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Accessible Biology Laboratory for Visually Impaired

KEYWORDS: Visually impaired, Accessible Biology Laboratory, Practical Problems.

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ABSTRACT *The present paper emphasizes on accessible biology laboratory which will be capable of accommodating visually impaired students along with normal vision student. The present study reveals that conventional biology laboratories without any assistive technologies for visually impaired are not able to provide wholesome learning environment to visually impaired students. In conventional laboratories visually impaired students face problems in performing practical of microscopy, anatomy, physiology, biochemistry, dissection, taxonomy and morphology. By making certain modifications and integrating assistive technologies, conventional laboratory can be made accessible for visually impaired where both visually impaired and normal students can work together.*

INTRODUCTION:
Visually Impaired people after completing matriculation generally prefer Arts and Commerce stream but avoid or in some cases were denied science stream for Higher Secondary Certificate (HSC). The major reason is difficulty in performing science practical.

Later, in 2006 according to circular issued by the Commissioner of Welfare of Disabilities, Maharashtra State Board of Secondary and Higher Secondary Education (MSBSHSE), Pune visually impaired student was allowed to take admission in science stream. But during examination as theory papers are written by scribe same way practical exams shall be performed by sighted person. Even now in MSBSHSE, Secondary School Certificate (S.S.C) exam visually impaired students are supposed to appear oral exam instead of practical exam.

Even though visually impaired are allowed for science stream, they are deprived from complete experience of science practical due to visual disability. Conventional biology laboratory are not able to fulfill special needs of visually impaired students, as this lab lacks assistive technologies which helps in learning of such students. Science practical is heart of science education. Acquiring science education without thorough without practical experience is in vain.

There is need of research which focuses on development of visually impaired accessible laboratory to impart hands on practical experience along with normal student leading to inclusive education (Fraser and Maguvhe, 2008).

THEORETICAL BACKGROUND:
The research is based on Bloom's Mastery Learning Theory, as this theory advocates that any individual who desires to learn can learn and have mastery on learning if learning conditions are modified according to individual needs of student. Based on this theory present research study tried to suggest solutions to create conducive environment in biology lab to enable visually impaired students to learn and perform practical work. (Bloom, 2000)

OPERATIONAL DEFINITIONS:
Visually Impaired: A person is defined as visually impaired who has no vision or greatly reduced vision or partial vision and cannot perform biology practical work without assistance of sighted person or assistive technology as the sighted person can do.

Biology Practical: Biology Practical is defined as a process of performing HSC biology experiments in biology laboratory as directed by MSBSHSE under the supervision of trained Biology teacher.

Practical problems: Practical problems can be defined as difficulties or problems faced by visually impaired student in performing biology practical.

Expert: Expert is defined as Biology learned visually impaired teachers/trainer and teachers educating visually impaired and normal student.

NEED AND IMPORTANCE:
There is a need to study what are the actual problems faced by visually impaired while performing Biology practical and every problem should be addressed with proper solutions. Suggested solutions should fit in conventional HSC science Biology laboratory so that visually impaired students are able to get conducive learning environment along with sighted students and bring inclusive education in laboratory. There is crucial need to bring visually impaired in main stream of science and technology so that even they can give their intellectual contribution in research and development which we are not able to harness efficiently just because of visually impaired are not getting proper learning environment.

OBJECTIVES:
1. To study problems faced by visually impaired students while performing HSC Biology practical of MSBSHSE.
2. To suggest solutions to develop visually impaired accessible biology laboratory.

RESEARCH METHODOLOGY:
Method of Research-
Researchers employed Survey method as this research has status paradigm and the target group and data required for research was scattered and widespread.

Population:
Visually impaired people of Maharashtra state only.

Sample:
10 visually impaired people who have studied Biology at HSC level. (Sample size is small as population of visually impaired people who have studied HSC Science with Biology is very less)

Sampling:
Non probability - Purposive sampling.

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Data collection tools:
Semi-structured interview were conducted to,

1) collect data related to problems in Biology practical from samples and
2) Get suggestions to develop visually impaired accessible biology lab from experts.

Data Analysis tools:
Qualitative analysis was done on data generated from samples.

RESULT AND DISCUSSION:
Problems faced by visually impaired in biology practical are categorized into following sections:
Laboratory: Samples faced problems in lab orientation in initial phase but later they got acclimatized to lab environment although navigation was with low speed.

Microscopy: Visually impaired students were unable to do focal adjustment of microscope and were not able to observe and identify micro slides. Students with low vision were able to make coarse focal adjustment but faced problem in identification.

