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Project Report on

"DEVELOPMENT OF ADAPTED SCIENCE EXPERIMENTS FOR IMPROVING SKILLS IN LEARNING SCIENCE OF STUDENTS WITH VISUAL IMPAIRMENT AT SECONDARY LEVEL"

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LIST OF CONTENT

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Introduction:

Special education is the practice of educating students in a way that addresses their individual differences and special needs. Ideally, this process involves the individually planned and systematically monitored arrangement of teaching procedures, adapted equipment and materials, and accessible settings. Children with visual impairment can certainly learn and perform well, but they lack the easy access to visual learning that sighted children have. The enormous amount of learning that takes place via vision must now be achieved using other senses and methods. Students with visual impairment, in order to meet the unique needs of they must have specialized services, books and materials in appropriate media (including Braille), as well as specialized equipment and technology to assure equal access to the core and specialized curricula, and to enable them to most effectively compete with their peers in schools and ultimately in society. Science instruction heavily depends on visual instruction; students with visual impairment may have difficulty in constructing abstract concepts because of the lack of visual input. Though they can understand the theoretical content, they do face problems in performing practical components. Hence when adaptations are made in the instructional methods, materials along with tactual and more hands on experiences to learn science, they perform better. Therefore the present study **"Development of Adapted Science Experiments for Improving Skills in Learning Science among Students with Visual Impairment at Secondary Level"** was carried out to find out the effectiveness of adapted experimental aids for enhancing the learning of science experiments among students with visual impairment.

Review of Literature:

The review of literature was divided in to four areas namely 'Importance of Science Curriculum and Laboratory, Science Education to Students with Disability, Need for

Teaching Science to Students with Visual Impairment and Adaptations in Science Content and Experiment for Students with Visual Impairment'. Findings from the literature review showed that most of the studies have been done in the foreign context and only few studies were done based on the Indian context. The review of the literature also reveals the fact that the adapted materials were made with high tech items and were highly expensive that could not be afforded by all students with visual impairment in India.

Methodology:

The present study aims to find out the effectiveness of adapted experimental aids on learning science subject by the students with visual impairment. This study explains the cause and effect relationship between the variables. Hence the experimental design was used. Purposive sampling technique was used. Forty students with visual impairment studying in 9^{th} and 10^{th} standard were selected from special, integrated and inclusive school in Coimbatore and Madurai Districts of Tamil Nadu State. In phase I, pre test was conducted among the selected students with visual impairment, in phase II intervention was provided using the adapted science experimental aids to the experimental group and the control group underwent conventional method of teaching science experiments. Each experiment was administered for 2 sessions (1 session is 30 minutes). Totally 20 sessions were allotted to 10 experiments for each student. In phase III, post test was conducted after the implementation of the intervention with the same tool used in pre-test to find out the level of performance of the sample after the treatment.

Analysis & Interpretation:

The data obtained was analysed by applying t-test. The results of the study showed that adapted science experimental aids were significantly effective for learning science experiments by the students with visual impairment than the conventional method.

Summary of Findings:

Findings based on Experiments: The results showed that the students with impairment in experimental group scored high when compared with the control group in all the experiments except the experiment 'Physical Status of Matters'. It shows that the adapted experimental aids were useful to improve the skills of students with visual impairment in learning science concepts.

Findings based on the Standards: Forty students with visual impairment studying in 9^{th} and 10^{th} standard were selected as sample for this study. Results of analysis showed that there is no significant difference between standards in performing experiments.

Conclusion:

Science is one of the major subjects in school curriculum which consists of more practical activities such as laboratory experiments. Hence science seems to be complicated subject for students with visual impairment. If adapted experimental aids are used for students with visual impairment, they will be able to understand the concept of that particular experiment without any ambiguity. Thus, students with visual impairment will get clear understanding about the concept when they participate in doing the experiments directly. This shows the importance of adapting experimental aids for students with visual impairment according to their specific needs. By using adapted experimental aids, students with visual impairment can realize the nature and impact of science. This develops self-confidence and independent skills among them and this in turn enhances their love for science subject and improves their knowledge about science.

Chapter I

Introduction

Introduction

Education is very important and necessary for each and every human being in order to improve knowledge and skills. Education is the fundamental right of every individual in a democratic society. Article 45 of the constitution of India recognises education as the basic right of every citizen. It is to be provided without any discrimination on the grounds of caste, creed, colour and disability.

Special Education

Special education is the practice of educating students with special needs in a way that addresses the students' individual differences and needs. The process of special education involves the selection of appropriate teaching procedures with adaptation in the equipment and materials, evaluation process to help students with special needs. Special education is provided to the students with special needs in the following ways or approaches, namely Special school education, integrated education and inclusive education.

Special School Education: In this approach students with disabilities are admitted to the schools meant for them namely school for Visually Impaired, School for Hearing Impaired and School for Intellectual Disability.

Integrated School: Integrated education is the educational programme in which children with disabilities attend classes with general school children on either a part or full-time basis. It is the placement of disabled children in ordinary schools with some specialised educational services.

Inclusive School: Students with disabilities are enrolled in general education schools and they are getting equal and appropriate education like their peer groups.

Education for Students with Visual Impairment

Students with visual impairment have unique educational needs because of their loss of vision. Auditory and tactile senses are important gateway for getting information from the environment. That is why sensory learning is so powerful for children with visual impairment and why they need to have as many opportunities as possible to experience objects directly.

In order to meet their unique needs, students must have specialized services, books and materials in appropriate media (including Braille), as well as specialized equipment and technology to assure equal access to the core and specialized curricula, and to enable them to most effectively compete with their peers in school and ultimately in society.

Science Curriculum for Students with Visual Impairment

Science instruction heavily depends on visual instruction; students with visual impairment may have difficulty in constructing abstract concepts because of the lack of visual input. They need mostly tactual and more hands-on experiences to learn science. To have an understanding of an object, students with visual impairment need to touch and feel it and this can take longer time for students with visual impairment than it is for sighted students. In addition, they may need mostly audio input and teachers have an important responsibility in providing these needs.

According to Ross and Robinson (2009), science is one of the critical content areas in the academic curriculum. In most cases, the special teacher of students with visual impairment collaborates with general education teachers and content area specialists to ensure that students with visual impairment benefit from the classroom instruction. The specialist in visual impairment provides adapted materials and equipment and teaches special skills prior to their use in the classroom. The teacher of students with visual impairment also provides information to the content teachers of modification in the presentation of the material. He/she makes suggestions on ways to ensure the inclusion of the students in all aspects of the class

and on ways to make learning as rewarding for the students who are visually impaired as it is for other students.

Modes of Learning by Student with Visual Impairment

Students with visual impairment have problems with vision, so they use their remaining senses for the learning and understanding process.

Tactile and Kinaesthetic Learning

Students with visual impairment use tactile and kinaesthetic input to learn about their environments. Such input should not be thought of as "lesser senses" to use in the absence of vision, but as another system through which learning takes place (Klatzy& Lederman, 1988). Tactile and kinaesthetic input can provide students with information about objects they come in contact with and use. Any visual materials used in classrooms need to be adapted for use by students who do not have the visual skills required for the task. Charts, models, maps, and graphs will have greater educational value for students with visual impairment if they can be "read" using the sense of touch. For example, outlining map boundaries with string enables students with visual impairment to use their sense of touch to read maps. Whenever teachers use manipulative, models, or other equipment, students with visual impairment need the opportunity to use their tactile and kinaesthetic senses to become familiar with the objects to benefit from their use in lessons. Teachers should introduce students with visual impairment to materials and equipment's used in activities such as science experiments before the activity. If students have the opportunity to learn about the materials or equipment before the activity begins, they will be able to concentrate more on the concept being taught rather than on what equipment they are using. Toward this end, a specialist will assist students and general classroom teachers with adaptations as needed.

Auditory Learning

Auditory input provides another way for students to gain information. Teachers should not assume, however, that students will understand verbal input in the same way and at the same depth as other students understand visual input. Auditory language triggers the creation of mental images that correspond with words. Images are recalled to assist students in comprehending verbal language. A student with visual impairment is likely to have fewer and less detailed mental images to correspond with verbal language.

Such images may differ according to a student's individual experiences and verbal input he or she has received from others. General education teachers should observe and interact with students with visual impairment in an effort to determine whether individual students understand verbal input. The teacher must check for comprehension during class discussions and when giving directions. If students are having difficulty in understanding what the teacher says, the teacher may need to clarify or expand on their background knowledge or vocabulary. Organizations providing services for people with visual impairment offer audio taped textbooks. Classmates can be designated as note takers for students with visual impairment. Class notes can then be audio taped or transcribed using an enlarged font or Braille. General education teachers may also develop verbal or other auditory cues as signals for attending to important information or particular events. Teaching listening skills is also important. Efficient listening is crucial to classroom success for students with visual impairment.

Improved listening skills help students with visual impairment increase their spoken and written communication and reading skills. Teachers can consult vision specialists to determine appropriate auditory accommodations for each student.

Visual Learning

Most students with visual impairment have some usable vision. Their visual learning can become more efficient if they can enhance their skill to use their vision through training or the use of assistive devices. Students can be observed to determine that they have visual skills sufficient for locating and tracking visual materials. Vision specialists can offer assistance in developing students' visual skills and in making accommodations necessary for helping students use their vision in productive ways. Such services include making maps, adapting reading materials, and assisting in general accommodations.

Many options are available for teachers selecting reading and writing materials for students with visual impairment. According to their needs and preferences, students may use printed or Braille materials. Printed materials should be clear and be printed using an easily readable font. Providing an easel to hold reading materials can help students with visual impairment do close work more easily (Barraga & Erin, 1992). Black felt-tip pens and soft lead pencils are useful writing utensils for students with visual impairment because of the increased amount of contrast they create against white writing paper (Koenig, 1996). An extra light source at the student's work area can be helpful for some students. If a student can benefit from an additional light, the light's placement should be determined in collaboration with the vision specialist. Some simple strategies for using printed materials can help students with visual impairment learn visually without requiring huge adjustments to the classroom environment. Using magnification devices or large print materials are two accommodations that are often implemented in the classroom. Such equipment's and materials are available for students who need them.

Adaptations for Students with Visual Impairment

Adaptation is a modification to the delivery of instructional methods and intended goals of student performance that does not change the content but does slightly change the conceptual

difficulty of the curriculum. Adaptations usually require more teacher effort and time than simply changing instructional methods or access as in an accommodation. An adaptation is a goal-driven process: in order to decide on an adaptation to curriculum, teachers first need to specify intended goals for individual students.

A major component of adaptation for blind students is texture. Texture can be used in a number of different ways. Braille, for example, conveys the most information, but it requires special equipment and an understanding of the system. It is primarily used for documents or labels that require written text. A low-touch method of texturing is simple using different types of materials, such as sand paper and felt.

Audible information can also be used for adaptations, and can be especially useful in a laboratory environment where an experiment is constantly changing and the student needs constant cues. Audible information is also useful for general studies in the form of talking books. While these books are useful as a complement to written text, they are not replacements and should not be used exclusively unless no other written material is available. Tape recorders can be used to record lectures and to take notes, which can be referenced later times.

Meaning of Adaptation

The word “adaptation” means the process of making suitable for a new use, need, situation, etc. in the context of students with visual impairment adaptation refers to the adjustments in the general curriculum meant for the sighted children in the regular schools. It bridges the gap between the sighted and visually impaired students in the process of attaining learning experiences and opportunities on par with sighted children on many occasions and the optimum experiences sometimes. Adapted teaching aid means the nature of special approaches and presentation styles that would be required for providing an optimal learning

experience to the visually impaired in the regular classroom. It is a process of making necessary changes such as duplication, modification, substitution and omission without changing the instructional objectives. The adaptation may be in terms of teaching methodology, special approaches, and presentation style.

General Principle for Adaptation

Dion et al. (2000) mentioned the general principle for adaptation. The first rule for making adaptations for a visually impaired student is 'minimization of adaptation'. Adaptation emphasizes the disability of the student. This emphasis creates a gap between the visually impaired student and their peers, which can hinder the student's social interactions. Another reason for minimizing adaptation is because this simplifies the work for the teacher. If adapted materials are significantly different from the original materials, the teacher has to make special provisions when referencing the material in class. Also, if adaptations are too detailed, they will take too long to develop and will appear cluttered to the student. When designing a complex adaptation, consider the significance of the information compared to the effort involved in utilizing the adaptation.

The second rule for adaptations is the 'avoidance of adaptation for basic skills'. Every student should be allowed to participate in every part of the classroom experience, which is why adaptations for some students are necessary. However, modifications can easily overcompensate and overlook the visually impaired student's ability to perform basic skills.

Concept of Adapted Teaching Aid

The concept of adapted teaching aid is fast catching on in the education of students with visual impairment. The use of appropriate teaching aids, applying innovative ideas and creativity of the teacher can make learning interesting in the classroom.

Adapted Experimental Aids

A child with visual impairment can learn better if a visual idea is presented in the form of non-visual ideas. Any abstract concept when taught to the children supported by relevant non-visual teaching learning material will certainly arouse the interest of the learner and contribute to the learning of the ideas in a better way. Appropriate teaching learning materials which are tactile in nature, will transform the visual ideas to non-visual experiences which enable the child with visual impairment to understand the concept effectively. Use of appropriate sounds in the teaching the concept enables the child with visual impairment to use his auditory sense to learn the concepts. Science subject has more experiments which include visual ideas. These visual experiments can change into non-visual experiments with the help of adapted experimental aids in terms of using auditory, kinaesthetic, olfactory, gustatory senses.

Students with visual impairment cannot see at all or have difficulty in seeing well and therefore have different ways of learning. Students with visual impairment do not respond to visual aids and stimuli, but have a heightened level of hearing and sense of touch. Therefore, these outlets can be used to connect students to what they are learning. It should be pointed out that students with visual impairment have the same range of cognitive ability as other students. However, since school learning relies very heavily on vision, students with this disability frequently experience academic problems. They must be exposed to a variety of experiences in science that can reasonably be explored. Although, visual disabilities tend to restrain individuals from highly variable experiences, overcoming barriers to experiencing activities that are unfamiliar is critical in stimulating the intellectual growth of students with visual disabilities.

Students with visual impairment respond well to sound and physical stimuli, which makes hands-on science programs a valuable approach to their education. Many schools for visual

impairment use a hands-on approach to their curriculum. It develops curiosity, manipulative skills, critical thinking, reasoning and problem solving capacity among them. But few experiments are very difficult for students with visual impairment to understand and to do independently because they are completely visually oriented. It is essential to find out the experiments which are causing difficulties for students with visual impairment to understand and to do independently.

The visual aspects of science present obstacles for any teacher and require them to find new ways of communication and instruction which go beyond visual aids in order to include students with visual impairment. Science has more visual ideas and fewer non- visual ideas, vision plays an important role in the as the science subject consists of more experiments and diagrams. Due to the loss of vision the students with visual impairment may not have such concept development power to learning science. Even though students with visual impairment learn science by using their remaining senses like auditory and kinesthetic.

Even though students with visual impairment use many adapted teaching aids to learn science, they learn only the theoretical part of it when compared to the practical aspects. Professionals in the field of educating students with visual impairment mostly agree that the methods followed for instructing sighted children can also be applied to students with visual impairment with appropriate modification.

Objectives of the Study

- To develop adapted science experimental aids for the science practical activities provided in the 9^{th} and 10^{th} Standard Tamil Nadu State Board syllabus for science subject.
- To study the effectiveness of adapted science experimental aids for improving the skills of students with visual impairment in learning science experiments.

Chapter II

Review of Literature

Review of Literature

Science Education to Students with Disability

Aydeniz et al. (2012) conducted a study on "Using Inquiry-Based Instruction for Teaching Science to Students with Learning Disabilities". The purpose of this study was to examine the effects of inquiry-based science instruction for five elementary students with learning disabilities (LD). Students participated in a series of inquiry-based activities targeting conceptual and application-based understanding of simple electric circuits, conductors and insulators, parallel circuits, and electricity and magnetism. Students' conceptual understanding of these concepts was tested. The students' attitudes towards science were measured through scientific attitudes inventory (SAI-II). They found that all students acquired the science content covered during the intervention and maintained their performance six weeks later. In addition, students improved their attitudes towards science.

Kumar (2012) stated that the education of students with exceptionalities is an area of emphasis in education reform. Research is consistent that students with disabilities who learn in regular classrooms often outperform their counterparts who experience academic instruction in segregated settings. General students benefit as well yielding social and emotional benefits for all students. As a result, it is critical that teachers need more than ever before to understand students with diverse exceptionalities, their characteristics, their needs, and effective strategies to work with them. However, students with disabilities are not adequately accommodated in science instruction and the condition of science education for these students remains very discouraging. The amount of time spent on science in the case of students with mild disabilities is considerably less than that spent on reading instruction.

Haakma et al (2018) conducted a research on need supportive teaching. They mentioned that according to self-determination theory (SDT), need-supportive teaching positively influences

students' engagement to learn. Need-supportive teaching involves teachers providing students with structure, autonomy support, and involvement. It enables teachers to support students' psychological needs to feel competent, autonomous, and related. Supporting students' needs consequently has a positive influence on students' engagement to learn. Little is known about need-supportive teaching in the education of students with visual impairments. The teachers and students scored highest on involvement, followed by structure, and then autonomy support. When looking at scores on an individual student level, they found large differences between students in the same class, which implies that need support requires an individualized approach. Hence, teachers need to be aware of their students' individual needs for structure, autonomy support, and involvement and should adjust their need-supportive teaching accordingly, thereby enabling teachers to have a positive impact on the engagement of students with visual impairments. In conclusion, a large amount of research highlights the importance of supporting the basic psychological needs of students in a classroom. The findings illustrate that need-supportive teaching is also important in the education of students with visual impairments.

Jill (2018) conducted a study on the experiences of students with vision impairment in mainstream schools. Policies of inclusion were considered, with analysis of how training and curriculum came together, as experienced by these students, to develop their inclusion in schools in Victoria. Interviews of each participant using interpretative phenomenological analysis revealed a number of themes, with lack of teacher understanding of vision impairment a common theme across all cases. The limited access to visiting teachers, specialists in vision impairment, points to the need for alternatives in the delivery of necessary expanded core curriculum components. It is proposed that teachers of these students would benefit from an online unit to educate them in vision impairment to eliminate

unintentional exclusion practices currently experienced and to encourage them to incorporate components of the expanded core curriculum into their everyday practices.

Fast (2018) stated that the practice of inclusive education—or inclusion—within general education classrooms is becoming more prevalent within early childhood settings. To successfully deliver classroom curriculums, promote learner growth, and meet the goals of all students served within inclusive settings, teachers must have a basic understanding of the unique learning needs of all students, including those with visual impairments. Because students learn best when the teachers who educate them first understand their needs.

Need for Teaching Science to Students with Visual Impairment

Kumar & Ramasamy (2011) stated that the preponderance of visually oriented and visually complex concepts and information in science classrooms poses significant challenges to learning among visually impaired students. Without systematic instructional attention to these challenges, science may seem inaccessible to many students with visual impairments. He *also* mentioned that students with visual impairment have the same range of cognitive ability as other students. They must be exposed to a variety of experiences in science that can reasonably be explored. Although, visual disabilities tend to restrain individuals from highly variable experiences, overcoming barriers to experiencing activities that are unfamiliar is critical in stimulating the intellectual growth of students with visual disabilities.

Reichert (2011) stated that students who are blind or visually impaired need science instruction that relies on other senses. Science concepts can be taught to visually impaired students using touch, smell and hearing and lesson plans can also be adapted to include science projects and experiments for visually impaired students. Students who are visually impaired can learn science in the classroom with patience and accommodation. Students who are blind or visually impaired with no additional disabilities are expected to master the same

academic subject matter like students without visual impairment. Science classes are challenging for students with visual impairment, since instruction in these subjects often involves the use of illustrations, maps, and diagrams and the students often need to use adapted and modified instructional tools to understand the concept that ate involved.

Kumar (2012) conducted a study on "teaching science to students with visual impairment" to find out various problems encountered in teaching/learning science with reference to students with visual impairment. 50 students with visual impairment and six teachers of three special schools situated in Haryana and Delhi were purposively selected in the study. Two questionnaires/ schedules prepared by the investigator were used to collect the data. The findings of the study reveal that although students with visual impairment face few problems in learning science but they consider science as an interesting subject. Teachers also reported that science can be taught to the students with visual impairment.

Maguvhe (2015) reported on factors that limit the participation of blind and partially sighted learners in mathematics and science education. A case study was conducted interrogating a blind technician, who regards himself as an unqualified scientist, in his understanding of various school factors that could entice blind and partially sighted learners to participate in mathematics and science education, and to promote their retention in related professions. The participant thus drew from his own experiences of the school environment and wider concentric social institutions. A semi-structured interview schedule was followed and the responses were recorded by mutual consent. Analysis was conducted based on questions put to the participant. The study revealed that teacher motivation and mentorship in mathematics and science methodologies and the use of tools for learner empowerment are lacking. It further revealed that teachers lack the requisite skills in special education to harness learner potential in mathematics and science. This situation necessitates government action in teacher training and development.

Willings (2019) reported that the student who is blind or visually impaired will typically need some accommodations in order to safely and fully access the science curriculum. It is important to meet with the teacher of students with visual impairments to discuss the curriculum and objectives and content that will be covered during the school year. This is important for students following the standard course of study as well as those following a modified curriculum. The student's unique visual needs should be taken into consideration when determining how to make materials accessible.

Adaptations in Science Content and Experiments for Students with Visual Impairment

Cary (2006) conducted a study on "seeing chemistry through sound". They have developed a submersible audible light sensor for observing chemical reactions for students who are blind or visually impaired. The study revealed that students with visual impairment performed chemistry experiments independently.

