learners.

Keywords: Astronomy, Visually Impaired Learners, TBIA

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Introduction:

Astronomy has always aroused curiosity in the minds of human beings. It is inseparable part of science. But the same field of knowledge remains largely inaccessible for the visually impaired (VI) learners. The main reason being it's highly visual and abstract nature. At the same time teaching learning strategies used for transacting this area for the VI learners also have been traditional and non-facilitating.

Insight from the Literature:

Students with visual impairments have huge barriers in learning most Astronomical phenomena because they frequently find the critical experiences in the classroom inaccessible and non-accommodative (Beck-Winchatz & Riccobono, 2008). Wild, Paul, and Kurz (2008) reported that the students with visual impairments often learned astronomy through memorization, the internet,

audio descriptions by the sighted persons and tactile diagrams or manipulative. Research in the field of disabilities education claim that inquiry-based teaching practices have been proved to be beneficial for the disabled students (Mastropieri, 2005). Several researchers abroad have also asserted that the technology based inquiry approach (TBIA) has been superior to inquiry approach alone for the disabled learners (Krajcik et al, 2000; Tapscott, 1996). But it is very disappointing that there are negligible number of studies available in India, on the effect of research based instructional strategies on the Education of the disabled students in general and the VI learners in particular. 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 Standard 6.

Brief Overview of the Study:

The study was based on a quasi-experimental research design and took a mixed method research paradigm. 22 VI students of Standard 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 post tests 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. The quantitative and qualitative analysis of data proved the effectiveness of TBIA over the traditional approach for enhancing the conceptual understanding of Astronomical concepts among the VI learners from the experimental group.

The 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 pedagogical issues and challenges occurred in the process of implementing TBIA for teaching astronomy concepts to the VI learners and the contribution of technology to make the learning of astronomy accessible for the VI learners. Specifically we sought to answer the

following research questions in this part:

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

RQ2- In what way technology can make the learning of astronomy accessible for the VI learners?

Method and Theoretical Foundation:

We adopted an interpretative qualitative research approach to gather and analyze the data collected through students' comments, researchers' and field workers' observations and 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 role of technology in solving those issues. 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 Standard 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 - 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 part of the study as already indicated above, we wished to analyze in detail the experiences of the researchers about exploring the feasibility of making astronomy learning accessible for the VI learners by

using TBIA and role of technology in the same, we gathered data through the researchers reflections and field notes of the field workers.

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:

The following table presents the challenges faced and the solutions sought.

| Sr. No. | Points | Challenges | Solutions |
|---------|---|---|---|
| 1 | Non-accommodative course content | <ul style="list-style-type: none"> Lack of graphical representations in the textbook Highly abstract nature of the content Linguistically inaccessible terminology and description | <ul style="list-style-type: none"> Simplified and descriptive textual language Tactile graphics |
| 2. | Inaccessibility of information | <ul style="list-style-type: none"> Not all VI learners were Braille users | <ul style="list-style-type: none"> Multiple means of representations: Material in DAISY, Audio format Talking models Movie with HD resolution and audio description |
| 3. | Lack of resources | <ul style="list-style-type: none"> Non availability of models, charts in special school | <ul style="list-style-type: none"> Developing low cost resources in multiple copies |
| 4. | Class management | <ul style="list-style-type: none"> Required self-exploration in inquiry learning was at times risky for totally blind learners. | <ul style="list-style-type: none"> Peer assistance for accessing Braille/ digital material. Sighted help by the mentors for doing activity. |
| 5. | Classroom setting | <ul style="list-style-type: none"> Regular classroom setting with fixed furniture was a barrier for inquiry and frequent movements for VI learners. | <ul style="list-style-type: none"> Using flexible setting Creating activity stations |
| 6. | Equality of inquiry learning experiences for the totally blind learners | <ul style="list-style-type: none"> Due to highly abstract and visual nature of Astronomical concepts, it was a challenge the totally blind learners to involve in inquiry learning process which required observation, interpretations and arriving at conclusion. | <ul style="list-style-type: none"> Sighted help to make observations. Accessible learning resources for explorations. |



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|----|--|--|--|
| 7. | Lack of inquiry skills among the VI learners | <ul style="list-style-type: none"> When engaging in inquiry, VI learners were expected to describe objects and events, ask questions, construct explanations, test those explanations against current scientific knowledge, and communicate their ideas to others. This was not happening initially because of lack of inquiry skills among them. | <ul style="list-style-type: none"> Adopting 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. |
| 8. | Assessment of inquiry learning | <ul style="list-style-type: none"> It was a challenge to assess the inquiry learning among totally blind as well as partially sighted 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, keeping in mind the barriers in abstractions and visualizations. | <p>Multiple forms of assessment:</p> <ul style="list-style-type: none"> Participation in inquiry process; Conceptual understanding test Participation in oral presentation |

RQ2-In what way technology can make the learning of astronomy accessible for the VI learners?

This section presents a brief account of technological contribution to the process of accessible astronomy learning of VI learners.

As discussed earlier, the highly visual and abstract nature of Astronomical concept, equally visual nature of its representation and the vision dominated nature of science language makes the learning of Astronomy inaccessible for the VI learners. But technology helped to facilitate the learning by providing:

- Multiple means of representations of the material:**

We could provide the material in Braille for totally blind learners, in large prints for partially sighted learners, audio format for non-Braille users and in DAISY formats for technology users.

- Multiple means of learners' engagement:**

With the help of technology we could engage the learners in variety of learning activities. They included, working with talking models, watching movie with audio description, using speech applications for content explorations, making group

presentations and participating in guided discovery process.

- Multiple means of expression:**

With technology it became feasible to allow the learners to express in variety of ways. Some submitted audio recordings, some presented in Braille, some in e format as well as some with tactile graphics.

- Equal opportunity to learners:**

The technology made it feasible to arrange multimodal presentation in the form of audio, visual, tactile format of content, learning resources as well as assessment strategies there by providing equal opportunity to totally as well as partially blind learners.

- Promoting research based practices:**

One of the major drawbacks in disability education is the lack of pedagogical innovations. But the optimum use of appropriate technology has made it possible to use a progressive pedagogical intervention namely TBIA for making astronomy learning not only accessible but even meaningful, engaging, enriching and constructivist.

**Key Learning:**

This study brought forth the following key learning:

- TBIA helps in promoting conceptual understanding of Astronomical concepts, inquiry, exploration and active engagement among VI learners.
- Multi-modal / multi-sensory teaching strategies make the Astronomical content, learning activities, assessment accessible for the VI learners.
- Accessibility should be in the center of designing of learning environment for the VI learners.
- Creating the culture of accessibility and empathy is essential for success of inclusion.

Summing up:

Astronomy as a field has a history of creating huge barriers for transacting the content. But, with the help of innovative and research based pedagogical practices, optimum use of technology and conducive learning environment the sky will not be the limit for the VI astronomers.

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