Anatomy: Samples responded that while preparing plant sections for studying plant anatomy they faced problem in selecting thin sections. During staining of the plant section they were not sure whether the staining done was to optimum level. They studied human bones with the help of tactile sensation, therefore studying animal anatomy was comparatively easy than plant anatomy.

Physiology: Samples reported that in physiological experiments like effect of light on photosynthesis they were not able identify different colours of light. Study of Plasmolysis in epidermal cells of plant was difficult as this experiment demands microscopic observation. In transpiration experiment calibration reading was difficult.

Biochemistry: Samples experienced that they were unable to read labels on reagent bottles. While performing biochemical test they were not able to observe change in colour or turbidity or formation of ring in given biological sample.

Dissection: Samples found difficulty in giving first incision to animal body. Dissection and study of small organs was tough.

Systematics/Taxonomy: Samples explained that as animal specimens were preserved in glass jar they were deprived of studying them by tactile sensation. They have to depend on visual sensation which was not enough for identification.

Morphology: Small and delicate plant parts were difficult to study as too much of handling for tactile examination can spoil the plant part.

Suggestions for developing accessible biology laboratory for visually impaired are based on literature analysis and recommendations given by experts and are categorized into following sub sections:
Laboratory:
Laboratory orientation and navigation session should be arranged on first day of practical for all students especially for visually impaired. visually impaired student should be given freedom to select the seat of his/her choice as some may prefer a front seat for better reception for the tape recorder while other may select seat having ample light. Numerical data, charts, and graphs rather all labels in lab should be done in braille or large, raised print. (Tombaugh & Tombaugh)

Microscopy:
An adapter may be used to link a computer camera to an eyepiece of the microscope to get enlarged image on computer screen; this is beneficial not only to those with limited vision, but is also suitable for class demonstrations. Microscope can be connected to Tactile Diagram Machine (Embosser) which is able to produced tactile diagram of specimen or sections under microscope. (Caldwell & Teagarden 2007)

Anatomy:
Command on getting thin sections of plant parts can be obtained by regular practice. Optimum staining of section is possible using colour detector. To observe sections, microscope can be connected to computer screen to get enlarged view or tactile diagram machine to obtain tactile diagram. Details of bone structure are evident to those with good tactile ability. For small holes in bones that might otherwise be missed a fine piece of wire can be inserted and labeled.

Physiology:
Different colours of the light during photosynthesis experiment can be identified with the help of colour detector. Experiment which needs microscopy work can be attached to computer screen to get expanded view. Talking measuring instruments are available which aids in calibration.

Biochemistry:
In tests for various chemicals the light sensor can be used to differentiate between clear and cloudy solutions. It announces the formation of a precipitate by recognizing the change in turbidity or color of a substance. The light sensor will not announce the exact color of the material (yet), but when it is employed repeatedly in similar situations the user frequently comes to recognize different tones as indicating certain colors. With a constant light source it is possible to use the light sensor to locate the meniscus in graduated cylinders or to locate the level of a liquid in a flask or beaker. Accuracy depends on the individual's hearing, tactile sensitivity, and experience. All reagent bottles must label in Braille. Penfriend device helps in knowing the details on the reagent/ chemical bottles through auditory output.

Dissection:
Only for visually impaired students special arrangement of large animals like rabbit or guinea pig should be made as they have large organs compared to small animals like cockroach or earthworm which are difficult to study. Teacher should guide student to give first incision on animal body after animal dissection demonstration. Animal fiber models having internal organs which can be dismantled can be used.

Systematics/Taxonomy:
Large fiber models of animals furnishing details of various organs can be used for learning animal kingdom. (Heck 2011)

Morphology:
Fiber models of plants parts can be used to learn small and delicate parts of the plant for e.g. flower. In order to identify plants visually-impaired persons need a new key based more on tactile and olfactory characteristics. With fresh plant material differences in the odor of leaves and stems are as distinctive as is the smell associated with flowers. Using the sense of touch, blind persons often notice details of plant stems and leaves which could be used in plant keys.

The light sensor detects differences in shades of green in leaves, variegation of leaves, and differences in color of flowers. It will give a tone pattern when the petals are variegated, striped, or multicolored.

CONCLUSION:
Biology laboratories can be made accessible to accommodate visually impaired students by modifying conventional laboratory set up and integrating various assistive technologies which can provide tactile and auditory output for facilitation of practical observation. This will help visually impaired science aspirants to yield basic science knowledge and open doors to pursue higher science education in future. Thus in future even visually impaired can contribute for the development science and technology.

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