Caldwell & Teagarden (2007) mentioned that they have adapted their general biology lab exercises to accommodate several blind students at West Virginia University (WVU). Upon reflection, they found that most standard lab exercises have a strong visual orientation, and some processes (e.g. mitosis) that are mainly explained through diagrams are difficult to understand from a verbal description alone. To address this problem they developed tactile models and developed Braille-labeled "manipulables" that allows blind students to make their own observations with the help of "seeing-eye student" assistants.

Rule (2011) conducted an experiment on "tactile earth and space science materials for students with visual impairment": contours, craters, asteroids and features of mars to 11 elementary and middle school students with sight impairment. Many of the lessons focused on spatial skills, an important skill area for persons with visual impairment. The pretest-intervention-post-test design study measured both attitude changes and gains in content

knowledge. Students reported significant improvements (with large effect sizes) in the frequency of science lessons, the concrete nature of science lessons, the enjoyment these lessons produced, and the amount of participation in the lessons at the summer camp for students with visual disabilities compared to students' regular schools.

Lumadi & Maguvhee (2012) conducted a study on "teaching life sciences to blind and visually impaired learners: issues to consider for effective learning mediation practice". This study aimed to determine the factors that contribute to the improvement of life science pedagogy, as viewed by both teachers (as learning mediators) and learners (as proprietors of knowledge). The conclusions drawn from the study are: Teachers should motivate learners to be committed during life science learning mediation. Teachers should always take into account the age and experience of blind learners, because this obviously influences the nature and quality of the perceived reality of the discipline being taught. The age and experience of blind learners enable them to understand, decode, analyse, interpret, assess and evaluate the various stimuli.

Kamble et al. (2013) conducted a study on "accessible biology laboratory for visually impaired". This study emphasized on accessible biology laboratory which will be capable of accommodating visually impaired students along with normal vision student. The results of the 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.

Overview

The chapter intends to obtain an intensive understanding of the theoretical perspective of the area under consideration. The present project was conducted to find out the effectiveness of adapted experimental aids on learning science experiments among students with visual impairment. The review of literature has been divided in to 3 areas.

Science Education to Students with Disability

Investigator noticed the following positive results in teaching science to students with disability from the studies reviewed in the section:

- Students with physical impairment can perform science experiments; it will not create any major problems.
- Few reviews suggested that students with disability can do laboratory work after making adaptations in the laboratory equipments.
- Students with learning disabilities showed better performance when used special method of teaching science.
- Studies indicated that cooperative group method (students with disability and their peers) has improved communication between disabled and their peers. It also indicated that non-disabled peers were able to help the students with disabilities on learning science curriculum.
- Computer technology has been used in few reviews. It has improved the learning outcome of disabled students.
- Multisensory approach and activity based teaching found to be effective methods for teaching science to students with disability.
- College students with disabilities faced problem in the laboratory setting. Science education, mathematics and engineering courses require laboratory work which may create challenges to students with disabilities.

Need for Teaching Science to Students with Visual Impairment

Studies stated that the problems of students with visual impairment in learning science subject and importance of teaching science subject to students with visual impairment.

- Students with visual impairment lack the skills in taking notes and recording data during laboratory work.
- Students with visual impairment can work with sighted peers in the experiment part of science subject.
- Few reviews indicated that students with visual impairment can perform the laboratory work by using adapted materials.
- Cultivation of scientific mind helps the child in many aspects in their life. Therefore the learning of science should be positively promoted and included in the curriculum of students with visual impairment.
- Few reviews found that most of the science teachers have little or no direct experience in teaching students with visual impairment.
- Some reviews incidated that the teachers have to do some adjustment in the learning environment and in the instructional techniques for successful science education to students with visual impairment. Students with visual impairment need more tactual and audio experience than visual instruction.
- The reviews revealed that students with visual impairment have same range of cognitive ability as other students. They must be exposed to a variety of experience in science that can improve their reasoning thinking and intellectual growth.

Adaptations in Science Content and Experiment for Students with Visual Impairment

- Few studies noted that children with normal vision can perform better when compare with the students with visual impairment in the science education.
- Some reviews pointed out the adaptations required in the science curriculum.

- Involvement of peer groups with visual disability in laboratory work helps not only in the facilitation of the experiments but also in the social interaction among the students with or without disability.
- Few reviews recommended that the adaptation and modification for the students with visual impairment in the science curriculum.
- Some of the reviews done based on the adapted materials which were developed by the researchers. The results showed that the adapted materials have been increased the knowledge about particular concepts.
- Most of the research revealed that the importance of experiments in science, need for making adaptation in experimental aids for students with visual impairment.

Findings from the Literature Review:

1. Most of the studies have been done by the foreign context. Only few reviews were done based on the Indian background.
2. There were many reviews that mentioned only the possibilities of adaptations in science subject, whereas only few reviews stated the experimental research.
3. Few research studies have been done on the topic of adapted experimental aids. The results of these research studies showed a positive impact of adapted aids. But these materials were made with high tech and highly expensive. Those materials cannot be affordable by all students with visual impairment in India.

Chapter III

Methodology

Methodology

Introduction

This chapter describes the methodology used to carry out the project. The main objectives of the chapter are to describe

- research design
- sample selection
- variables
- tool
- research procedure and
- analysis of the study

Research Design

Research design is the plan, structure and strategy of investigation conceived so as to obtain answer to research question and to control variance. The present study aims to find out the effectiveness of adapted experimental aids on learning science subject by the students with visual impairment. This study explains the cause and effect relationship between the variables. Hence the experimental design was used to find out the effect of adapted experimental aids on learning science among students with visual impairment.

Research Procedure

It describes the processes involved in identifying and developing a topic for research investigation.

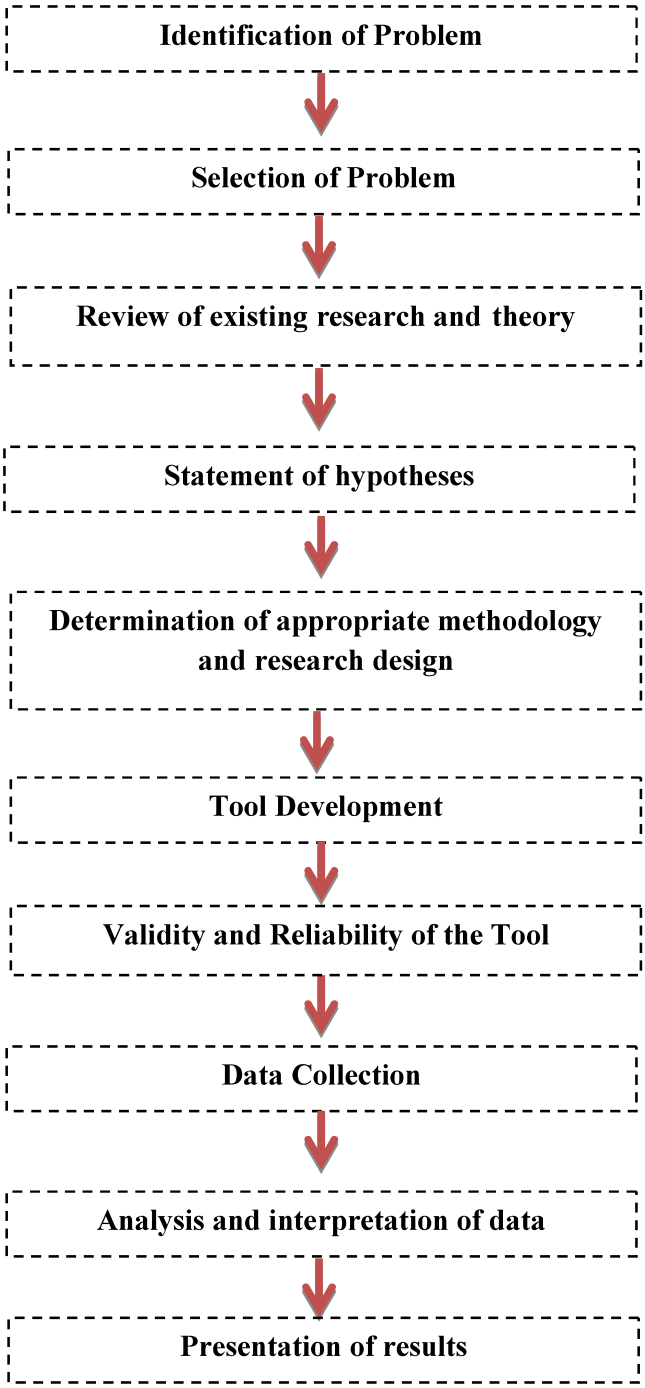

Fig No. 1 – Research procedure

Sampling Procedure

Sample as a group of subjects selected from a larger group and includes a less number than all the subjects in that larger group. The samples for the present study were selected from special, integrated and inclusive school in Coimbatore and Madurai District (Tamilnadu). Since insufficient number of sample was found in Coimbatore district, the investigator selected sample from Madurai district also. Students with visual impairment without any additional disability were selected as sample for the study. Purposive sampling method under non probability sampling techniques was used to select the samples for the present study.

Sample Size

Forty students with visual impairment were selected for the present study and the distribution of the sample is depicted in the table no.1

Table No. 1 – Details of Samples

S.No.	Name of the Schools	Standard		Total Number of Students
		9th Standard	10th Standard	
1	Govt. Hr.Sec. School, Naickenpalayam, Coimbatore	1	-	1
2	CSI Girls Hr. Sec. School, Coimbatore	2	1	3
3	Govt. Hr.Sec. School, Pujanganur, Coimbatore	3	1	4
4	CSI Boys Hr. Sec. School, Coimbatore	2	2	3
5	Sri Ramakrishna Mission Vidyalaya High School, P.N. Palayam, Coimbatore	2	1	4
6	Govt. Girls Hr. Sec. School, Asokapuram, Coimbatore	-	1	1
7	Govt. Boys Hr. Sec. School, Asokapuram, Coimbatore	-	2	2
8	VCV Govt. Hr.Sec. School, Vellakinar, Coimbatore	-	1	1
9	Govt. Hr. Sec. School, Karamadai, Coimbatore	-	1	1
10	St. Joseph Blind School, Paravai, Madurai	10	10	20
Total		**20**	**20**	**40**

Variables used in the Study

1. Standard - 9^{th} and 10^{th} standard
2. Group - Control group and Experimental group

Subjects

Subject Selection Criteria

The samples for the present study were selected from special, integrated and inclusive school in Coimbatore District and Madurai District (Tamil Nadu). Students with visual impairment without any additional disability were selected as sample for the study. The following inclusion and exclusion criteria were followed in sample selection of the study:

Inclusion Criteria

1. Students with visual impairment.
2. Studying in 9^{th} and 10^{th} standard of Tamil Nadu State Board Syllabus.
3. Samples scored below 7 marks in each experiment in pre test were selected for the intervention.

Exclusion Criteria

1. Student with visual impairment associated with any other additional disability.
2. Samples scored above 7 marks in pre test were not selected for intervention.

Tool Development

Selection of the tool is an important ingredient for a successful research study. There are various types of tools available to collect the necessary data for a research study. To make this job more scientific and purposeful, the investigators have to select a suitable tool. For the present study the following tools were developed to collect data from the samples to find out the effectiveness of adapted experimental aids on learning science among students with visual impairment.

Table No 2 – Details of the Research Tools

S. No	Title	Research Tool
1	Developing the adapted experimental aids for learning science concept and developing practical booklet for the same experiments in both printed and Braille format.	Experimental aids were adapted according to the needs of the students with visual impairment to do it independently. Tool No 1 – A three point rating scale was prepared to find out the appropriateness of the developed adapted experimental aids.
2	Effectiveness of adapted experimental aids on learning science.	Tool No 2 – A three point rating scale was prepared to find out the effectiveness of adapted experimental aids on learning science concepts among selected samples.

Nature of the Tools

Tool No 1 – Rating Scale to find the appropriateness of adapted experimental aids

Adapted Experimental Aids: Investigators have developed experimental aids with suitable adaptations of selected experiments for teaching the students with visual impairment.

Practical Booklet: A practical booklet based on the developed adapted experimental aids, which included the name of the experiment, aim, materials required, procedure and result of selected experiments was prepared by the investigators. Apart from print version, Braille and large print versions of the Booklet were also prepared so that to benefit students with total blindness and low vision.

To check the appropriateness of adapted experimental aids and practical booklet, a rating scale was prepared with 15 questions to be rated on the basis of the utility of senses in learning, instructions given, ease in handling the materials and durability of it, with 3 options "Appropriate, Modification required and Not Appropriate". The developed adapted

experimental aids were distributed to the 15 experts including special educators qualified in visual impairment specialization to seek their opinion. Based on the majority of opinion received from them, the investigators finalized the adapted experimental aids.

Tool No 2 - Rating scale to find the effectiveness of adapted experimental aids on learning science

A three point rating scale was developed by the investigators to find out the effectiveness of adapted experimental aids on learning science among students with visual impairment. The three point rating scale contained the options “Correct”, “Satisfactory” and “Wrong” to find out the performance by the selected samples. Five questions related to each experiment and a total of 50 questions were asked to the students with visual impairment at each standard.

Validity of the Tools

Validity: “Validity refers to the degree to which evidence and theory support the interpretation of test scores entailed by proposed used of tests”. Content validity is a non-statistical type of validity that involves "the systematic examination of the test content to determine whether it covers a representative sample of the behavior domain to be measured".

Focus Group Meeting

Focus group meeting was organised with the experts such as special educators and science teachers to select the experiments. Based on the discussion the following experiments were selected for adaptation.

Table No. 3 – Names of the Selected Experiments from 9th Standard

S.No	Name of the Experiment
1	Animal Cell
2	DNA Structure
3	Physical States of Matters
4	Elements & Electronic Configuration
5	Pressure & Depth
6	Archimedes Principle
7	Chemical Equation
8	Purity of Milk
9	Simple Pendulum
10	Human Body Organ – Heart & Kidney

Table No. 4 – Names of the Selected Experiments from 10th Standard

S.No	Name of the Experiment
1	Nervous System – Neurons and its Types
2	Fermentation
3	Iodine Test (Starch Identification)
4	Identification of given models
5	Acid/ Base Test
6	Electric Circuit
7	Test Tube and Funnel
8	Periodic Table
9	Elements and Electronic Configurations
10	Chemical Equation

Tool No 1 – Tool to be administered on the special educators to find out the appropriateness of adapted experimental aids to teach science to students with visual impairment. The developed tool was given to 15 experts including special educators handling students with visual impairment. The responses of the special educators were collected with the options "Appropriate" "Modification required" "Not Appropriate". Content validity was done to establish the validity of the tool.

Modifications incorporated in the adapted materials according to the Experts' suggestions

Electric Circuit: Previously the apparatus was prepared with the wooden board and based on the suggestions of the experts, later on it was changed to weightless metal board in order to facilitate its portability.

Chemical Equation:

All the chemicals that were made with white rubbers were replaced with rubbers of various colours for each chemical for easy identification.

Item Selection

The tool consisted of 15 questions with three options. The tool was given to 15 experts in the field of Special Education including special educators handling students with visual impairment. Content validity ratio obtained for the above mentioned experiments from the panellist was more than 0.42 which indicates that all the adapted experimental material developed for the particular experiment was suitable.

Tool No 2 - Tool to find out the appropriateness of the questions that are related to each experiment. Content validity was done to establish the validity of the tool. For this study the tool was given to 10 experts from the general education field including science teachers to find out the relevance of the questions asked in each experiment with two options "Appropriate" and "Not appropriate".

Reliability of the Tool

Tool No 2 – Three point rating scale to find out the effectiveness of adapted experimental aids.

Reliability: Reliability is the consistency of measurement, or the degree to which an instrument measures the same way each time it is used under the same condition with the same subjects. In short, it is the repeatability of the measurement. A measure is considered reliable if a person's score on the same test given twice is similar. Inter-rater reliability establishes the equivalence of ratings obtained with an instrument when used by different observers.

For the present study Cohen's Kappa Inter-rater reliability was administered to find out the reliability of the tool. Five students with visual impairment were selected and a test was conducted for them for 5 days with the developed adapted aids. Scores from the two raters were obtained at the end of 5th day (Rater 1 – Investigator, Rater 2 – Class Teacher) in 3- point rating scale with the options "Correct Answer – 2 marks" "Satisfactory Answer – 1 mark" and "Wrong Answer – 0 mark". Reliability for each experiment was established based on the marks given by the two raters.

Table No 5 - Difference between the Traditional Experimental Aids and Adapted Experimental Aids - 9th Standard

Traditional Experimental Aids	Adapted Experimental Aids
Experiment No 1 – Animal Cell • The normal picture or model of animal cell .	• Animal cell model was made with tactile form with Braille information. • Tactile mode of adaptation was adopted for this experiment
Experiment No 2 – DNA Structure • The normal picture or model of DNA	• DNA structure model was made with tactile form with Braille information. • Kinaesthetic mode of adaptation was adopted for this experiment

Experiment No 3 – Physical Status of Matters • The molecules structure of each matters were made with tactile diagrams. • No separate material was used to teach this experiment.	• The molecules structure of each matters (solid, liquid and gas) were made with beads. • Each matter was filled in the bottles. • Here, kinaesthetic mode of adaptation was adopted.
Experiment No 4 – Elements and Electronic Configuration • Elements and Electronic Configuration were shown in picture.	• Elements and Electronic Configuration were modified with wooden board with beads • Thus kinaesthetic mode of adaptation was adopted in this experiment
Experiment No 5 – Pressure and Depth • The holes are presented in the bottle in the same direction. • No additional material was used to identify the force of water.	• The holes are presented in the bottle in three directions. • To identify the speed of the water separate material was made with three layers with segments. • Kinaesthetic mode of adaptation was adopted for this experiment
Experiment No 6 – Archimedes Law • Normal water was used. • Apparatus were made with glass.	• Normal water was replaced with ice water. • Plastic was used in the place of Glass wares. • All the apparatus used in this experiment were adapted with tactile format. • Digital weigh machine was used. • Kinaesthetic & Auditory modes of adaptations were adopted.

Experiment No 7 – Chemical Equation and Structure • The names and formulas of chemicals were used in print material.	• The names and formulas of Chemicals were modified into Braille format. • Chart was prepared with Braille letters and the names of the chemicals were pasted in the cubes. Kinaesthetic mode of adaptation was made for this experiment.
Experiment No 8– Purity of Milk • Milk and glassware were used.	• Tactile syringe was used. • Ice milk was used. • Kinaesthetic mode of adaptation was made for this experiment.
Experiment No 9 – Simple Pendulum • The common simple pendulum was used.	• The simple pendulum with vibration tool was used. • Talking watch also used for experiment. • Kinesthetic, Tactile and Auditory modes of adaptations were used for this experiment.
Experiment No 10 – Human Body Organ – Heart & Kidney • The pictures or models of heart & kidney were used.	• Heart and kidney models were made with tactile form with Braille information. • Tactile mode of adaptation was adopted for this experiment

Table No. 6 - Difference between the Traditional Experimental Aids and Adapted Experimental Aids - 10th Standard

Traditional Experimental Aids	Adapted Experimental Aids
Experiment No 1 – Neurons and its Types • The pictures or models of neurons.	• Different types of neurons were made with tactile form with Braille information. • Tactile mode of adaptation was adopted for this experiment

Experiment No 2 – Fermentation • Pictures and glass aids were used	• The diagram of this experiment was made into tactile form. • Syringe and tactile measuring cup was used to take appropriate quantity of the solutions. • Colour identifier app was used to identify the colour change through auditory output.
Experiment No 3 – Iodine Test (Starch Identification) • Glass aids were used	• Tactile syringe was used. • Liquids with different smell were used. • Colour identifier app which gives auditory output was used to identify the colour change. • Kinaesthetic mode of adaptation was made for this experiment.
Experiment No 4- Identification of Given Models • Pictures or models were used.	• Heart and kidney models were made with tactile form with Braille information. • Tactile mode of adaptation was adopted for this experiment
Experiment No 5 – Acid/ Base Test • Pictures and glass aids were used	• Auditory Mode - Colour identifier app was to identify the colour change. • Olfactory Mode – Food samples such as lime water and vinegar
Experiment No 6 – Electric Circuit • Three glowing bulbs were used for showing circuit.	• The light glowing from three bulbs was replaced with three different sound signals. • Thus auditory mode of adaptation was adopted in this experiment.

Experiment No 7 - Test Tube and Funnel • Pictures and glass aids were used	• Tactile mode plastic materials were used.
Experiment No 8 - Periodic Table • Picture of periodic table	• Tactile model of periodic table was used.
Experiment No 9 – Elements and Electronic Configuration • Elements and Electronic Configuration were shown in picture.	• Elements and Electronic Configuration were modified with wooden board with beads • Thus kinaesthetic mode of adaptation was adopted in this experiment
Experiment No 10 – Chemical Equation and Structure • Chemicals name and formulas were used in print material.	• The names and formulas of chemicals were modified into Braille format. • Chart was prepared with Braille letters and the names of chemicals were pasted in the cubes. Kinaesthetic mode of adaptation was made for this experiment.

Data Collection Procedure/ Intervention Process

In collecting data for research, the investigators either makes direct observation which he / she carefully records or collects information from a variety of reliable sources, library and other written materials, individuals or institutions. For this present study, the data was collected in the following three phases.

Phase I: The investigators selected samples from the schools with prior permission sought from the Heads of the school. After orientation, pre test was conducted to the selected students with visual impairment studying in 9^{th} and 10^{th} standard.

Phase II: In phase two, samples were divided into two groups namely experimental group and control group. Intervention was provided by using the adapted experimental aids to the experimental group. Traditional method was provided to the control group and each experiment was administered for 2 sessions (1 session is for 30 minutes).

Phase III: In phase three, post test was conducted after the implementation of the intervention with the same tool used in pre-test to find out the level of performance of the sample.

Scheme of Analysis

Analysis means categorizing, ordering, manipulating and summarizing the collected data to obtain the answer to research questions. The purpose of analysis is to reduce data to intelligible and interpretable form so that the relations of research problems can be studied and tested.

