

**CASE STUDIES OF ACCESSIBILITY OF SCIENCE LABORATORY FOR THE
CHILDREN WITH SPECIAL NEEDS AT HIGHER SECONDARY STAGE**

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Abstract

The visually impaired and locomotor disability students rarely opt for science-stream in higher secondary schools due to lack of resources to access science laboratory and the absence of experts in the field. Research studies prove that cognitive abilities of visually impaired students are of the same range compared to the sighted students. However, the lack of appropriate methods, accessible technology, and teaching-learning materials in a tactile format, interactive auditory mode and well trained teachers hinder the advanced learning in Science by the children with special needs. The present study is an attempt to observe the accessible infrastructural facilities available in science laboratories of two private schools in Delhi for the students with visual disability and locomotor disability and the problems faced by the students as well as teachers with visual and locomotor disabilities in performing experiments. The study concludes that the schools have made all possible efforts to provide accessible science laboratory environment to the students. However, there were limited scopes for the use of assistive technologies and doing more experiments science.

Key Words: special needs children

Introduction

'Sarva Shiksha Abhiyan' and 'Rashtriya Madhamik Shiksha Abhiyan' have made some efforts for preparing guidelines for barrier-free school environment for children with special needs in schools. However, science laboratories are not accessible to students with locomotor and visual disability. Accessible India Campaign launched by the Government of India under Ministry of Social Justice and Empowerment in 2016, for achieving universal accessibility, also focused on these aspects.

How far our science laboratories are well equipped to develop the skills required for learning science like observation, problem solving, drawing and labelling, analysis, synthesis and creativity among the students with locomotors disability and visual disability is a serious matter of concern. There are many obstacles experience by students with disabilities that

discourage them to take science stream. Some of them are lack of mentors in special education, inaccessible laboratories, negative attitudes of teachers, knowledge gap in the teaching–learning process, etc. Sheryl (2012) pointed out that access barriers may prevent students from gaining knowledge, demonstrating knowledge and fully participating in lab activities. Singh (2016) concludes that the majority of schools in India are not well designed and equipped to meet the educational needs of students with disabilities. Also, there are challenges in procuring and resourcing for assistive devices for ensuring quality teaching–learning environment.

It is our responsibility to provide a learning environment in which the students understand the abstract notions of the scientific concepts through science experiments by manipulating the equipment, observing the changes, etc. to develop critical thinking, problem solving and creativity among them.

Science education at higher secondary level helps the students with visual disability to understand concepts and to develop social interactions with sighted students (Wild & Koehler, 2012). A year’s experience study in preparing and delivering teaching materials specially designed for students with visual disability, including blind students, Chevins and Nacer (2007) had shown that these students were capable of achieving many of the learning outcomes expected from the abled students. Mahadeo, et al. (2014) pointed out that the students with disabilities face so many obstacles like lack of mentors in the field, inaccessible laboratories, negative attitude of instructors, a knowledge gap about how to instruct the students and lack of knowledge on how to instruct using computer simulation learning for the students who have low vision. Another study conducted by Burgstahler (2016) concludes that students with disabilities face access challenges to typical science laboratories in gaining knowledge, demonstrating knowledge, and fully participating in laboratory activities.

CBSE syllabus gives some exemption to the students with special needs for the assessment of practical examinations at higher secondary stage. The board gives provision of separate question papers and questions in lieu of practical component. Circular of CBSE states that; Visually Impaired candidates are-Given separate question papers containing multiple

choice questions based on Practicals in the subjects of physics, chemistry and biology subsequent to notification of The Rights of Person With Disabilities Act, 2016. Instead of giving exemptions, it is our responsibility to provide congenial learning environment to the students in the science laboratories at higher level.

IEDC scheme implemented by the government of India in 1974 was a beginning to ensure equal opportunity for children with disabilities in general schools. National policy on education, 1986 made provisions for integration of students with physical challenges to enable them to face life with confidence. Further, the World Declaration for Education for All (1990), the National Policy for Person with disability (2006), RTE Act, 2009, etc stressed the importance of giving attention to the education of the children with special needs.