For this present study the investigators used paired t-test statistical techniques for analysing the data collected from the samples.

Hypotheses

Based on the adapted experimental aids, the following hypotheses were framed:

1. There will be no significant difference between pre and post test scores of control group.
2. There will be no significant difference between pre and post test scores of experimental group.
3. There will be no significant difference between control and experimental group in post test scores based on the experiments.
4. There will be no significant difference between the pre and post test scores based on the standards.

Chapter IV

Analysis and Interpretation

Analysis and Interpretation

This chapter deals with the analysis and interpretation of the data collected from the samples of the study. The data has been analysed based on the variables set for the study. The major sections of the data analysis are discussed below:

- Pre and Post Test Scores of Control Group
- Pre and Post Test Scores of Experimental Group
- Pre and Post Test Scores between Control and Experimental Group

Analysis Based on Pre and Post Test Scores of Control Group

Table No 7- Mean, S.D and t value of Pre and Post Scores of Control Group

	Mean	S.D	t-value	Sig
Pre Test	5.45	7.35	13.757	**
Post Test	54.15	14.71		

** Significant at 5% level significance

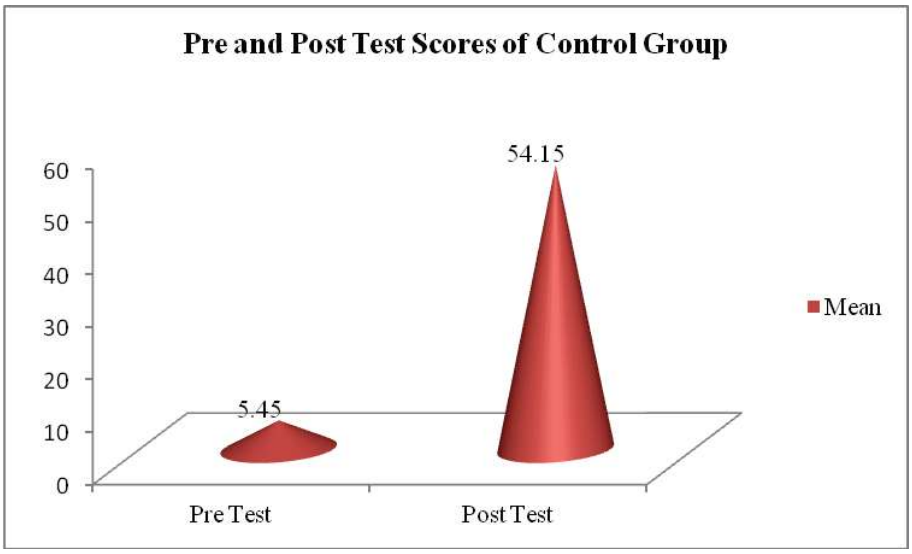

Fig No. 20 – Pre and post test scores of control group

Interpretation

The t- test was used to find out the significant difference between pre and post test scores of control group. The calculated t-test value 13.757 is greater than the table value of 2.093 at 5% level of significance. Since the calculated value is more than the table value, it is inferred that there is a significant difference in the pre and post test score. Hence, it is inferred that the conventional teaching method had significant effect on learning science experiments among students with visual impairment. Hence the hypothesis is rejected.

Analysis Based on Pre and Post Test Scores of Experimental Group

Table No 8- Mean, S.D and t value of Pre and Post Scores of Experimental Group

	Mean	S.D	t-value	Sig
Pre Test	4.50	3.69	62.23	**
Post Test	85.95	4.16		

** Significant at 5% level significance

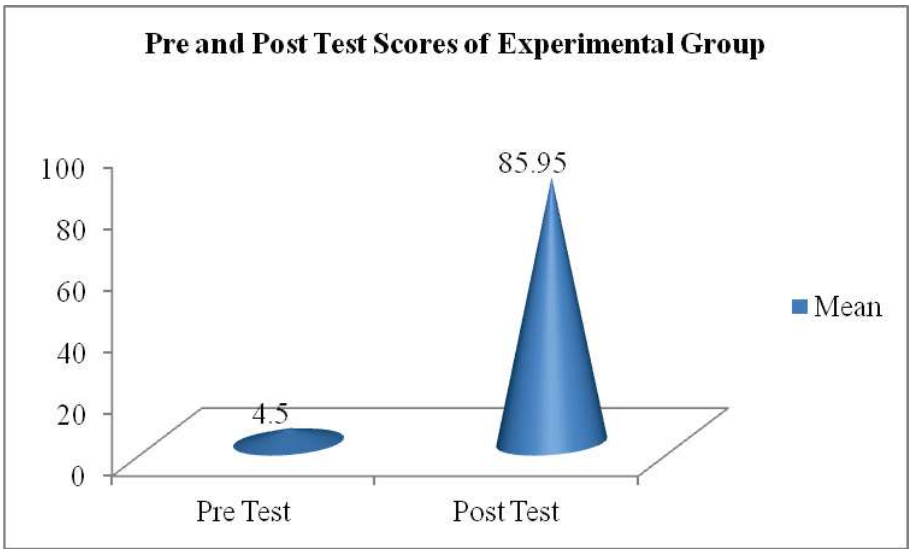

Fig No. 21 – Pre and post test scores of experimental group

Interpretation

The t- test was used to find the significant difference between the pre and post test scores of experimental group. The calculated t-test value 62.23 is greater than the table value of 2.093 at 5% level of significance. Since the calculated value is more than the table value, it is inferred that there is a significant difference in the pre and post test scores among the experimental group. Hence, it is inferred that the adapted experimental aids had significant effect on learning science experiments among the students with visual impairment. Hence the hypothesis is rejected.

Analysis Based on Post Test Scores between Control and Experimental Groups

Table No 9- Mean, S.D and t value of Pre and Post Scores of Control and Experimental Groups

	Group	Mean	S.D	t-value	Sig
Pre Test	Control Group	5.45	7.35	0.051	NS
	Experimental Group	4.50	3.69		
Post Test	Control Group	54.15	14.71	9.29	**
	Experimental Group	85.95	4.16		

Not Significant at 5% level significance, ** Significant at 5% level significance

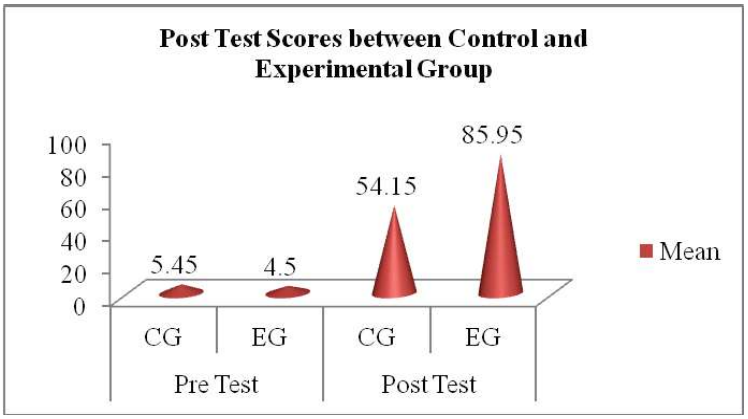

Fig No. 22 – Post test scores between control and experimental groups

Interpretation

The t- test was used to find the significant difference between the pre test scores among control and experimental groups. The calculated t-test value 0.051 is less than the table value of 2.021 at 5% level of significance. Since the calculated value is less than the table value, it is inferred that there is no significant difference in the pre test scores among the group. But in the post test, the calculated t-test value 9.29 is more than the table value of 2.021 at 5% level of significance. Since the calculated value is more than the table value, it is inferred that there is a significant difference in the post test scores among the experimental and control groups. It can be inferred that the adapted experimental aids are highly effective than the conventional aids on learning science experimental concepts among students with visual impairment. Hence the hypothesis is rejected.

Analysis Based on Post Test Scores based on the Standards

Table No 10- Mean, and t value of Post Scores of Control and Experimental Groups based on standard

	Mean	t-value	Sig
10th Standard	8.51	0.97	NS
9th Standard	8.68		

Not Significant at 5% level significance

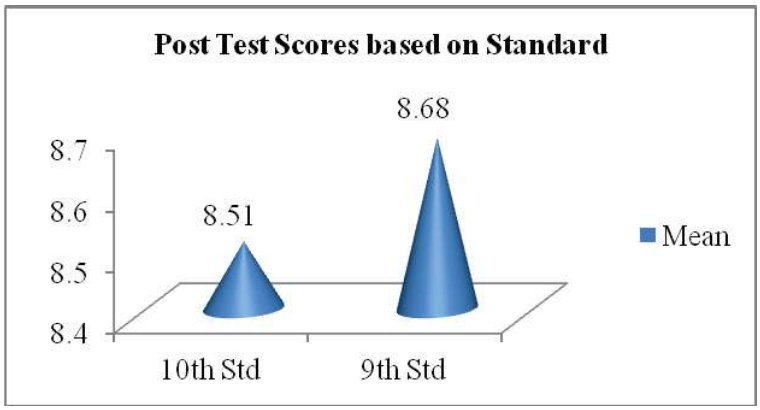

Fig No. 23 – Post test scores based on the standards

Interpretation

The t- test was used to find the significant difference between the post test scores based on the standards. The calculated t-test value 0.97 is less than the table value of 2.093 at 5% level of significance. Since the calculated value is less than the table value, it is inferred that there is no significant difference in learning science experimental concepts based on the standards.

Analysis Based on Experiments - Standard – 9th Standard

Name of the Experiment: Animal Cell

Table No 11- Mean, and t value of Post Scores of Control and Experimental Groups on the Experiment of Animal Cell

	Mean	t-value	Sig
Experimental Group	9	4.11	**
Control Group	6.7		

** Significant at 5% level significance

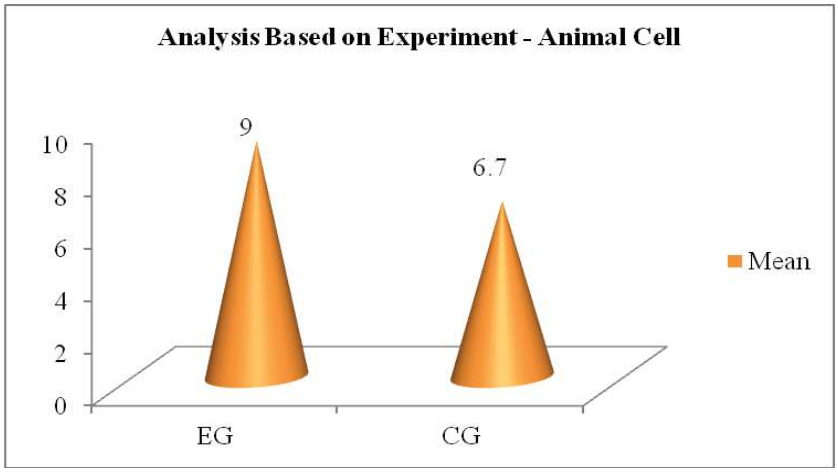

Fig No. 24 – Post test scores between control and experimental groups – animal cell

Interpretation:

The t- test was used to find the significant difference between control and experimental group in performing animal cell experiment. The calculated t-test value 4.11 is more than the table value of 2.228 at 5% level of significance. Since the calculated value is greater than the table value, it is inferred that there is a significant difference in performing animal cell experiment between the control and experimental groups. It is also inferred that the experimental group performance is better than the control group. It shows that the effectiveness of adapted experimental aids in learning science concepts.

Name of the Experiment: DNA Structure

Table No 12- Mean, and t value of Post Scores of Control and Experimental Groups on the Experiment of DNA Structure

	Mean	t-value	Sig
Experimental Group	8	3.35	**
Control Group	6.1		

** Significant at 5% level significance

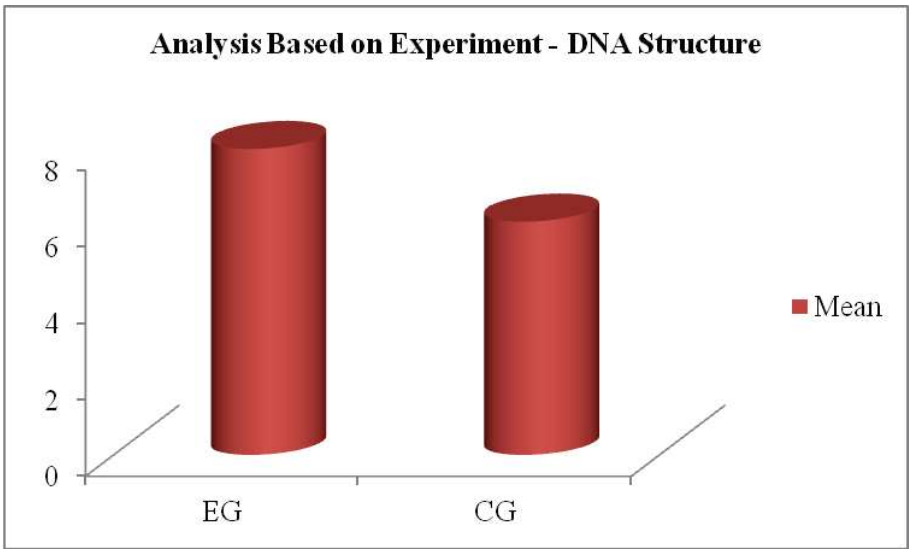

Fig No. 25 – Post test scores between control and experimental groups – DNA structure

Interpretation

The t- test was used to find the significant difference between control and experimental group in performing DNA Experiment. The calculated t-test value 3.35 is more than the table value of 2.228 at 5% level of significance. Since the calculated value is greater than the table value it is inferred that there is a significant difference in performing DNA structure experiment between the control and experimental group. It is also inferred that the experimental group performance is better than the control group. It shows that the effectiveness of adapted experimental aids in learning science concepts.

Name of the Experiment: Physical Status of Matters

Table No 13- Mean, and t value of Post Scores of Control and Experimental Groups on the Experiment of Physical Status of Matters

	Mean	t-value	Sig
Experimental Group	9.7	2.02	NS
Control Group	8.1		

Not Significant at 5% level significance

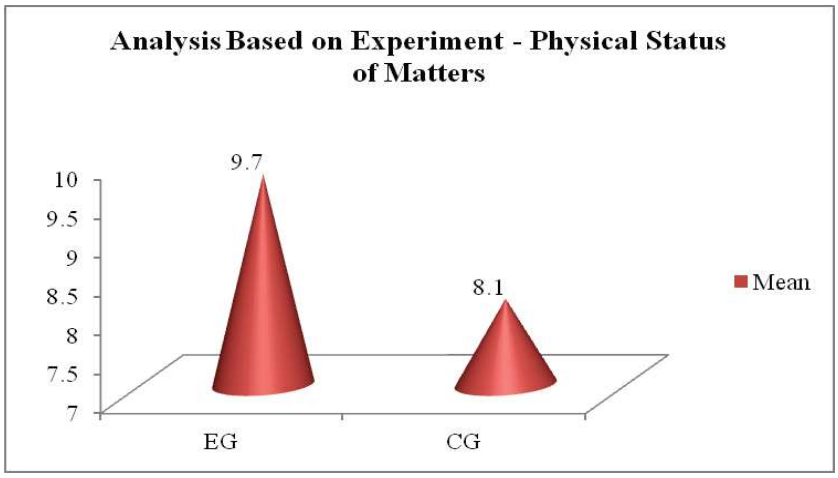

Fig No. 26 – Post test scores between control and experimental groups – Physical status of matter

Interpretation

The t- test was used to find the significant difference between control and experimental group in performing physical status of matters. The calculated t-test value 2.02 is less than the table value of 2.228 at 5% level of significance. Since the calculated value is less than the table value, it is inferred that there is no significant difference in performing physical status of matters between the control and experimental group. It is also inferred that both and conventional method and using of adapted experimental aids shows effective in learning science concepts.

Name of the Experiment: Elements and Electronic Configuration

Table No 14- Mean, and t value of Post Scores of Control and Experimental Groups on the Experiment of Elements of Electronic Configuration

	Mean	t-value	Sig
Experimental Group	8.9	5.12	**
Control Group	5.8		

** Significant at 5% level significance

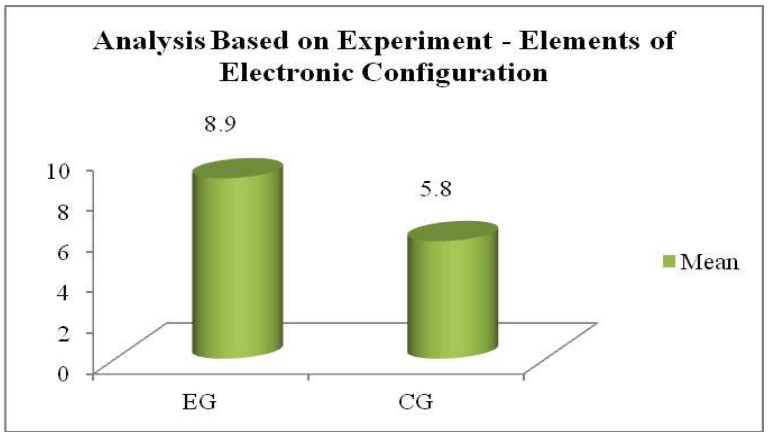

Fig No. 27 – Post test scores between control and experimental groups – Elements and electronic configuration

Interpretation

The t- test was used to find the significant difference between control and experimental group in performing elements and electronic configuration experiment. The calculated t-test value 5.12 is more than the table value of 2.228 at 5% level of significance. Since the calculated value is greater than the table value it is inferred that there is a significant difference in performing elements of electronic configuration experiment between the control and experimental groups. It is also inferred that the experimental group performance is better than the control group. It shows that the effectiveness of adapted experimental aids in learning science concepts.

Name of the Experiment: Pressure and Depth Perception

Table No 15- Mean, and t value of Post Scores of Control and Experimental Groups on the Experiment of Pressure & Depth

	Mean	t-value	Sig
Experimental Group	8.9	5.12	**
Control Group	5.8		

** Significant at 5% level significance

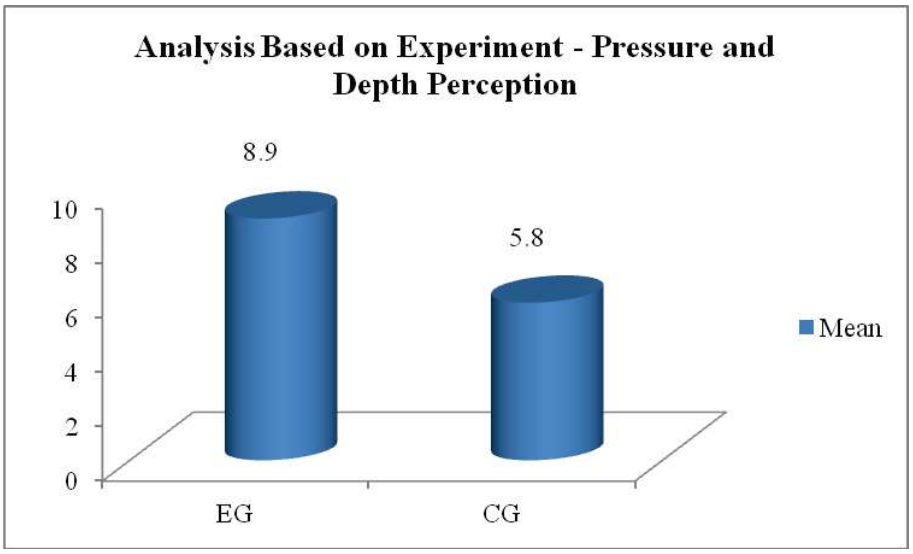

Fig No. 28 – Post test scores between control and experimental groups – Pressure and depth perception

Interpretation

The t- test was used to find the significant difference between control and experimental group in performing pressure and depth perception experiment. The calculated t-test value 5.12 is more than the table value of 2.228 at 5% level of significance. Since the calculated value is greater than the table value, it is inferred that there is a significant difference in performing pressure and depth perception experiment between the control and experimental group. It is also inferred that the experimental group performance is better than the control group. It shows that the effectiveness of adapted experimental aids in learning science concepts.

Name of the Experiment: Archimedes Principle

Table No 16- Mean, and t value of Post Scores of Control and Experimental Groups on the Experiment of Archimedes Principle

	Mean	t-value	Sig
Experimental Group	8.2	2.74	**
Control Group	5.7		

** Significant at 5% level significance

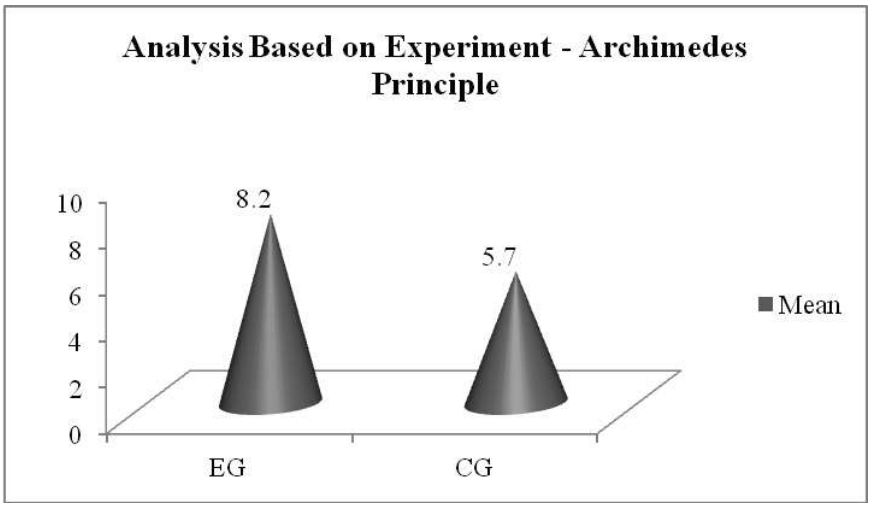

Fig No. 29 – Post test scores between control and experimental groups – Archimedes principle

Interpretation

The t- test was used to find the significant difference between control and experimental group in performing Archimedes principle experiment. The calculated t-test value 2.74 is more than the table value of 2.228 at 5% level of significance. Since the calculated value is greater than the table value, it is inferred that there is a significant difference in performing Archimedes principle experiment between the control and experimental groups. It is also inferred that the performance of experimental group is better than the control group. It shows that the effectiveness of adapted experimental aids in learning science concepts.