The Scheme of Inclusive Education for Disabled at Secondary Stage (IEDSS), 2009-10 replaced the scheme of Integrated Education for Disabled Children (IEDC) and provides assistance for the inclusive education of the disabled children in classes IX-XII. This scheme now subsumed under Rashtriya Madhyamik Shiksha Abhiyan (RMSA) from 2013. It covers all children studying at the secondary stage in Government, local body and Government-aided schools, with one or more disabilities as defined under the Persons with Disabilities Act (1995) and the National Trust Act (1999) in the class IX to XII, namely, blindness, low vision, leprosy cured, hearing impairment, locomotor disabilities, mental retardation, mental illness, autism, and cerebral palsy and may eventually cover speech impairment, learning disabilities, etc. Girls with the disabilities receive special focus to help them gain access to secondary schools, as also to information and guidance for developing their potential.

However, very few students select science stream in the higher secondary schools in India due to poor motivation, lack of facilities in the school, lack of accessible science laboratories, etc. se The case study is conducted to bring to light the challenges faced by the students with visual disability and locomotor disability in performing the science laboratory experiments and the other the innovative strategies adopted by the teachers to help the students to perform the science experiments in effective way.

Objectives of the Study

The study was conducted with the objectives:

- 1) To study the accessible infrastructural facilities available in the science laboratory for the students with visual disability and locomotor disability
- 2) To explore the adaptations made by the students and by the teachers to help the students with visual disabilities and locomotor disability in performing science laboratory experiments.
- 3) To study the problems faced by the students with visual disability in performing science experiments.

Research Questions

This study will attempt to answer the following research questions:

- To what extent the science laboratories in the higher secondary schools are accessible for the students with visual disabilities?
- To what extent do they get assistance from the teachers and peer group to perform the science experiments successfully?
- How far the teachers use ICT and other assistive technologies to help the students with visual disability and locomotor disabilities to perform the science experiments successfully?
- What are the major problems faced by the students with visual disability and locomotor disabilities in performing the science experiments?

Methodology

The investigators used case study method for the collection of data.

Tools Used for the Study

The following tools were used for the study

- A checklist to study the accessible infrastructural facilities available in the science laboratories for the students with visual disability and locomotors disabilities.

- An observation schedule to observe science laboratory tasks performed by the students with visual disability and locomotor disabilities and also to study the ICT and other assistive strategies used by teachers.
- A questionnaire to study the major problems faced by the students with visual disability and locomotor disabilities in performing the science experiments

Sample

The schools selected for the study were Tagore International School, Vasant Vihar, New Delhi and Salwan Public School Old Rajendra Place, Delhi. In both the schools, one student each opted Science stream. In Tagore International School, Vasant Vihar, New Delhi, a visually impaired student with B1 blindness category, also a resident of National Association for Blind, R.K Puram was studying in class XI. He learned subjects like physics, chemistry, mathematics, English and computer science. He used a screen reading software, JAWS which converts text into audio.

In Salwan Public School Old Rajendra Place, Delhi, a visually impaired student with total blindness in class XI was able to demonstrate various experiments like Ohms law, Half Deflection experiment smoothly and with ease. After class X, he opted for Science stream because he was very keen on learning science and performing experiments. He has subjects like physics, chemistry, English, mathematics and computer science. Physics was his favourite subject because he liked the teaching style of teachers and grew interest in performing experiments. Salwan Public School got maximum number of students with visual impairment from primary to upper secondary stage. 18 students in total were visually impaired in school; all of them were trained so well that they hardly needed any assistance from others. Special educators performed their duties diligently and tried to come up with best methods for such children. All the visually impaired students were enthusiastic and dedicated towards their studies and slightly more inclined towards Science. Most of them were willing to pursue Science stream after class X.

Analysis and Interpretation of Data

Accessible Infrastructural Facilities Available in the Science Laboratory

How can we create an ideal laboratory learning environment for children with special needs? It is a challenge in front of educationalists, especially for the visually impaired students. Our schools lack of infrastructural facilities like ramps with the railings, widened doors for easy movement with wheelchair, proper flooring with substantial moving space and adequate ventilation, sufficient slab height which would be accessible to both visually impaired as well as locomotor disability students, screen-reader softwares, Braille labeled equipment and apparatus like beaker, funnel, etc., tactile lab manual, talking digital thermometer that tells temperature in digital voice, talking watch which tells the time in human voice, Braille geometry basically used for learning geometry structure in chemistry, presence of fire extinguisher, first-aid kit, presence of laboratory assistance, availability of computer in the lab with all required software, use of ICT and other assistive technologies to help the students with visual disability and locomotor disabilities, etc.

Table 1. Availability of Various Facilities in Tagore International School for Students with Visual Disability and Locomotor Disabilities

S.No	Facility	Available in School	Non- Available in School
1.	Infrastructural	<ul style="list-style-type: none"> • Ramps • Adequate moving space • Fire extinguisher • Suitable height of work station 	<ul style="list-style-type: none"> • Motion sensor doors for CWSN • Braille labeled arrow sign (for guidance).
2.	Lab Accessibility	<ul style="list-style-type: none"> • well ventilation • proper flooring • Space • water supply 	<ul style="list-style-type: none"> • Tactile lab manual

			<ul style="list-style-type: none">• sink• Dustbins
3.	Modification of Equipments	-	<ul style="list-style-type: none">• Modified apparatus with elevated reading like meter scale etc.• laboratory apparatus were not labeled with Braille• no special modifications in equipments for CWSN and lack of tactile lab manual
4.	Use of ICT	-	<ul style="list-style-type: none">• Modified instruments with ICT for laboratory.• Projector for smart teaching• Screen reader software like JAWS, NVDA etc.• E-labs• Audio tapes• Talking watch

The infrastructural facilities available in the school were ramps, fire extinguisher, and suitable work station height for visually and locomotive disabled students. Regarding the Lab Accessibility, it was visible that the laboratory has well ventilation, proper flooring, space, water supply, sink, dustbins, etc. The laboratory was in a good condition to do all the practical works. The students always got the support from a lab assistant. During practical's, the students worked in groups. However, the visually disabled students were unable to perform experiments. It was noticed that the laboratory apparatuses were not labelled in Braille and were without special modifications in equipments for CWSN and lack of tactile lab manual.

Table 2. Availability of Various Facilities in Salwan Public School for Students with Visual Disability and Locomotor Disabilities

S.No.	Facility	Available in School	Non-Available in School
1.	Infrastructural	<ul style="list-style-type: none"> • Ramps • Adequate moving space • Fire extinguisher • Suitable height of work station 	<ul style="list-style-type: none"> • Motion sensor doors for CWSN • Braille labeled arrow sign for guidance
2.	Lab Accessibility	<ul style="list-style-type: none"> • First-aid kit • Lab assistance available • Clean Work station • Buddy system while doing experiments 	<ul style="list-style-type: none"> • Tactile lab manual
3.	Modification of Equipments	<ul style="list-style-type: none"> • 3-D models of different body parts in biology • Skeletal model • Braille labeled apparatus • Talking digital thermometer 	<ul style="list-style-type: none"> • Modified apparatus with elevated reading like meter scale etc.
4.	Use of ICT	<ul style="list-style-type: none"> • Projector for smart study 	<ul style="list-style-type: none"> • Modified instruments with ICT for laboratory.

- Screen reader software like JAWS, NVDA etc.
- E-labs
- Audio tapes
- Talking watch

It is evident from Table 2 that the school has made a good effort in providing quality Science laboratory experiments to the special need students who opt for Science-stream. Facilities like ramps with railing on sides, spacious lab, fire extinguisher, suitable work station height for visually and locomotor disabled students, provision of washroom with western commode facility, lab assistant, first aid kit, well ventilation, proper flooring, space, water supply, sink, dustbins, etc.

Regarding the Modification of Equipments, it was visible that in the Biology lab, the apparatuses were labeled in Braille such as funnel, beaker, 3-D model of heart, brain, digestive system, skeleton, etc. Talking digital thermometer that tells temperature in digital voice, talking watch which tells the time in human voice and Braille geometry basically used for learning geometry in mathematics was also present. However, tactile lab manuals were absent in the school.

Use of ICT in Science Laboratory

Recent researches proved that the students are highly motivated when their learning is supported by the use of ICT. They get opportunities to access more resources, engage in activities with more interest and also demonstrate more attention span. Availability of multi-media resources ensure visualisation and manipulation of complex models, three dimensional images and movement to enhance understanding of scientific ideas (The University of York Science Education Group, 2002).