Name of the Experiment: Chemical Equation

Table No 17 Mean, and t value of Post Scores of Control and Experimental Groups on the Experiment of Chemical Equation

	Mean	t-value	Sig
Experimental Group	8.2	2.74	**
Control Group	5.7		

** Significant at 5% level significance

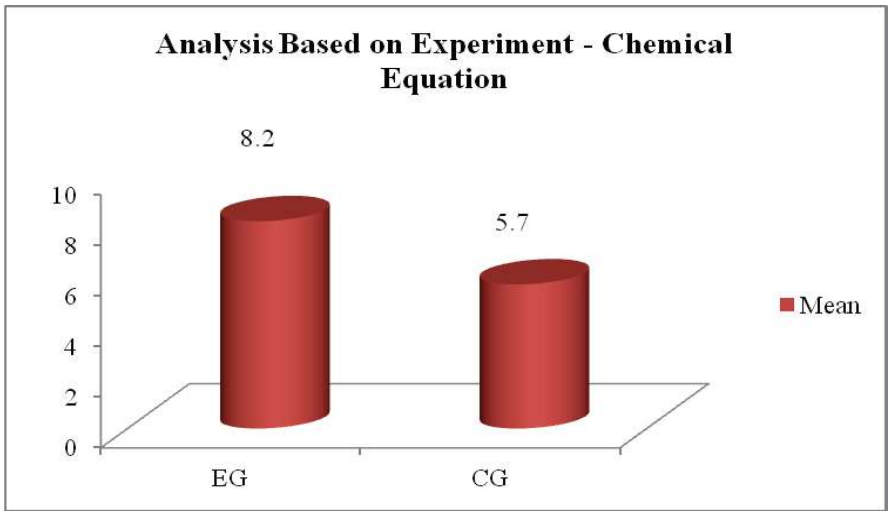

Fig No. 30 – Post test scores between control and experimental groups – Chemical equation

Interpretation

The t- test was used to find the significant difference between control and experimental group in performing chemical equation experiment. The calculated t-test value is 2.74 which is more than the table value of 2.228 at 5% level of significance. Since the calculated value is greater than the table value it is inferred that there is a significant difference in performing chemical equation experiment between the control and experimental group. It is also inferred that the experimental group performance is better than the control group. It shows that the effectiveness of adapted experimental aids in learning science concepts.

Name of the Experiment: Purity of Milk

Table No 18- Mean, and t value of Post Scores of Control and Experimental Groups on the Experiment of Purity of Milk

	Mean	t-value	Sig
Experimental Group	7.9	6.26	**
Control Group	4		

** Significant at 5% level significance

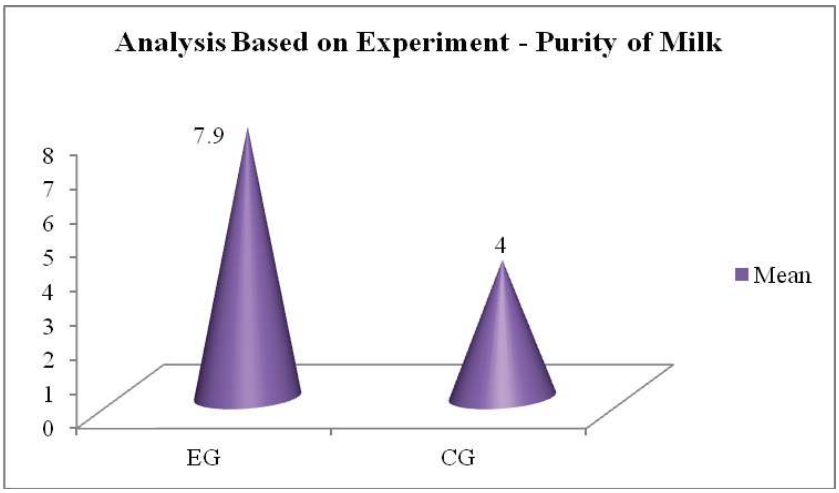

Fig No.31 – Post test scores between control and experimental groups – Purity of milk

Interpretation

The t- test was used to find the significant difference between control and experimental group in performing purity of milk experiment. The calculated t-test value 6.26 is more than the table value of 2.228 at 5% level of significance. Since the calculated value is greater than the table value it is inferred that there is a significant difference in performing purity of milk experiment between the control and experimental group. It is also inferred that the experimental group performance is better than the control group. It shows that the effectiveness of adapted experimental aids in learning science concepts.

Name of the Experiment: Simple Pendulum

Table No 19- Mean, and t value of Post Scores of Control and Experimental Groups on the Experiment of Simple Pendulum

	Mean	t-value	Sig
Experimental Group	7.9	6.26	**
Control Group	4		

** Significant at 5% level significance

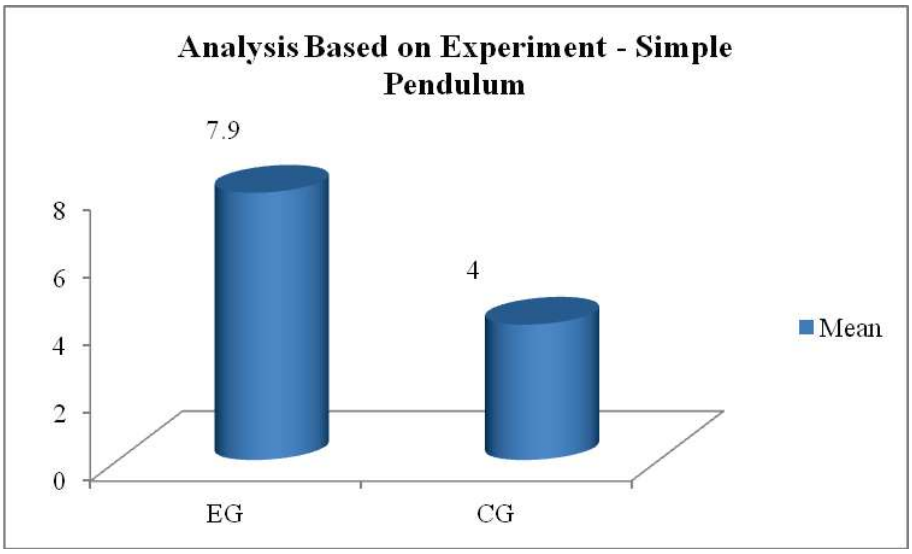

Fig No. 32 – Post test scores between control and experimental groups – Simple pendulum

Interpretation

The t- test was used to find the significant difference between control and experimental group in performing simple pendulum experiment. The calculated t-test value 6.26 is more than the table value of 2.228 at 5% level of significance. Since the calculated value is greater than the table value, it is inferred that there is a significant difference in performing simple pendulum experiment between the control and experimental group. It is also inferred that the experimental group performance is better than the control group. It shows that the effectiveness of adapted experimental aids in learning science concepts.

Name of the Experiment: Human Body Organs

Table No 20- Mean, and t value of Post Scores of Control and Experimental Groups on the Experiment of Human Body Organs

	Mean	t-value	Sig
Experimental Group	9	2.52	**
Control Group	7.1		

** Significant at 5% level significance

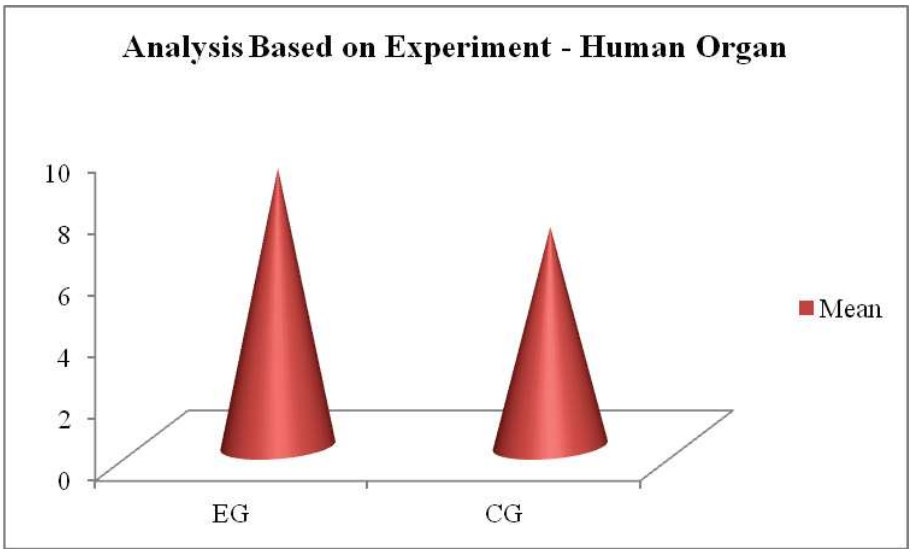

Fig No. 33 – Post test scores between control and experimental groups – Human body organs

Interpretation

The t- test was used to find the significant difference between control and experimental group in performing human body organs. The calculated t-test value 2.52 is more than the table value of 2.228 at 5% level of significance. Since the calculated value is greater than the table value, it is inferred that there is a significant difference in performing human body organs experiment between the control and experimental group. It is also inferred that the performance of experimental group is better than the control group. It shows that the effectiveness of adapted experimental aids in learning science concepts.

Standard - 10th Standard

Name of the Experiment: Nervous System – Neurons

Table No 22- Mean, and t value of Post Scores of Control and Experimental Groups on the Experiment of on Neurons

	Mean	t-value	Sig
Experimental Group	8.6	6.40	**
Control Group	5		

** Significant at 5% level significance

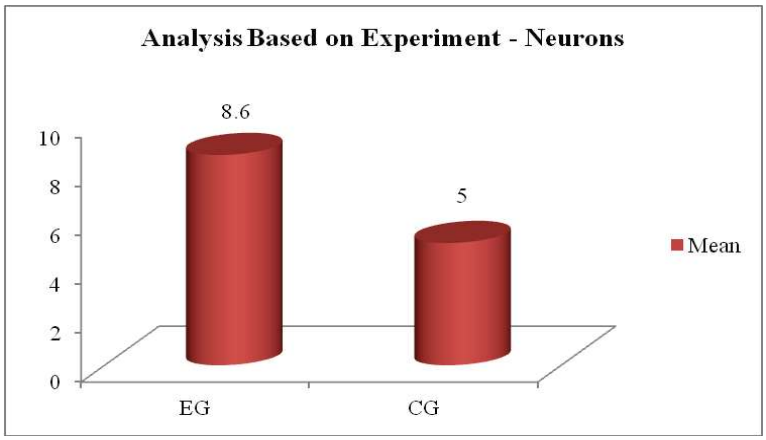

Fig No. 35 – Post test scores between control and experimental groups – Neurons

Interpretation

The t- test was used to find the significant difference between control and experimental group in performing nervous system – neurons and its types experiment. The calculated t-test value 6.40 is more than the table value of 2.228 at 5% level of significance. Since the calculated value is greater than the table value it is inferred that there is a significant difference in performing the experiment 'nervous system – neurons and its types' between the control and experimental groups. It is also inferred that the performance of experimental group is better than the control group. It shows that the effectiveness of adapted experimental aids in learning science concepts.

Name of the Experiment: Fermentation

Table No 21- Mean, and t value of Post Scores of Control and Experimental Groups on the Experiment of Fermentation

	Mean	t-value	Sig
Experimental Group	8.1	8.83	**
Control Group	5.8		

** Significant at 5% level significance

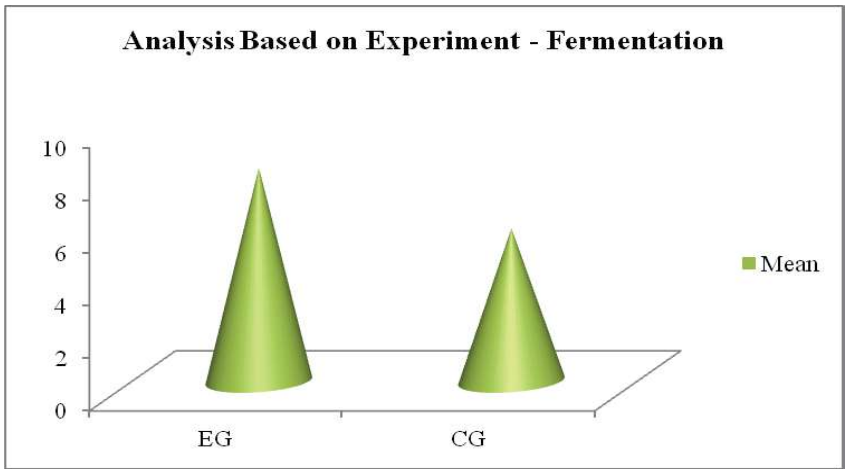

Fig No. 34 – Post test scores between control and experimental groups – Fermentation

Interpretation

The t- test was used to find the significant difference between control and experimental group in performing fermentation experiment. The calculated t-test value 8.83 is more than the table value of 2.228 at 5% level of significance. Since the calculated value is greater than the table value, it is inferred that there is a significant difference in performing fermentation experiment between the control and experimental group. It is also inferred that the performance of experimental group is better than the control group. It shows that the effectiveness of adapted experimental aids in learning science concepts.

Name of the Experiment: Iodine Test

Table No 30- Mean, and t value of Post Scores of Control and Experimental Groups on the Experiment of Iodine Test

	Mean	t-value	Sig
Experimental Group	8.2	15.92	**
Control Group	3		

** Significant at 5% level significance

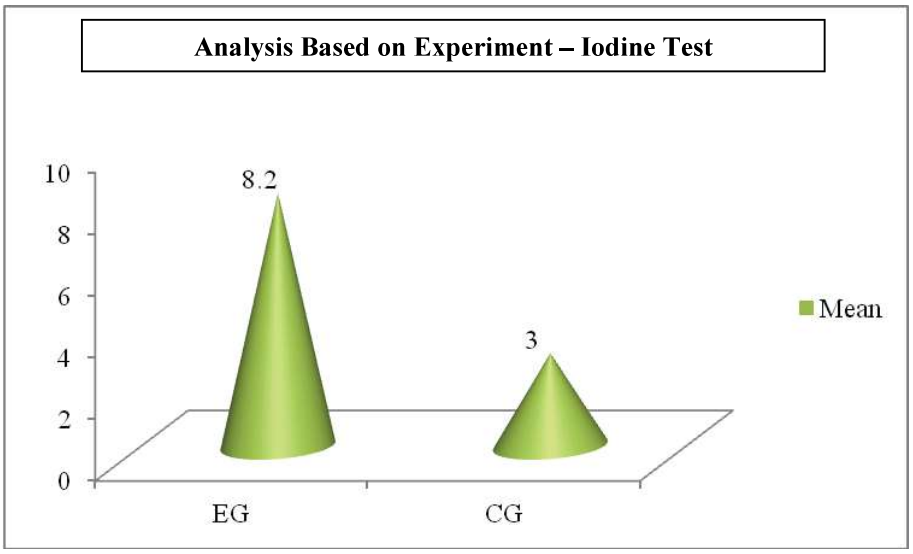

Fig No. 43 – Post test scores between control and experimental groups – Iodine Test

Interpretation

The t- test was used to find the significant difference between control and experimental group in performing iodine test. The calculated t-test value 15.92 is more than the table value of 2.228 at 5% level of significance. Since the calculated value is greater than the table value it is inferred that there is a significant difference in performing iodine test between the control and experimental groups. It is also inferred that the performance of experimental group is better than the control group. It shows that the effectiveness of adapted experimental aids in learning science concepts.

Name of the Experiment: Identification of Given Models

Table No 24- Mean, and t value of Post Scores of Control and Experimental Groups on the Experiment of Identification of Given Models

	Mean	t-value	Sig
Experimental Group	9.4	5.08	**
Control Group	6.2		

** Significant at 5% level significance

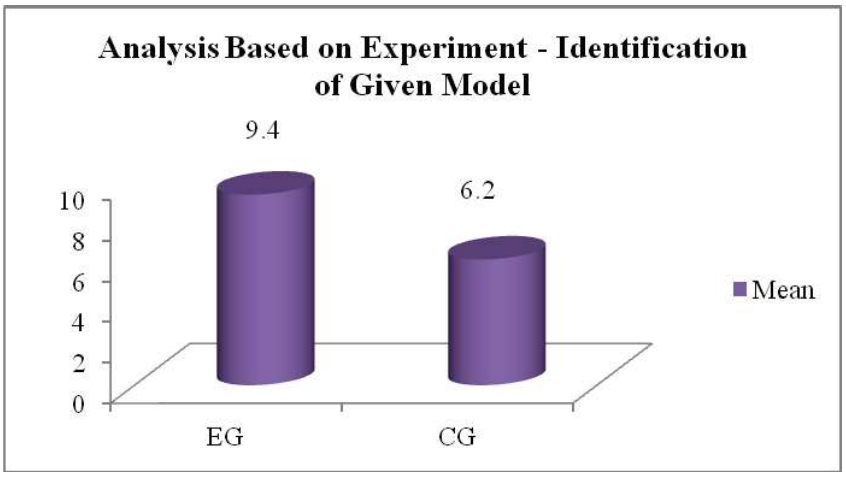

Fig No. 37 – Post test scores between control and experimental groups – Identification of given Models

Interpretation

The t- test was used to find the significant difference between control and experimental group in performing identification of given model experiment. The calculated t-test value 5.08 is more than the table value of 2.228 at 5% level of significance. Since the calculated value is greater than the table value, it is inferred that there is a significant difference in performing the experiment 'identification of given model' between the control and experimental groups. It is also inferred that the experimental group performance is better than the control group. It shows that the effectiveness of adapted experimental aids in learning science concepts.

Name of the Experiment: Acid / Base

Table No 25- Mean, and t value of Post Scores of Control and Experimental Groups on the Experiment of Acid/ Base Test

	Mean	t-value	Sig
Experimental Group	9.1	5.37	**
Control Group	4.7		

** Significant at 5% level significance

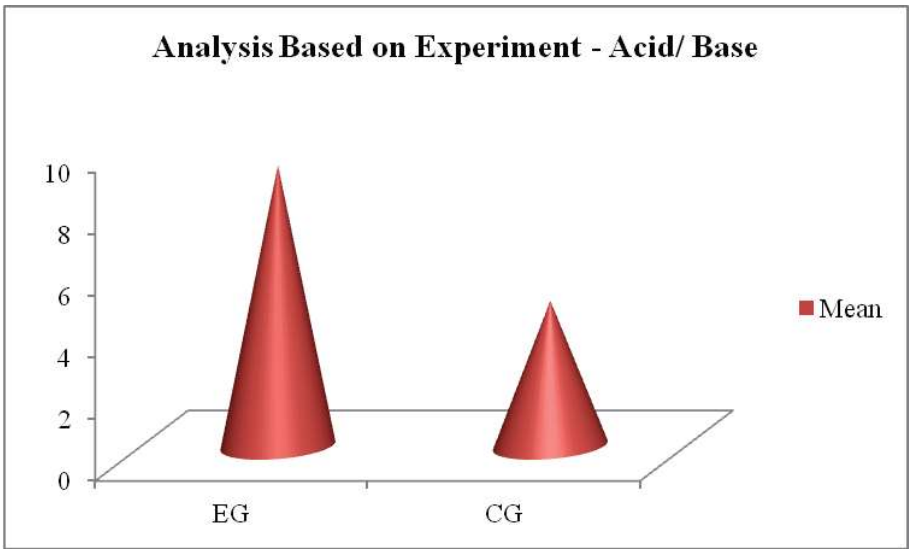

Fig No. 38 – Post test scores between control and experimental groups – Acid/ Base

Interpretation

The t- test was used to find the significant difference between control and experimental group in performing acid/ base experiment. The calculated t-test value 5.37 is more than the table value of 2.228 at 5% level of significance. Since the calculated value is greater than the table value it is inferred that there is a significant difference in the performance of the experiment 'acid/ base' between the control and experimental groups. It is also inferred that the experimental group performance is better than the control group. It shows that the effectiveness of adapted experimental aids in learning science concepts.

Name of the Experiment: Electric Circuit

Table No 28- Mean, and t value of Post Scores of Control and Experimental Groups on the Experiment of Electric Circuit

	Mean	t-value	Sig
Experimental Group	7.7	5.90	**
Control Group	4.4		

** Significant at 5% level significance

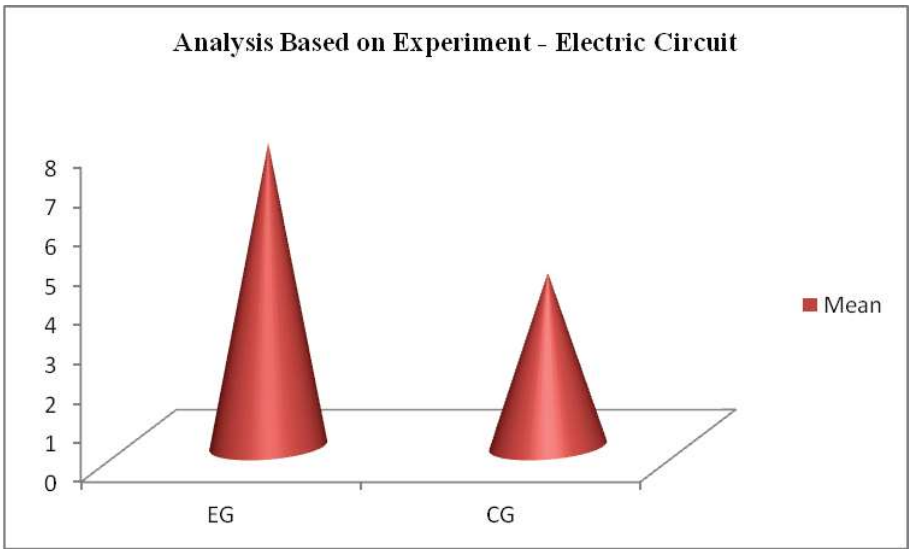

Fig No. 41 – Post test scores between control and experimental groups – Electric circuit

Interpretation

The t- test was used to find the significant difference between control and experimental group in performing electric circuit experiment. The calculated t-test value 5.90 is more than the table value of 2.228 at 5% level of significance. Since the calculated value is greater than the table value it is inferred that there is a significant difference in performing electric circuit experiment between the control and experimental groups. It is also inferred that the experimental group performance is better than the control group. It shows that the effectiveness of adapted experimental aids in learning science concepts.