Salwan Public School has taken care of using ICT in the laboratory works. Projector was present in Laboratory for audio-video representation. The school used e-labs, e-books and

screen reader software, JAWS and NVDA for visually impaired students. Students did the practical works in groups. The visually impaired student did the practical with the help of his classmates. Because of total blindness it's not possible for him to perform the practicals alone so it is ensured that he always works in a group of one or two students. Teachers demonstrated each practical individually and the student touched the apparatus or set-up and understood the procedure. Some of the practicals are done by him without facing any difficulties. Some of the modification of apparatus comprises labeling in Braille on the beaker, test tube, funnel, etc. 3-D models of various body parts in order to feel the student and make him understand better includes 3-D model of brain, heart, digestive system, skeleton, etc. The student easily grasped whatever teachers taught him and he was totally on computer with screen reader software called JAWS that converts text into audio, although he was able to read Braille as well.

In the case of Tagore International School, the use of ICT was limited during science practical. A projector was present in the laboratory for presentations. E-labs were also there and the visually impaired students used screen reader software, JAWS etc.. The school provided all the emotional support to the students by encouraging him to study, especially with the help of classmates. The students assisted him in coming to the science laboratory, familiarising the lab equipment's and understanding the experiments. The teachers assigned extra period for him and explained individually about the experiments and its features. However, it was not enough in developing the laboratory skills like manipulation of materials, understanding of content, developing science process skills, developing scientific attitude and cognitive abilities. He faced difficulty to match with the pace of teachers and the students. There was lack of modified equipments that helps him to do experiments. There was lack of books and manuals in Braille and he was not allowed to perform experiments due to lack of expertise and equipments.

The teachers expressed that it was the first time in the history of the school a blind student opted science stream that is why the school has not prepared enough to provide quality science learning environment to him. The teachers were ready to learn more and even the Braille also. They pointed out that the teachers need special training to teach the children with special needs.

Problems Faced by the Students with Visual Impairment

Both the schools were not prepared enough to provide quality laboratory learning experiences to the students with visual impairment and locomotor disabilities. In Tagore International school the visually impaired student did not get opportunities to do the practical. He came to the practical class and listened everything instruct by the teachers and the peer group. He understood things but there was no scope for doing practical. There was a lack of tactile lab manual or any assistive technology to help the students to learn the practical. National Association for Blind, R. K. Puram, New Delhi has taken care of him and helped him in his studies. Special teachers were available there to taught him. The school teachers said that they got some training to teach the child but it was not enough to develop all the laboratory skills in the student. They expressed that they need more training especially in using ICT for helping the special need students.

The visually impaired students did experiments with the help teachers and students. They faced difficulties to match the pace of the teachers and students. There were limited scopes for the use of assistive technology during the practical. The schools provided friendly environment, encouraged peer tutoring and ensured the presence of special educators.

Conclusions and Suggestions

This study proves that both the schools have made some efforts in providing good infrastructural facilities to the students. The facilities available in the school were ramps, fire extinguisher, suitable work station height, well ventilation, proper flooring, space, water supply, sink, dustbins, etc. The laboratories were in good condition to do all the practical works. Moreover, the students get assistance and support from teachers, peer group and the lab assistants. In Tagore International School, the laboratory apparatuses were not labeled in Braille and lack of tactile lab manuals were visible in both the schools.

The student in Tagore International School did not get opportunity to do experiments in the laboratory. In both the schools, the teachers and students helped students to understand the science practical. The student in the Salwan Public school was able to identify the apparatus in the laboratory by touching it and able to do practicals with the help of teachers.

It was also visible that the students did not get opportunities for adaptations during science laboratory experiments and there was limited scope for assistive technologies for the students in performing laboratory experiments. The major problem faced by the students are that they did not get opportunities to do the practical, face difficulty in keeping pace with the classmates, absence of well trained teachers and assistive technology.

In order to improve the condition of the schools in providing quality learning experiences to the special need students in science laboratories, the teachers should use ICT and various artificial intelligence techniques and plenty of modified equipments. Continuous training to the teachers is necessary to keep them updated and enhance their laboratory skills, capacities to carry out experiments, demonstrations more effectively and efficiently for the special need students.

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