Name of the Experiment: Test Tube and Funnel

Table No 29- Mean, and t value of Post Scores of Control and Experimental Groups on the Experiment of Test Tube and Funnel

	Mean	t-value	Sig
Experimental Group	7.8	3.48	**
Control Group	5.1		

** Significant at 5% level significance

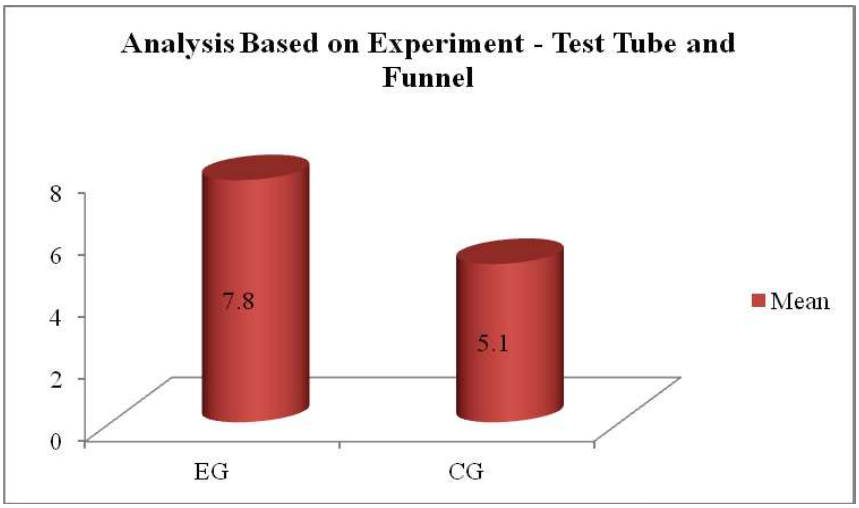

Fig No. 42 – Post test scores between control and experimental groups – Test tube and funnel

Interpretation

The t- test was used to find the significant difference between control and experimental group in performing test tube and funnel experiment. The calculated t-test value 3.48 is more than the table value of 2.228 at 5% level of significance. Since the calculated value is greater than the table value, it is inferred that there is a significant difference in performing test tube and funnel experiment between the control and experimental group. It is also inferred that the performance of experimental group is better than the control group. It shows that the effectiveness of adapted experimental aids in learning science concepts.

Name of the Experiment: Periodic Table

Table No 26- Mean, and t value of Post Scores of Control and Experimental Groups on the Experiment of Periodic Table

	Mean	t-value	Sig
Experimental Group	8.9	7.91	**
Control Group	4.3		

** Significant at 5% level significance

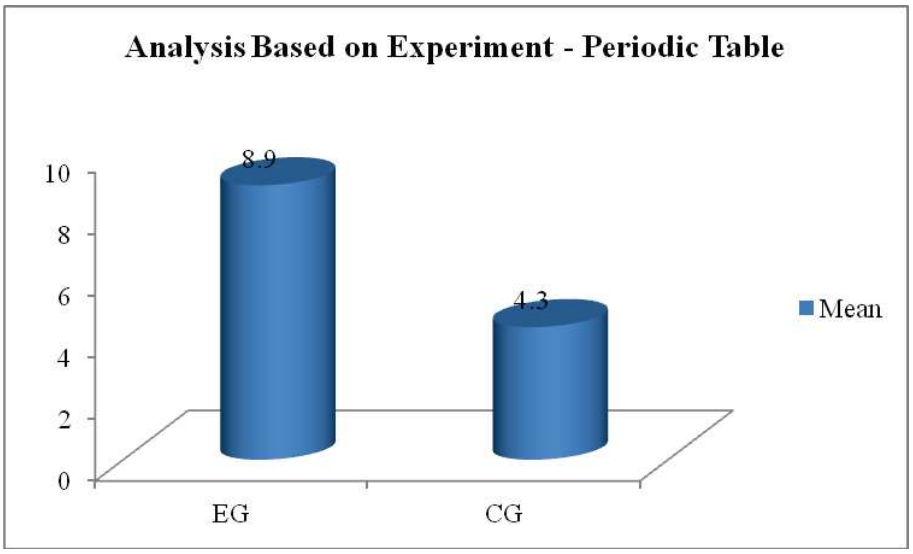

Fig No. 39 – Post test scores between control and experimental groups–Periodic table

Interpretation

The t- test was used to find the significant difference between control and experimental group in performing periodic table experiment. The calculated t-test value 7.91 is more than the table value of 2.228 at 5% level of significance. Since the calculated value is greater than the table value, it is inferred that there is a significant difference in performing periodic table experiment between the control and experimental groups. It is also inferred that the experimental group performance is better than the control group. It shows that the effectiveness of adapted experimental aids in learning science concepts.

Name of the Experiment: Elements and Electronic Configuration

Table No 23- Mean, and t value of Post Scores of Control and Experimental Groups on the Experiment of Elements and Electronic Configuration

	Mean	t-value	Sig
Experimental Group	8.6	4.71	**
Control Group	5.3		

** Significant at 5% level significance

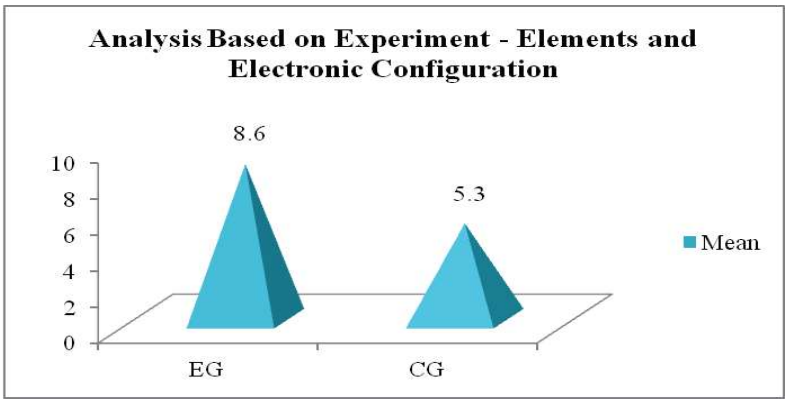

Fig No. 36 – Post test scores between control and experimental groups – Elements and electronic configuration

Interpretation

The t- test was used to find the significant difference between control and experimental group in performing elements and electronic configuration experiment. The calculated t-test value 4.71 is more than the table value of 2.228 at 5% level of significance. Since the calculated value is greater than the table value, it is inferred that there is a significant difference in performing elements and electronic configuration experiment between the control and experimental group. It is also inferred that the performance of experimental group is better than the control group. It shows that the effectiveness of adapted experimental aids in learning science concepts.

Name of the Experiment: Chemical Equation

Table No 27- Mean, and t value of Post Scores of Control and Experimental Groups on the Experiment of Chemical Equation

	Mean	t-value	Sig
Experimental Group	8.7	9.48	**
Control Group	4		

** Significant at 5% level significance

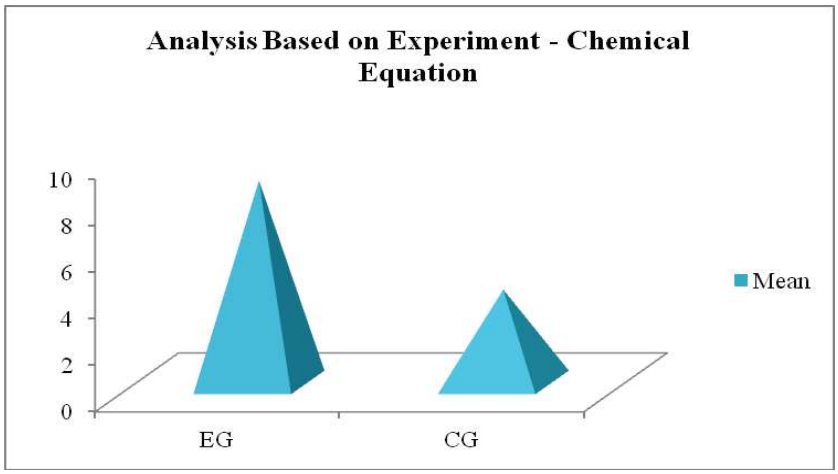

Fig No. 40 – Post test scores between control and experimental groups – Chemical equation

Interpretation

The t- test was used to find the significant difference between control and experimental groups in performing chemical equation experiment. The calculated t-test value 9.48 is more than the table value of 2.228 at 5% level of significance. Since the calculated value is greater than the table value it is inferred that there is a significant difference in performing chemical equation experiment between the control and experimental groups. It is also inferred that the experimental group performance is better than the control group. It shows that the effectiveness of adapted experimental aids in learning science concepts.

Chapter V

SUMMARY OF FINDINGS

SUMMARY OF FINDINGS

Introduction

The present study has been designed to find out the effect of adapted experimental aids on learning science experimental concepts among students with visual impairment studying in 9^{th} and 10^{th} Standards. The data has been analysed based on the variables used for the study and to test the hypotheses to make recommendations based on the findings. The findings and the discussion of the study are discussed in this chapter.

Findings based on Hypotheses

Hypothesis # 1 - There will be no significant difference between Pre and Post Test Scores of Control Group

The results of analysis showed that there is a significant difference between the pre and post test scores among the control group in learning science experiments in all three science subjects such as biology, chemistry and physics. It shows that the students with visual impairment in control group had improvement in post test scores. Hence it is inferred that the conventional aids of teaching showed improvement in learning experimental concepts among the students with visual impairment.

Hypothesis # 2 - There will be no significant difference between Pre and Post Test Scores of Experimental Group

The results of analysis showed that there is a significant difference between the pre and post test scores among the experimental group in learning experiments in all three science subjects. It shows that the students with visual impairment in experimental group had improvement in post test scores. Hence it is inferred that the adapted science experimental aids enhanced the learning of science experiments among the students with visual

impairment. The result is supported by the research done by Chevins and Nacer (2007) and it was mentioned in their result that a years' experience preparing and delivering teaching materials specially designed for visually impaired including blind students had shown that they were capable of achieving many of the learning outcomes expected of sighted students.

Hypothesis # 3 - There will be no significant difference between control and experimental groups in performance.

The results of t-test indicate that there is a significant difference between control and experimental group in performing science experiments. It indicates that adapted experimental aids are very useful in teaching science experimental concepts among students with visual impairment. The result shows that experimental group students got more scores than the control group. It shows that the adapted experimental aids play more significant role than the conventional aids on learning biology experiments among the students with visual impairment. The research done by Shapiro (2009) also supported the result. Their study results mentioned that learning of science for students with visual impairment is possible and meaningful. Science helps these students to explore the world in which they live with modified science materials.

9th Standard:

Animal Cell: The calculated value (4.11) is greater than the table value (2.228), it is inferred that there is a significant difference in performing the experiment 'Animal Cell' between the control and experimental groups. It is also inferred that the performance of experimental group is better than the control group.

DNA Structure: The calculated value (3.35) is greater than the table value (2.228), it is inferred that there is a significant difference in performing the experiment 'DNA concept'

between the control and experimental groups. It is also inferred that the performance of experimental group is better than the control group.

Physical Status of Matters: The calculated value (2.02) is less than the table value (2.228), it is inferred that there is a no significant difference in performing the experiment 'Physical Status of Matters' between the control and experimental groups. It is also inferred that both and conventional method and using of adapted experimental aids shows effectiveness in learning science concepts.

Elements of Electronic Configuration: The calculated value (5.12) is greater than the table value (2.228) it is inferred that there is a significant difference in performing the experiment 'Elements of Electronic Configuration' between the control and experimental groups. It is also inferred that the performance of experimental group is better than the control group.

Pressure and Depth Perception: The calculated value (5.12) is greater than the table value (2.228), it is inferred that there is a significant difference in performing the experiment 'Pressure and Depth Perception' between the control and experimental groups. It is also inferred that the performance of experimental group is better than the control group.

Archimedes Principle: The calculated value (2.74) is greater than the table value (2.228), it is inferred that there is a significant difference in performing the experiment 'Archimedes principle' between the control and experimental groups. It is also inferred that the performance of experimental group is better than the control group.

Chemical Equation: The calculated value (2.74) is greater than the table value (2.228) it is inferred that there is a significant difference in performing the experiment 'Chemical Equation' between the control and experimental group. It is also inferred that the experimental group performance is better than the control group.

Purity of Milk: The calculated value (6.26) is greater than the table value (2.228), it is inferred that there is a significant difference in performing the experiment 'Purity of Milk'

between the control and experimental group. It is also inferred that the experimental group performance is better than the control group.

Simple Pendulum: The calculated value (6.26) is greater than the table value (2.228), it is inferred that there is a significant difference in performing the experiment 'Simple Pendulum' between the control and experimental groups. It is also inferred that the experimental group performance is better than the control group.

Human Body Organs: The calculated value (2.52) is greater than the table value (2.228), it is inferred that there is a significant difference in performing the experiment 'Human Organs' between the control and experimental groups. It is also inferred that the performance of experimental group is better than the control group.

10th Standard:

Neurons and its Types: The calculated value (6.4) is greater than the table value (2.228), it is inferred that there is a significant difference in performing nervous system – neurons and its types experiment between the control and experimental group. It is also inferred that the experimental group performance is better than the control group.

Fermentation: The calculated value (8.83) is greater than the table value (2.228), it is inferred that there is a significant difference in performing the experiment 'Fermentation' between the control and experimental groups. It is also inferred that the performance of experimental group is better than the control group.

Iodine Test: The calculated value (15.92) is greater than the table value (2.228), it is inferred that there is a significant difference in performing the experiment 'Iodine Test' between the control and experimental groups. It is also inferred that the experimental group performance is better than the control group. It shows that the effectiveness of adapted experimental aids in learning science concepts.

Identification of Given Model: The calculated value (5.08) is greater than the table value (2.228) it is inferred that there is a significant difference in performing the experiment 'Identification of Given Model' between the control and experimental groups. It is also inferred that the performance of experimental group is better than the control group.

Acid / Base: The calculated value (5.37) is greater than the table value (2.228), it is inferred that there is a significant difference in the experiment 'Acid/ Base' between the control and experimental groups. It is also inferred that the performance of experimental group is better than the control group.

Electric Circuit: The calculated value (5.9) is greater than the table value (2.228) it is inferred that there is a significant difference in performing the experiment 'Electric Circuit' between the control and experimental groups. It is also inferred that the experimental group performance is better than the control group.

Test Tube and Funnel: The calculated value (3.48) is greater than the table value (2.228) it is inferred that there is a significant difference in performing the experiment 'Test Tube and Funnel' between the control and experimental groups. It is also inferred that the experimental group performance is better than the control group.

Periodic Table: The calculated value (7.91) is greater than the table value (2.228), it is inferred that there is a significant difference in performing the experiment 'Periodic Table' between the control and experimental groups. It is also inferred that the experimental group performance is better than the control group.

Elements and Electronic Configuration: The calculated value (4.71) is greater than the table value (2.228), it is inferred that there is a significant difference in performing the experiment 'Elements and Electronic Configuration' between the control and experimental groups. It is also inferred that the performance of experimental group is better than the control group.

Chemical Equation

The calculated value (9.48) is greater than the table value (2.228) it is inferred that there is a significant difference in performing the experiment 'Chemical Equation' between the control and experimental groups. It is also inferred that the experimental group performance is better than the control group.

Hypothesis # 4 - There will be no significant difference between the pre and post test scores based on standard.

Result of analysis showed that there is no significant difference between standards in performing post test scores in all three science subjects. It is because of the impact of the intervention that the students with visual impairment had shown improvement in post test.

Findings based on Experiments

Forty students with visual impairment studying 9^{th} and 10^{th} standard were selected as sample for the present study. Further they were divided into two groups namely control and experimental groups. In each standard 10 experiments were selected and adaptations were made accordingly in the procedure of the experiment. The results show that the students with impairment in experimental group scored high when compared with the control group in all the experiments except the experiment 'Physical Status of Matters'. It shows that the adapted experimental aids were useful to improve the skills of students with visual impairment in learning science concepts.

Table No. 31 – Findings based on Experiments - 9^{th} Standard

S.No	Name of the Experiment	Result

1	Animal Cell	Significant difference
2	DNA Structure	Significant difference
3	Physical States of Matters	No Significant difference
4	Elements and Electronic Configuration	Significant difference
5	Pressure & Depth	Significant difference
6	Archimedes Principle	Significant difference
7	Chemical Equation	Significant difference
8	Purity of Milk	Significant difference
9	Simple Pendulum	Significant difference
10	Human Body Organ – Heart & Kidney	Significant difference

Table No. 32 – Findings based on Experiments - 10th Standard

S.No	Name of the Experiment	Result
1	Nervous System – Neurons and its Types	Significant difference
2	Fermentation	Significant difference
3	Iodine Test (Starch Identification)	Significant difference
4	Identification of given models	Significant difference
5	Acid/ Base Test	Significant difference
6	Electric Circuit	Significant difference
7	Test Tube and Funnel	Significant difference
8	Periodic Table	Significant difference

9	Elements and Electronic Configurations	Significant difference
10	Chemical Equation	Significant difference

Findings based on Standard

Forty students with visual impairment studying 9^{th} and 10^{th} standard were selected as sample for this study. Results of analysis showed that there is no significant difference between standards in performing post test scores in all experiments.

Suggestions and Recommendations

On the basis of the above conclusions, the following suggestions are made:

1. Appropriate training should be provided to the teachers who work with the students with visual impairment to help them understand the importance of adapted aids for teaching all the subjects.
2. Teachers handling students with visual impairment should be motivated to develop adapted experimental aids so that to enhance experimental skills of students with visual impairment.
3. The teachers should ensure the involvement of students with visual impairment in all science experiment classes. Arranging peer-tutoring would assist students with visual impairment to perform better.
4. Guidelines to prepare adapted experimental aids for students with visual impairment should be included in the practical booklets of the concerned subject.
5. Policy makers and curriculum designers should focus on planning appropriate adaptive teaching aids for all the subjects to provide holistic learning environment to facilitate the learning of students with visual impairment.

Suggestion for Future Research

The present study was aimed to find out the effectiveness of adapted experimental aids on learning science concepts among the students with visual impairment. From the findings that have emerged from the present study and from the personal experience gained by the investigators the following suggestions are listed for future research.

1. Similar study can be conducted for other subjects in the curriculum such as mathematics.
2. Conducting similar study with larger sample would yield generalisation of the results.
3. The same study can be carried out with more numbers of experiments.
4. Similar studies can be conducted for students with visual impairment at higher secondary level.

Outcomes of the Research Project

- **Adapted Science Experimental Aids:** Twenty experiments were selected from 9th and 10th Standard Science Book, Tamil Nadu State Board Syllabus. Tools and equipments were modified and adapted based on the experiments. These adapted science experimental aids were useful for students with visual impairment to perform and learn the concept of each experiment.
- **Booklet:** A booklet was prepared in print and Braille format which contains the information related to experiments such as such as aim, material required, procedure, inference, and results for the benefit of the teachers and students with visual impairment.

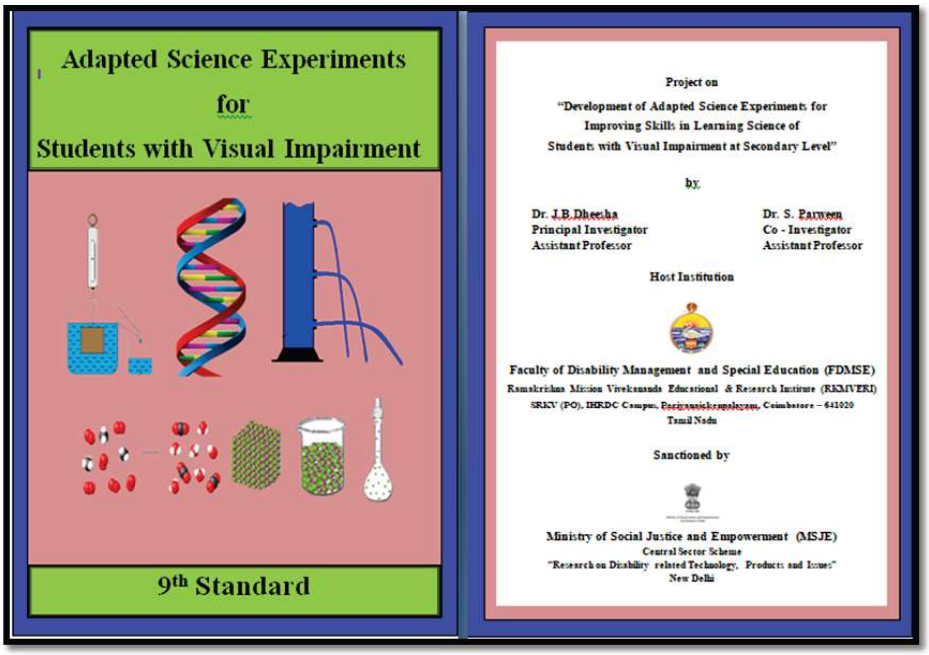

Fig No. 44 – Booklet for 9th Standard

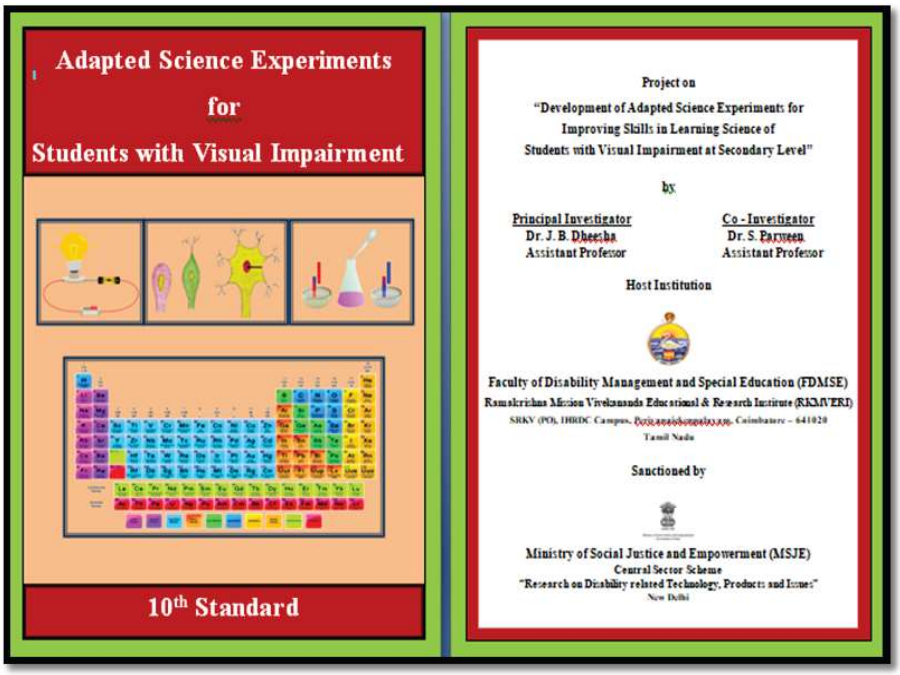

Fig No. 45 – Booklet for 10th Standard

- **Orientation Programme:**

  An orientation programme was conducted to the teachers of students with visual impairment. The main objective of this programme was to enhance their skills in science teaching. The training provided them the strategies on how to teach science concepts to students with visual impairment through adapted science experimental aids.

Fig No. 46 – Orientation Programme to Teachers

Conclusion

Science subject is one of the major subjects in school curriculum which consists of more practical oriented experiments. Hence science seems to be complicated subject for students with visual impairment. More adaptations have to be made in order to make the students with visual impairment to help them understand the concept of the experiments. Adaptations can be applied to activities, items, procedure or environment. The purpose of adaptation is to maximize the participation of the students with visual impairment in various functions without making drastic alterations. In general an adaptation means to change the rules, strategies and routine to reduce the complexity and to provide clues or offer personal assistance.

If adapted experimental aids are used for students with visual impairment they will be able to understand the concept of that particular experiment without any confusion. Thus students with visual impairment will get clear understanding about the concept when they participate in doing the experiments directly. This shows the importance of adapting experimental aids for students with visual impairment according to their specific needs. By using adapted experimental aids students with visual impairment can realize the nature and impact of science. This develops self-confidence and independent skills among them and this in turn enhances their love for science subject and improves their knowledge about science.

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APPENDIX

General Information about the Expert

1. Name :
2. Age :
3. Gender :
5. Educational Qualification :
6. Professional Qualification :
7. Years of Experiences :
8. Specialization :
9. Name of the School :
10. Type of the school :
11. Address of the School :

Tool - 1

TO FIND OUT THE APPROPRIATENESS OF THE DEVELOPED ADAPTED EXPERIMENTAL AIDS

Q.No	Questions	Appropriate	Modification Required	Not Appropriate
	Questions related to sense organs			
1	Are the adapted materials legible and clearly visible by the students with low vision?			
2	Are the letters large enough to be read by students with low vision?			
3	Are the adapted experimental aids easily distinguishable by touch?			
4	Are the adapted experimental aids easy to carry out the experiment?			
5	Are the audible tones readily distinguishable?			
	Questions related to instructions			
6	Are the instructions available in all appropriate mediums?			
7	Are the adapted experimental aids easy to orientate?			
8	Is the adapted experimental aid appropriate for the selected experiment?			
9	Do the adapted experimental aids not change the meaning of the experiment?			
10	Is the student with visual impairment able to do and understand without any assistance?			
	Question related to handling			
11	Do the adapted experimental aids not have any sharp edges or rough surfaces?			
12	Are the adapted experimental aids easy to clean and maintain?			
13	Are the adapted experimental aids durable enough?			
14	Are the adapted experimental aids easy to portable?			
15	Do the adapted experimental aids not consuming more time?			

Tool - 2

RATING SCALE TO FIND OUT THE EFFECTIVENESS OF ADAPTED SCIENCE EXPERIMENTAL AIDS ON LEARNING SCIENCE

General Information about the Sample

1. Name :
2. Age :
3. Date of Birth :
4. Gender :
5. Nature of visual impairment : Totally Blind/ Low Vision
6. Onset of visual impairment :
7. Causes of visual impairment :
8. Class :
9. Name of the School :
10. Type of the school :
11. Specialization of resource teacher :
12. Address of the School :
13. Father's Name :
    Qualification :
    Occupation :
14. Mother's Name :
    Qualification :
    Occupation :
15. No. of siblings :
16. Any family history of disability :
17. Residential Address :
18. Contact Number :

9TH STANDARD

Name of the Student:

S. No	Questions	Pre Test			Post Test		
		C.A	S.A	W.A	C.A	S.A	W.A
Animal Cell							
1	What do you mean by cell? செல் என்றால் என்ன?						
2	What is cytoplasam? சைட்டோபிளாசம் என்பது என்ன?						
3	Mention the functions of mitocondria. மைட்டோகாண்டீரியாவின் பணி யாது?						
4	What is the improtance of nucleus? உட்கருவின் முக்கியத்துவம் என்ன?						
5	Which part of the cell is named as suicidal bags? செல்லில் தற்கொலைப்பைகள் என்று அழைக்கப்படும் உறுப்பு யாது?						
DNA Structure							
6	Expand DNA. DNA- வின் விரிவாக்கம் என்ன?						
7	What are the components of neucleotide? நியூக்ளியோடைடின் உட்கூறுகள் யாது?						
8	Who discovered the structure of DNA? DNA - வின் அமைப்பு யாரால் வெளியிடப்பட்டது?						
9	What is the structure of DNA? DNA - வின் அமைப்பு என்ன?						
10	What is the importance of DNA? DNA – வின் முக்கியத்துவம் என்ன?						
Physical Status of Matters							
11	What are the various types of physical status of matters? இயற்பியல் நிலையின் அடிப்படையில் பருப்பொருளின் வகைகள் என்ன?						
12	What are the characteristics of solid? திண்மத்தின் தன்மைகள் யாது?						
13	What are the characteristics of liquid? நீர்மத்தின் தன்மைகள் யாது?						
14	What are the characteristics of gas? வாயுவின் தன்மைகள் யாது?						
15	Differentate solid, liquid and gas. திண்மம், நீர்மம் மற்றும் வாயு – வேறுபடுத்துக.						

Elements of Electronic Configuration								
16	Atoms are made up of what? அணுக்கள் எதனால் உருவாக்கப்படுகிறது?							
17	What is the electric charge of electron? எலக்ட்ரானின் மின்சுமை யாது?							
18	What is the atomic number of Helium? ஹீலியத்தின் அணு எண் எவ்வளவு?							
19	Make the electron structure of Nitrogen. நைட்ரஜனின் எலக்ட்ரான் புள்ளி அமைப்பை அமைக்கவும்.							
20	Make the electron structure of Sodium. சோடியத்தின் எலக்ட்ரான் புள்ளி அமைப்பை அமைக்கவும்							

Pressure and Depth Perception								
21	What apparatus is used for the experiment? இச்செய்முறைக்கு தேவையான உபகரணங்கள் யாது?							
22	What is depth? ஆழம் என்றால் என்ன?							
23	What is pressure? அழுத்தம் என்றால் என்ன?							
24	What is the relationship between depth and pressure? ஆழத்திற்கும் அழுத்தத்திற்கும் இடையே உள்ள தொடர்பு யாது?							
25	What is the aim and result of this experiment? இச்செய்முறையின் நோக்கம் மற்றும் முடிவு யாது?							
Archemede's Principle								
26	Mention the Archemedes principle. ஆர்க்கிமிடிஸ் தத்துவத்தை கூறுக?							
27	What is the reason for the weight reduction of the materials when immersed in water? ஒரு பொருள் நீரில் மூழ்குவதால் தோன்றும் எடை இழப்புக்கு காரணம் என்ன?							
28	How will you evaluate the archemedes principle? ஆர்க்கிமிடிஸ் தத்துவத்தை எவ்வாறு சரிபார்ப்பாய்?							
29	What do you understand from this experiment? இச்சோதனையில் அறிந்து கொண்டது என்ன?							
30	Mention the uses of Archemedes principle. ஆர்க்கிமிடிஸ் தத்துவத்தின் பயன்பாடுகள் யாது?							

Chemical Equation							
31	What do you mean by chemical equation? வேதிசமன்பாடு என்றால் என்ன?						
32	What is reactant? வினைபடுபொருள்கள் என்றால் என்ன?						
33	What do you mean by product? வினைவிளைபொருள்கள் என்றால் என்ன?						
34	What is the chemical equation for 2Na+ Cl2? 2Na+ Cl_2 சமன்பாடு யாது?						
35	Mention the required environment for the chemical reaction. வேதிவினை நிகழ்வதற்கு தேவையான சூழ்நிலைகள் யாது?						
Purity of Milk							
36	What device is used to identify the purity of milk? பாலின் தூய்மை தன்மையை கண்டறியும் உபகரணத்தின் பெயர் என்ன?						
37	Mention the principle to identify the purity of milk. பாலின் தூய்மை தன்மையை கண்டறியும் தத்துவம் என்ன?						
38	What apparatus is used for the experiment? சோதனைக்கு தேவையான பொருள்கள் என்ன?						
39	Explain the procedure of this experiment. இச்சோதனையின் செய்முறையை விவரி.						
40	What you understand from this experiment? இச்சோதனையின் மூலம் அறிந்தது என்ன?						
Simple Pendulum							
41	What is simple pendulum? தனி ஊசல் என்றால் என்ன?						
42	Who invented simple pendulum? தனி ஊசலை கண்டறிந்தவர் யார்?						
43	What is the formula of simple pendulum? தனி ஊசல் விதியின் வாய்ப்பாடு என்ன?						
44	What are the apparatus required to identify the osillation? அலைவு காலம் கண்டறிய தேவையான கருவிகள் என்ன?						
45	Mention the procedure of this experiment. இச்சோதனையின் செய்முறையை விவரி?						

Human Organs: Kidney & Heart							
46	What is the function of kidney? சிறுநீரகத்தின் முக்கிய பணி என்ன?						
47	What is the main unit of kidney? சிறுநீரகத்தின் அடிப்படை அலகு என்ன?						
48	Mention the functions of heart. இதயத்தின் பணிகனை கூறுக.						
49	Name the different chambers of heart. இதயத்தின் நான்கு அறைகளின் பெயர்களை கூறு?						
50	Mention the name of the covering layer of heart. இதயத்தை சுற்றியுள்ள உறையின் பெயர் என்ன?						
	Total						

CA - Correct Answer Given - 2 marks

SA - Satisfactory Answer Given - 1 mark

WA - Wrong Answer Given - 0 mark

10TH STANDARD

Name of the Student:

S. No	Questions	Pre Test			Post Test		
		C.A	S.A	W.A	C.A	S.A	W.A
Fermentation							
1	What is fermentation? நொதித்தல் என்றால் என்ன?						
2	What are the materials required for fermentation experiment? நொதித்தல் ஆய்வுக்கு தேவையான பொருட்கள் யாவை?						
3	What gas is produced when the sugar soluation is fermented by the yeast? ஈஸ்ட் சர்க்கரை கரைசலை நொதிக்க செய்வதனால் வெளியேறும் வாயு எது?						
4	Explain the process of colour change of lemon water. எலுமிச்சை நீர் எவ்வாறு நிறம் மாறுகிறது ?						
5	How ethanol is formed? எத்தனால் எவ்வாறு உருவாகிறது ?						
Iodine Test							
6	What is the aim of iodine test? அயோடின் ஆய்வின் நோக்கம் என்ன ?						
7	What are the materials requied for iodine experiment? அயோடின் ஆய்வு முறைக்கு தேவையான உபகரணங்கள் கூறுக.?						
8	Mention the given samples A, B & C. தரப்பட்டுள்ள A,B,C உணவு கரைசல்கள் யாவை?						
9	Describe the procedure of iodine test. அயோடின் ஆய்வின் செய்முறையை கூறுக?						
10	What is the reason for color change of iodine solution when starch is present? அயோடின் ஆய்வில் ஸ்டார்ச் உள்ள பொருட்கள் நிறம் மாற காரணம் என்ன ?						
Elements of Electronic Configuration							
11	How atoms are made? அணுக்கள் எதனால் உருவாக்கப்படுகிறது?						
12	What is the electric charge of electron? எலக்ட்ரானின் மின்சுமை யாது?						
13	What is the atomic number of Helium? ஹீலியத்தின் அணு எண் எவ்வளவு?						
14	Make the electron structure of Nitrogen. நைட்ரஜனின் எலக்ட்ரான் புள்ளி அமைப்பை அமைக்கவும்.						
15	Make the electron structure of Sodium. சோடியத்தின் எலக்ட்ரான் புள்ளி அமைப்பை அமைக்கவும்						

Identification of Given Models								
16	What is the structure of human heart? மனித இதயத்தின் தோற்றம் யாது?							
17	How many chambers are there in human heart? இதயம் எத்தனை அறைகளை கொண்டுள்ளது?							
18	Mention the major excretory part of human. மனிதனின் முக்கிய கழிவு நீக்கும் உறுப்பு எது?							
19	Name the inner and outer layer of kidney. சிறுநீரகத்தின் வெளிப்பகுதி மற்றும் உட்பகுதி எவ்வாறு அழைக்கப்படுகிறது?							
20	How many parts are there in human brain? மனித மூளை எத்தனை பாகங்களாக பிரிக்கப்பட்டுள்ளது?							

Acid Base Test								
21	What is the aim of acid base test? இச்சோதனையின் நோக்கம் என்ன?							
22	What apparatus is used for acid base test? இச்சோதனைக்கு தேவைப்படும் உபகரணங்கள் யாவை?							
23	What is the colour of litmus paper? லிட்மஸ் காகிதத்தின் நிறம் என்ன ?							
24	What is the colour of litmus paper in acid solution? லிட்மஸ் காகிதம் அமில கரைசலில் இருக்கும் போது அதன் நிறம் என்ன?							
25	What is the colour of litmus paper in base solution? லிட்மஸ் காகிதம் கார கரைசலில் இருக்கும் போது அதன் நிறம் என்ன?							
Periodic Table								
26	Name the horizonatal and vertical rows in the periodic table. கிடைமட்ட வரிசைகள், செங்குத்து வரிசைகள் எவ்வாறு அழைக்கப்படுகிறது?							
27	Whis is transition elements? இடைநிலைத் தனிமங்கள் என்றால் என்ன?							
28	In which group transition elements are present? இடைநிலைத் தனிமங்கள் எந்த தொகுதியில் உள்ளன?							
29	What do you mean by noble or inert gases? மந்த அல்லது உயரிய வாயுக்கள் என்றால் என்ன?							
30	What is meant by ores? தாது என்றால் என்ன?							

Chemical Equation							
31	What is chemical reaction? வேதி வினைகள் என்றால் என்ன?						
32	Mention the different types of chemical reactions. வேதி வினைகளின் வகைகள் யாவை?						
33	Name the product that is produced during chemical reaction of hydrogen and oxygen. ஹைட்ரஜனும், ஆக்சிஜனும் வினை புரியும் போது உருவாகும் பொருளின் பெயரை குறிப்பிடுக.						
34	What is displacement reaction? இடப்பெயர்ச்சி வினை என்றால் என்ன?						
35	What is decomposition reaction? சிதைவுறுதல் வினை என்றால் என்ன?						
Electric Circuit							
36	What do you understand by Electric current? மின் சுற்று என்றால் என்ன?						
37	What are the materials required for this experiment? இச்சோதனைக்கு தேவையான பொருள்கள் யாவை?						
38	How will you set the electric circuit? மின் சுற்றினை எவ்வாறு அமைப்பாய்?						
39	What are the uses of electric circuit? மின் சுற்றின் பயன்பாடு என்ன?						
40	How many electric charges are present in electric circuit? மின் சுற்றில் எத்தனை மின்னோட்டகள் உள்ளன?						
Test tube &Funnel experiment							
41	Mention the aim of test tube and funnel experiment. ஆய்வுக்குழாய் மற்றும் புனல் ஆய்வு - நோக்கம் எழுதுக.						
42	What is the biproduct of photosynthesis? ஒளிச்சேர்க்கையின் போது துணைப் பொருளாக வெளியேறுவது யாது?						
43	Describe the procedure of photosynthesis. ஒளிச்சேர்க்கையின் செய்முறையை குறிப்பிடுக?						
44	What plant is used for photosynthesis experiment? ஒளிச்சேர்க்கை ஆய்வில் பயன்படுத்தும் தாவரம் என்ன?						
45	What do you understand by this experiment? இவ்வாய்வில் அறிந்து கொண்டது என்ன?						

Nervous and its Types							
46	What is neuron? நியூரான் என்றால் என்ன?						
47	Mention the types of neuron. நியூரானின் வகைகள் யாவை?						
48	In which part of the human body the unipolar neurons are present? ஒருமுனை நியூரான்கள் மனித உடலில் எப்பகுதியில் அமைந்துள்ளது?						
49	On what basis neurons can be classified? நியூரான்களை எதன் அடிப்படையில் வகைப்படுத்துவாய்?						
50	In which part of the human body the multipolar neurons are present? பலமுனை நியூரான்கள் எங்கு அமைந்துள்ளது ?						
	Total						

CA - Correct Answer Given - 2 marks

SA - Satisfactory Answer Given - 1 mark

WA - Wrong Answer Given - 0 mark

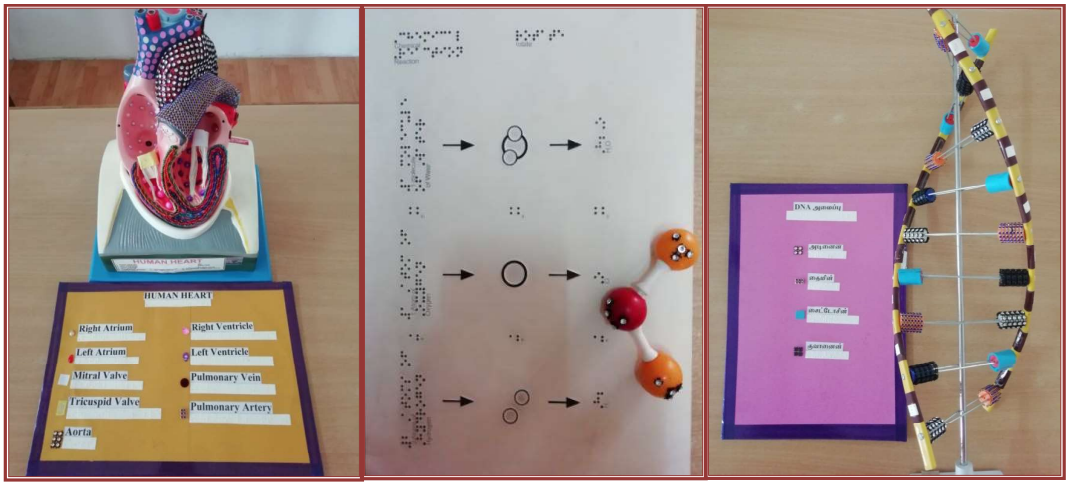
APPENDIX

PRACTICAL BOOKLET

Faculty of Disability Management and Special Education (FDMSE)
Ramakrishna Mission Vivekananda Educational & Research Institute (RKMVERI)
SRKV (PO), IHRDC Campus, Periyanaickenpalayam, Coimbatore – 641020
Tamil Nadu

Booklet on

Adapted Science Experiments for Students with Visual Impairment



Sanctioned by

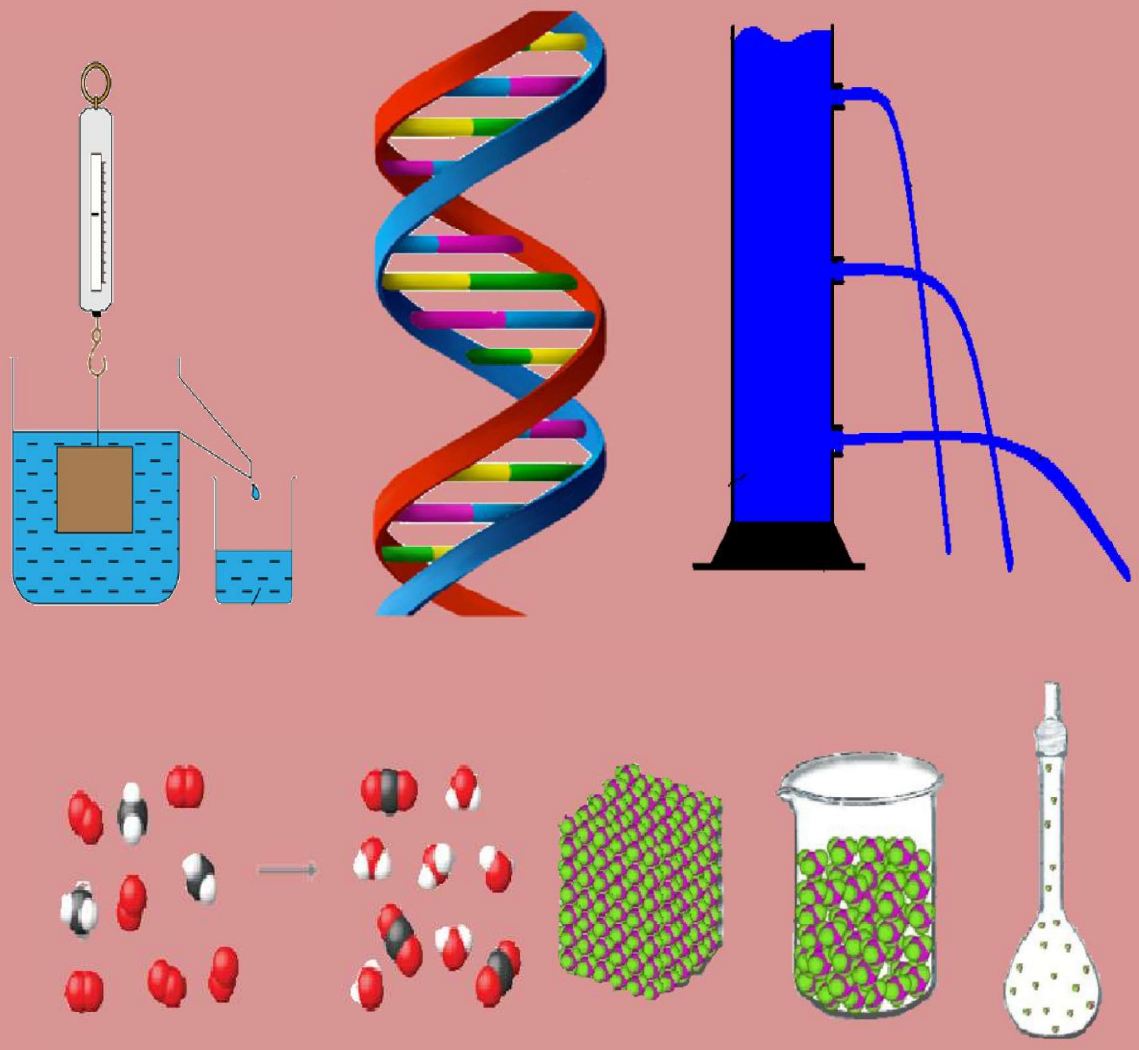
Ministry of Social Justice and Empowerment
Government of India

Ministry of Social Justice and Empowerment (MSJE)
Govt. of India, New Delhi

Adapted Science Experiments

for

Students with Visual Impairment



9th Standard

CONTENT

1. ANIMAL CELL

Aim:

To identify the different parts of animal cell and understand the structure of animal cell.

Materials required:

Tactile model of animal cell.

Procedure:

- Touch and explore the different parts of given model.
- Name the parts and write its functions.

Result:

The given part of animal cell is_____.

Adaptation Used:

Tactile mode: The parts of animal cell are tactually modified.

2. DNA STRUCTURE

Aim:

To identify the different parts of DNA and understand the structure of DNA.

Materials required:

Tactile model of DNA.

Procedure:

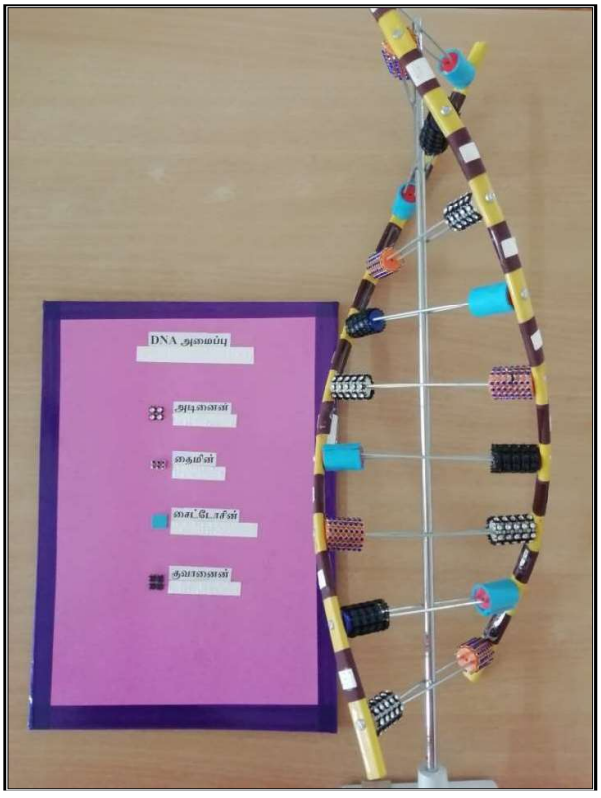
- Touch and explore the different parts of given model.
- Name the parts

Result:

The given part of DNA is_____.

Adaptation Used:

Tactile mode: The parts of DNA are tactually modified.



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3. PHYSICAL STATES OF MATTER

Aim:

To identify the different states of matters and understand the properties of it.

Materials required:

Tactile model of molecules.

Procedure:

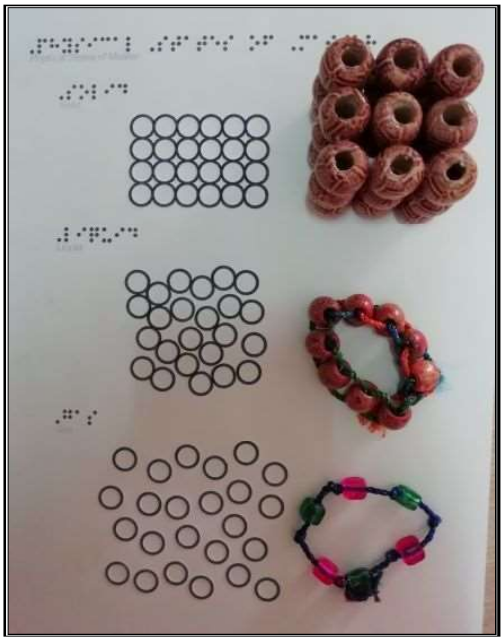
- Touch and explore the different parts of molecules and understand the physical states of matters.
- **Solid**: Solids have a definite shape and a definite volume. They take a lot of energy to change the shape. They are rigid and not compressed appreciably even at high pressures. They usually have high densities and expand only very slightly, when heated. In a solid, the molecules are held tightly together in definite arrangements.
- **Liquid**: Liquids have no definite shape and they take the shape of the container. They have a definite volume. They are not appreciably compressed by moderate pressures. They expand more than solids on heating and change into the gaseous state. They have lower densities than solids.
- **Gas**: Gases have no definite shape. They take the shape of the containing vessel. Gases have no definite volume. They have the property to occupy the entire space available to them. They are easily compressed by even small pressures and also expand more than liquids on heating. They have low densities.

Result:

The given part of the molecule is_____.

Adaptation Used:

Tactile mode: Physical statuses of matters are made up tactual material.



4. ELEMENTS AND THEIR ELECTRONIC CONFIGURATIONS

Aim:

To identify the electronic configurations of the given elements.

Materials required:

Wooden board with circles and beads

Procedure: 1

- Find out the number of beads (electrons) in the each circle.
- Calculate the total beads present in the orbit.

Procedure: 2

- Find out the number of electrons in the given element.
- Set the appropriate number of electrons in the circle (orbit).

Result:

The given element is_____and having_____electrons.

Adaptation Used:

Tactile mode of adaptation was used.

5. PRESSURE AND DEPTH

Aim:

To prove water pressure increases with depth.

Materials required:

- Bottle.
- Hammer and nail
- Tactile Ruler
- Tactile wooden plate with separated circles
- Water

Procedure:

1. Punch three holes in three different sides of the container at one inch intervals.
2. Place the container in the wooden plate.
3. Fill the container with water.
4. Measure the distance from the container that the water squirts out of each hole in the circle wooden plate.

Inference:

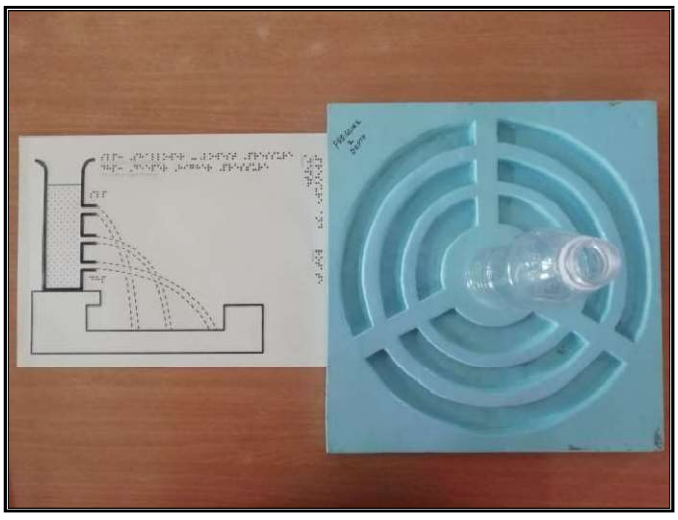
1. The water squirt form the hole which is pouched upper side of the container is filled in the inner circle of the wooden plate.
2. The water squirt form the hole which is pouched middle side of the container is filled in the inner and middle circles of the wooden plate.
3. The water squirt form the hole which is pouched lower side of the container is filled in the outer, middle and inner circle of the wooden plate. It is because of the higher pressure that is present in the bottom of the container.

Result:

It proves that the water pressure increases with depth.

Adaptation Used:

Tactile mode of adaptation was used.



6. ARCHIMEDES' PRINCIPLE

Aim:

To prove Archimedes principle - When a body is immersed in a fluid, it experiences an apparent loss of weight which is equal to the weight of the fluid displaced.

Materials required:

- Spring balance
- Sample A, B, and C
- Overflow jar
- Plastic plate

Procedure:

- Suspend a piece of stone (sample A) from the hook of a spring balance. ƒ
- Note the weight of the stone in air (w1).
- Take the overflowing jar and place in the plastic plate which is useful to collect the water from the overflow jar. ƒ
- Fill the water in the overflow jar by using the syringe up to the mark.
- Gently lower the stone into an overflowing jar filled with water.
- Now note the weight of the stone (w2). ƒ
- Take a empty overflow jar and weigh the jar (w3)
- Pour the water from the plastic plate to the empty jar.
- Weigh the jar with water (w4). ƒ
- Find the weight of the displaced water (w4 – w3).
- Find the loss of weight of the stone (w1 –w2).
- Same procedure can be performed with different samples.
- Mark the numbers in the given table.

S.No	Sample	(w1 – w2)	(w4 – w3)
1	A		
2	B		
3	C		

Inference:

We find that (w1 – w2) = (w4 – w3).

Result:

When an object is immersed in a fluid, it experiences an apparent loss of weight which is equal to the weight of the fluid displaced.

Adaptation Made:

Tactile spring balance

Syringe (Used to fill the water to the overflow jar)

7. CHEMICAL REACTION

Aim:

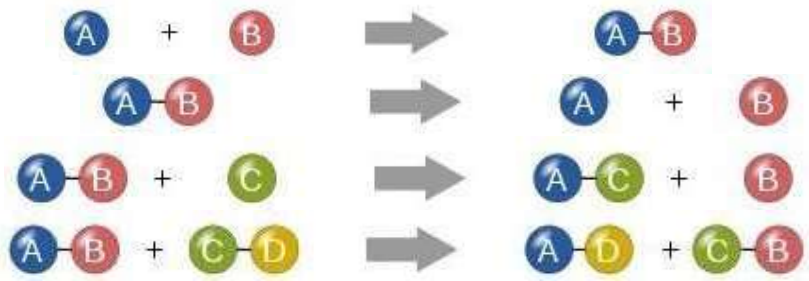
To find out the type of chemical reaction.

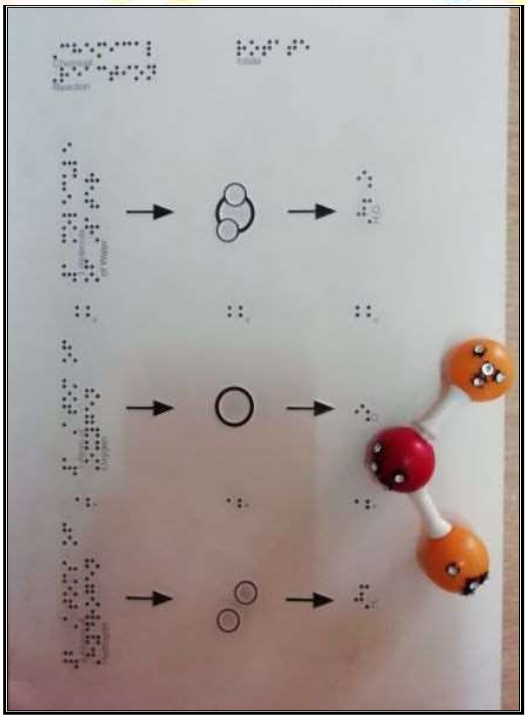
Material Required:

Tactile models of atomic balls

Procedure:

- Set the chemical reaction with the help of tactile atomic balls
- Find out the type of chemical reactions
    1) Combination Reaction
    2) Decomposition Reaction
    3) Displacement Reaction
    4) Double Displacement Reaction





Result:

The given chemical reaction is_____.

Adaptation Used:

- Tactile chemical balls
- Tactile reaction bond

8. PURITY OF MILK

Aim:

To find out the purity of milk by using a lactometer.

Requirements:

Milk, tactile lactometer.

Principle:

- 100ml of pure milk is taken in a beaker with the help of syringe.
- The tactile lactometer is dipped into the beaker.
- The bulb just sinks and then begins to float.
- Note down the mark in the lactometer.
- Now add 25% water in the milk and continue the procedure.
- Add 50% of water in the milk and continue the procedure.
- Add 75% of water in the milk and continue the procedure.

Sl.No	Milk	Water	Lactometer reading
1.	100 ml	Nil	
2.	75 ml	25 ml	
3.	50 ml	50 ml	
4.	25 ml	75 ml	

Observation:

If the bulb sinks deeper, it indicates that the milk contains more water and if the reading is at mark, it shows that the milk is very rich and pure.

Inference:

The reading on the meter_____indicates the purity of milk.

Result:

Thus the lactometer is used to find out the purity of the milk.

9. SIMPLE PENDULUM

Aim:

To find the period of oscillation of a simple pendulum and to prove that l/T^2 is a constant.

Apparatus required:

Simple pendulum apparatus, thread at three different meters, object detecting sensor, tactile scale and talking watch.

Procedure:

- Suspend the simple pendulum for a length of 70cm by using tactile scale.
- Make the pendulum oscillate with small amplitude.
- When the pendulum crosses the mean position towards the right, start a stop watch (talking watch) and count zero.
- When it crosses the mean position towards the right next time, count one.
- Like this, count up to twenty and stop the stopwatch.
- Find the time taken for 20 oscillations and record in the tabulation.
- Repeat the experiment by changing the length to 80cm, 90cm and 100cm.
- Tabulate the readings.

S.No.	Length of the simple pendulum M	Time taken for 20 oscillations s	Period T (s)	T^2 (S^2)	L/T^2 $m\ s^{-2}$
1	0.7				
2	0.8				
3	0.9				
4	1.0				

Formula: l/T^2 is a constant**,** where, l is the length of the simple pendulum(m)
T is the period of oscillation of the simple pendulum (s)

Inference:

The last column of the tabulation is found to be constant, hence proving l/T^2 is a constant.

Result:

From the table, it is found that l/T^2 is a constant.

10. IDENTIFICATION OF GIVEN MODELS

Aim:

To identify and name of the given models.

Materials required:

Model of heart and kidney.

Procedure:

Touch and explore the different models.

Explain the structure and function of given model

L.S. of Human heart

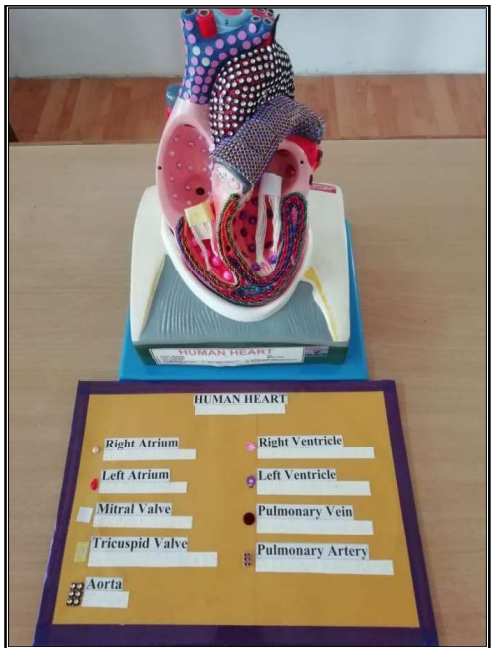
Identification: The given model is identified as a_____.

Structure:

- The heart is a hollow fibro muscular organ, which is conical in shape.
- It has four chambers namely two auricles and two ventricles.

Function:

- The heart is a pumping organ which pumps blood to all parts of the body.



L.S. of Human Kidney:

Identification: The given model is identified as_____.

Structure:

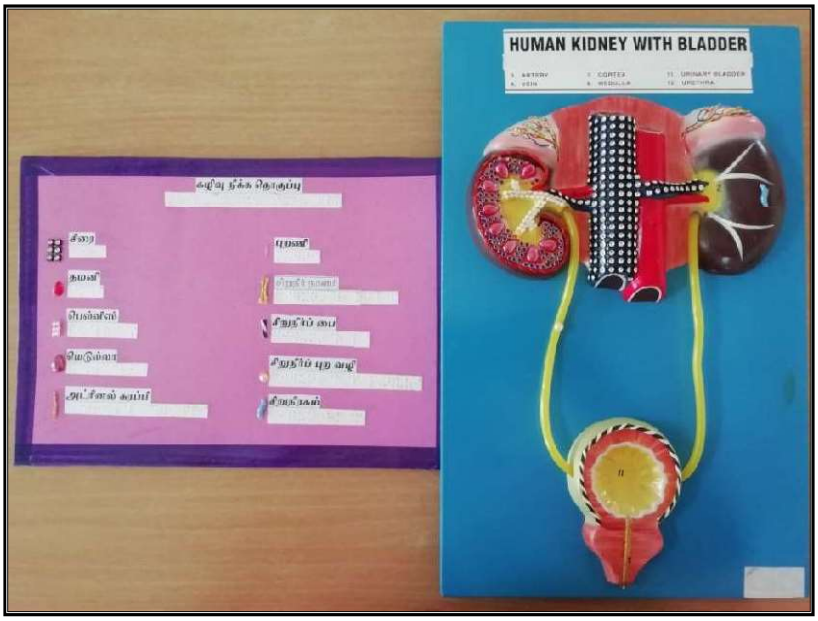
- The kidney is bean shaped paired structure and located in the upper abdominal region.
- A thin transparent membrane called capsule covers the kidney.
- The outer portion of the kidney is the renal cortex and the inner portion is the renal medulla.

Function:

- The kidney is the major excretory organ of our body.

Adaptation used:

- Tactile mode – Parts of kidney and hear are tactually modified.



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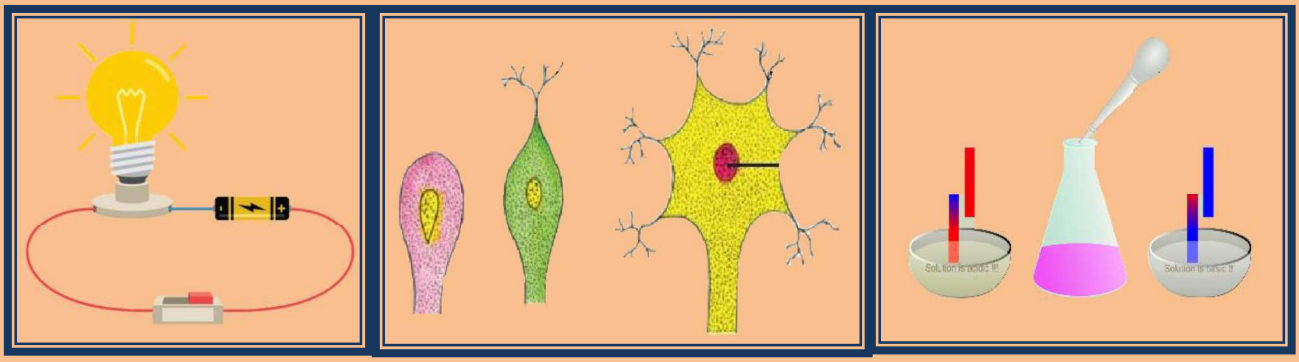
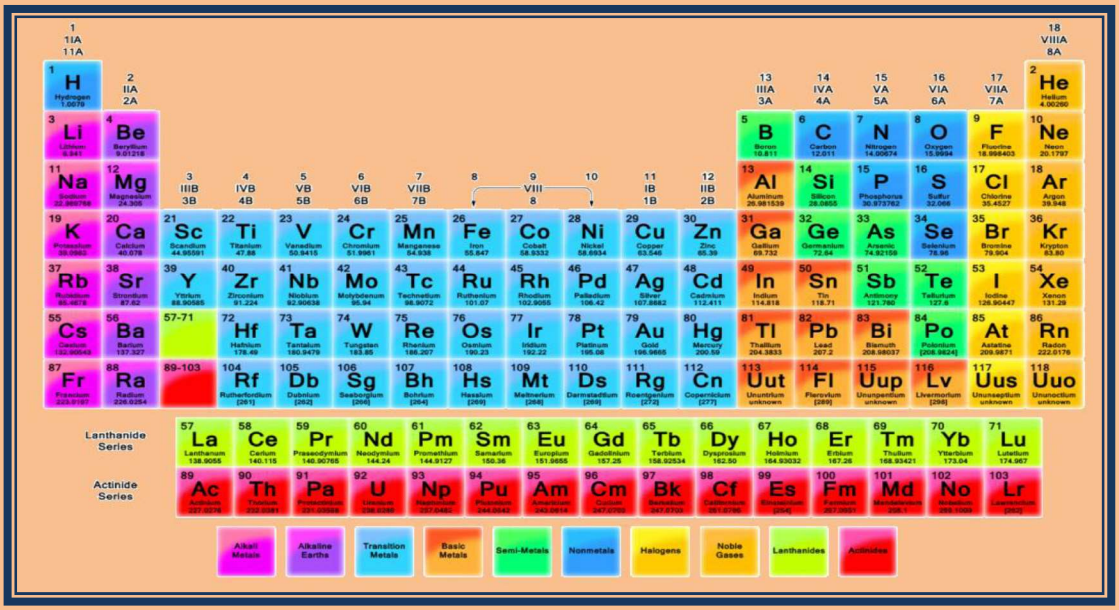




10th Standard

CONTENT

1. NEURONS AND ITS TYPES

Aim:

To identify the different types of neurons.

Materials required:

Tactile model of different neurons.

Procedure:

Touch and explore the different types of neurons models (tactile model) and identify the names.

- **Unipolar Neuron:**

  The unipolar neuron has a nerve cell body with a single process or fibre, which acts both as axon and dendron.

  The developing embryonic nervous tissue contains unipolar neurons.

- **Bipolar Neuron:**

  Bipolar neuron has a cell body and two processes or fibers at the ends, one acting as axon and the other acting as dendron.

  Rods and cones of retina are made up of bipolar neurons.

- **Multipolar Neuron**:

  Each multipolar neuron has a cell body with many dendrites and an axon.

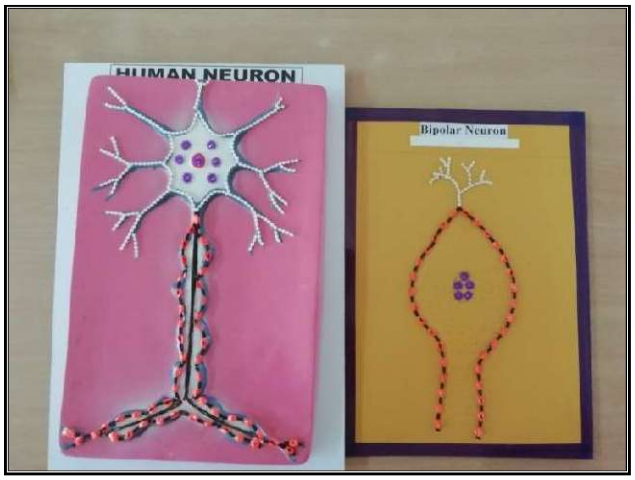
  Cerebral cortex contains multipolar neurons.

Result:

Name the different neuron model.

Adaptation used:

Tactile mode of adaptation was used to identify the different neuron models.



2. FERMENTATION EXPERIMENT

Aim:

To prove the fermentation process.

Materials required:

Sugar solution, Baker's yeast, conical flask, beaker and lime water.

Procedure:

- Take 100 ml of sugar solution by using the syringe and tactile measuring cup and transfer the solution into the conical flask.
- Add 1 tea spoon of baker's yeast in the solution.
- Take 50 ml of lime water by using the syringe and tactile measuring cup in a beaker.
- Close the mouth of the conical flask with a one holed rubber cork and insert a delivery tube in the cork.
- Immerse the other end of the delivery tube in a beaker containing lime water.
- Keep the apparatus in sunlight for two hours.
- Note the colour of the lime water by using colour identifier app.

Observation:

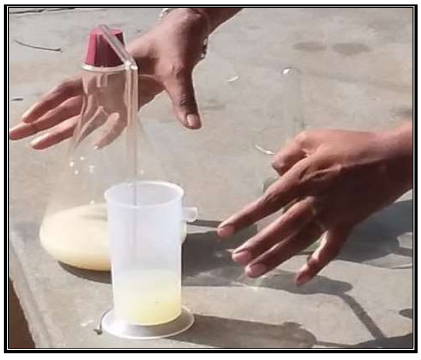
- After two hours, it is observed by using the colour identifier app that the lime water in the beaker turns milky.
- Remove the stopper of the flask, an alcoholic smell is observed in the sugar solution.

Result:

- Due to fermentation of sugar solution, CO_2 is released and ethanol is formed.
- The CO_2 turns the lime water milky and the smell is due to the formation of ethanol.
- Hence the process of fermentation is proved.

Adaptation Used:

- Tactile Mode - Diagram of this experiment was made into tactile form. Syringe and tactile measuring cup was used to take appropriate quantity of the solutions.
- Auditory Mode - Colour identifier app was used to identify the colour change through auditory output.



3. IODINE TEST

Aim:

To find out the presence of starch in the given food samples A, B and C by Iodine test.

Materials and apparatus required:

Food sample A, B and C, Iodine solution, test tubes, test tube holder and test tube stand.

Procedure:

- Take three test tubes and mark A, B and C by using Braille label.
- Take 10 ml of food samples A, B and C by using the 10ml syringe and pour in to the mentioned test tubes.
- Add 2 ml of Iodine solution to each of the test tubes (by using 2ml syringe) and mix well.
- Note the changes that occur in the colour by using the colour identifier app and tabulate the results.

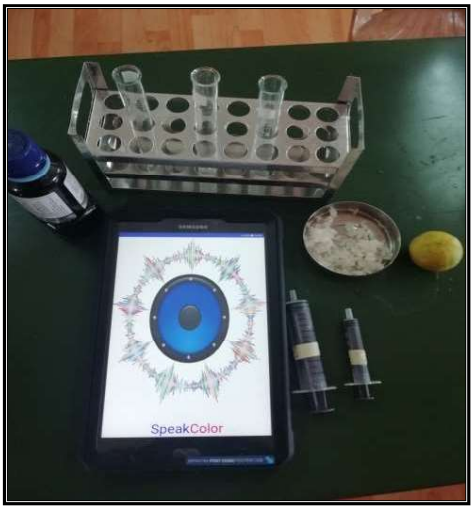
Observation Table:

Sample	Observation	Inference
A		
B		
C		

Result: Appearance of dark blue colour in the Sample_____indicates the presence of starch.

Adaptation Used:

- Tactile Mode – Syringe was used to take appropriate quantity of the sampleand solution.
- Auditory Mode - Colour identifier app which gives auditory output was usedto identify the colour change.
- Olfactory Mode – Food samples with different smell such as rice porridge(conjee), lime juice, potato juice.



4. IDENTIFICATION OF GIVEN MODELS

Aim:

To identify and name the given models.

Materials required:
Models of heart, brain and kidney.

Procedure:
Touch and explore the different models.

Explain the structure and function of given model

L.S. of Human Heart

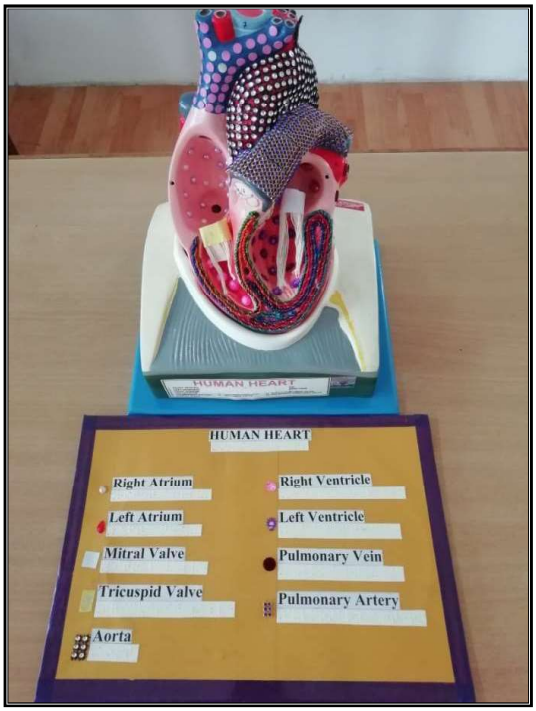
Identification: The given model is identified as a_____.

Structure:

- The heart is a hollow fibro muscular organ, which is conical in shape.
- It has four chambers namely two auricles and two ventricles.

Function:

- The heart is a pumping organ which pumps blood to all parts of the body.



L.S. of Human Brain

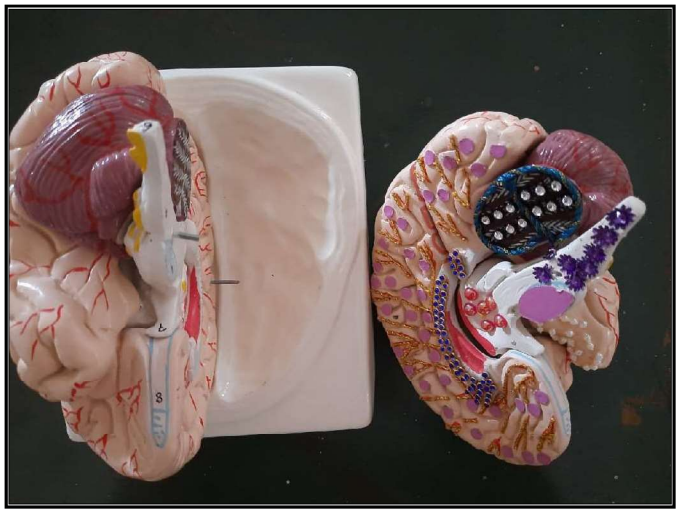
Identification: The given model is identified as_____.

Structure:

- The human brain is placed inside the cranial cavity.
- It is covered by three protective coverings called meninges.
- The human brain is divided into three major parts namely forebrain, midbrain and hind brain.
- The human brain contains millions of neurons.

Function

- Brain acts as a command and co-ordinating system of the human body.



L.S. of Human Kidney Identification

The given model is identified as_____.

Structure:

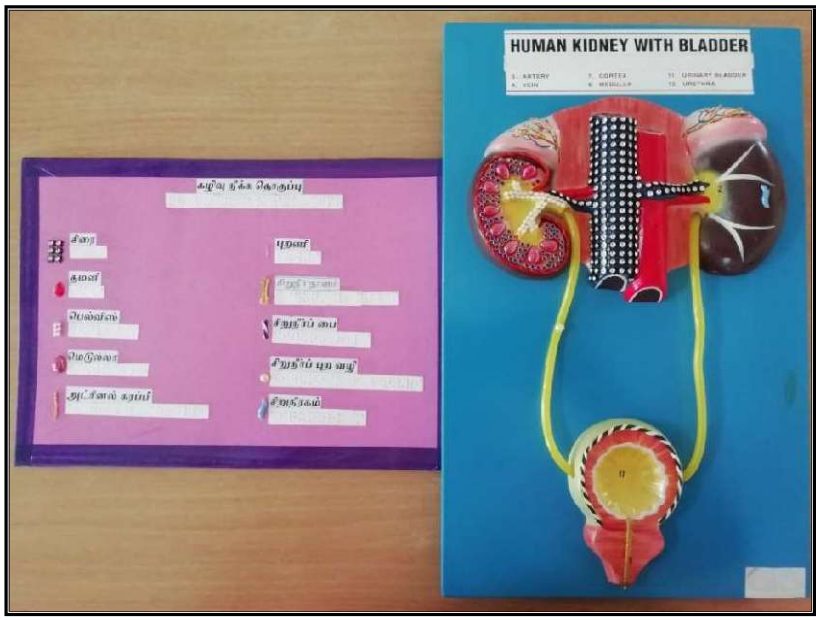
- The kidney is bean shaped paired structure and located in the upper abdominal region.
- A thin transparent membrane called capsule covers the kidney.
- The outer portion of the kidney is the renal cortex and the inner portion is the renal medulla.

Function:

- The kidney is the major excretory organ of our body.

Adaptation used:

- Tactile mode – Parts of heart, brain and kidney are tactually modified.



5. ACID/ BASE TEST

Aim:

To identify the nature (acid/ base) of the given solution by using P^H paper.

Materials required:

Test tubes, test tube stand, glass rod, litmus paper and samples.

Procedure:

- Take three test tubes and mark A, B and C by using Braille label.
- Take 10 ml of three different samples A, B and C by using the 10 ml syringe and pour in to the mentioned test tubes.
- Note the colour of the litmus paper by colour identifier app.
- Take three different litmus papers and dip in the solutions.
- Note the changes that occur in the colour of the litmus papers through colour identifier app.
- Blue litmus paper turns red under acidic conditions and red litmus paper turns blue under or basic or alkaline conditions.
- Neutral litmus paper is purple.

Observation:

S.No	Solution	Colour		Acid / Base
		From	To	
1	A			
2	B			
3	C			

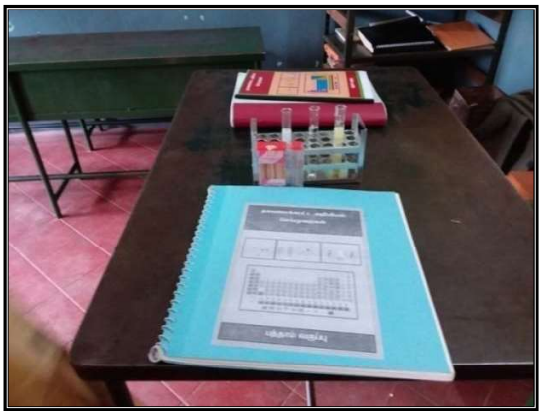
Result:

The given sample

A is_____in nature

B is_____in nature

C is_____in nature



Adaptation Used:

- Auditory Mode - Colour identifier app was to identify the colour change.
- Olfactory Mode – Food samples such as lime water and vinegar

6. ELECTRIC CIRCUIT

Aim:

To understand the electric circuit.

Materials required:

Battery, Bulb / fan, Switch and Wire

Procedure:

- Connect the one end of the wire with battery, and other end with bulb/ fan
- Connect the bulb/ fan with switch with the help of wire.
- The other end of the battery should connect with the switch.

Observation:

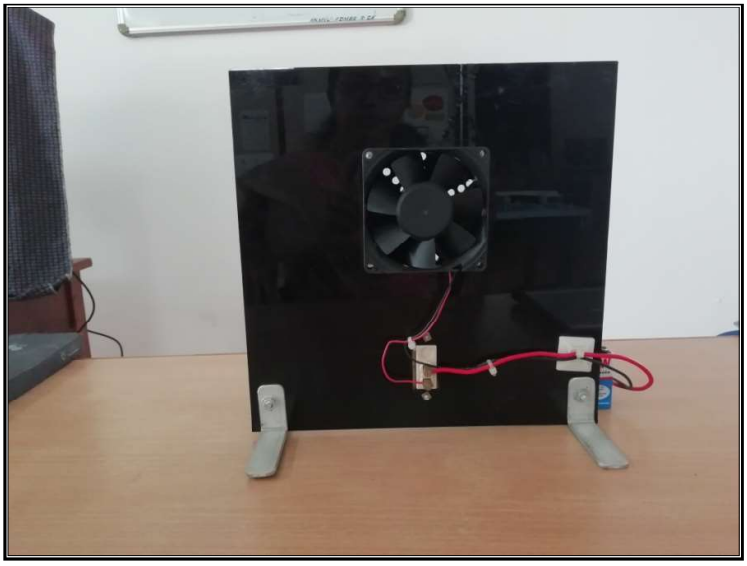
The fan will be rotating or the bulb will be glowing once the switch is on.

Result:

The fan or bulb will function once the electricity passes in the wire.

Adaptation Used:

- Auditory and Kinesthetic mode: The bulb was replaced with fan.



7. TEST TUBE AND FUNNEL EXPERIMENT

Aim:

To prove that Oxygen is evolved during Photosynthesis.

Materials required:

Test tube, funnel, beaker, pound water and Hydrilla plant.

Procedure:

- Take 250 ml of pond water by using syringe into the beaker.
- Keep a few twigs of Hydrilla plant in the beaker containing pond water.
- Place an inverted funnel over the plant.
- Invert a test tube filled with water over the stem of the funnel.
- Keep the apparatus in the sunlight for few hours.

Observation:

After one hour, it is noted that water gets displaced down from the test tube.

Inference:

- During photosynthesis, Oxygen is evolved as a byproduct. Gas bubbles liberated from the Hydrilla plant reach the top of the test tube and it displaces the water downwards.
- Take the test tube and keep the burning stick near the mouth of the test tube. Increased flame will be appeared.
- Hence, it is proved that Oxygen is evolved during photosynthesis.

Adaptation used:

Tactile mode and auditory mode used.

8. MODERN PERIODIC TABLE

Aim:

To identify the chemical elements (subcategory in the metal, metalloid, non-metal trend and its status (Gas, Solid or Liquid)

Materials required:

Tactile periodic table, Tactile Chemical Orbit Structure

Procedure:

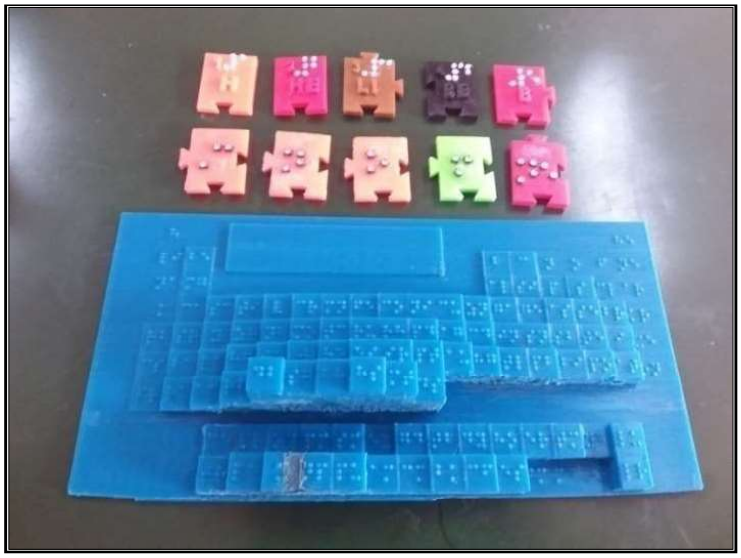
- Take chemical element pieces and set based on the atomic number.
- Find out the element is metal or metalloid or non-metal
- Find out the element status – Gas or Solid or Liquid

Result:

The given chemical element is _____

Adaptation Used:

- Tactile Periodic Table
- Tactile Chemical Orbit Structure



9. ELEMENTS AND ELECTRONIC CONFIGURATIONS

Aim:

To identify the electronic configurations of the given elements.

Materials required:

Wooden board with circles and beads

Procedure: 1

- Find out the number of beads (electrons) in the each circle.
- Calculate the total beads present in the orbit.

Procedure: 2

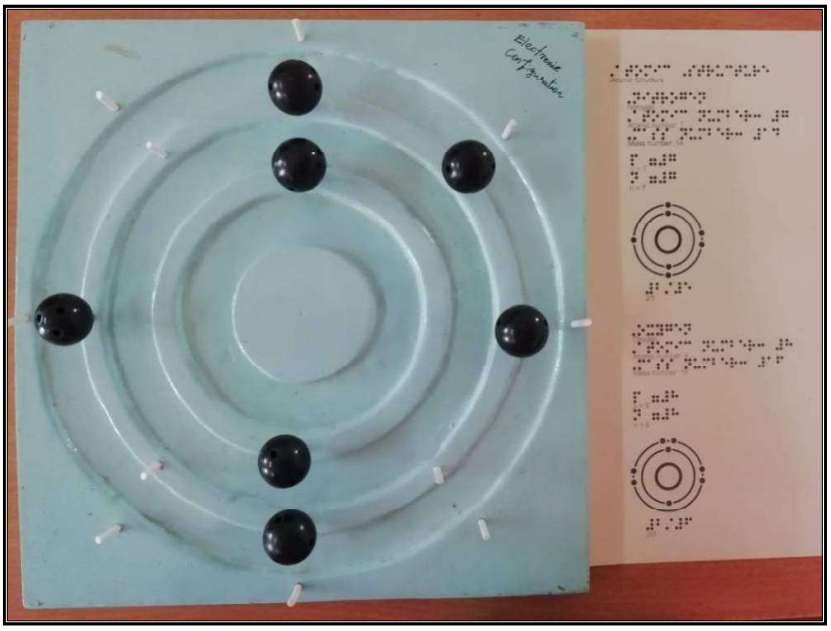
- Find out the number of electrons in the given element.
- Set the appropriate number of electrons in the circle (orbit).

Result:

The given element is_____and having_____electrons.

Adaptation Used:

Tactile mode of adaptation was used.



10. CHEMICAL REACTION

Aim:

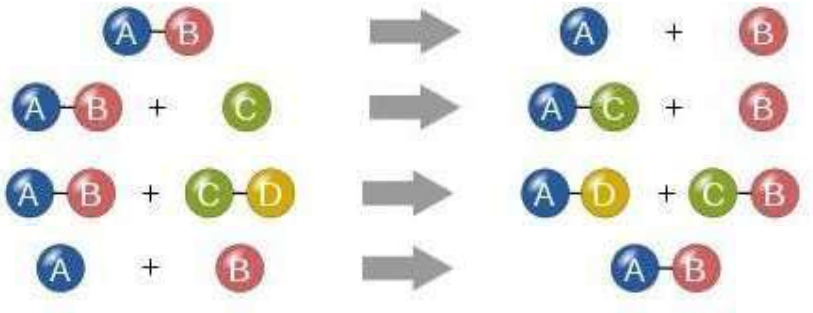
To find out the type of chemical reaction.

Material Required:
Tactile model of atomic balls

Procedure:

- Set the chemical reaction with the help of tactile atomic balls
- Find out the type of chemical reactions

1) Combination Reaction
2) Decomposition Reaction
3) Displacement Reaction
4) Double Displacement Reaction



Result:

The given chemical reaction is_____.

Adaptation Used:

- Chemical equations in Braille
- Tactile reaction bond with balls