DEVELOPING BASIC INTEGER FOR STUDENTS WITH VISUAL IMPAIRMENT USING NUMBER LINE

Submitted by

KEERTHANA S
(Reg.No.20PSE002)

Under the guidance of

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Assistant Professor
Department of Special Education

A THESIS SUBMITTED TO THE
AVINASHILINGAM INSTITUTE FOR HOMESCIENCE AND
HIGHER EDUCATION FOR WOMEN
COIMBATORE-641043

INPARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF

MASTER OF EDUCATION SPECIAL EDUCATION
(VISUAL IMPAIRMENT)

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CERTIFIED AS A BONAFIDE RESEARCH WORK

Signature of the Head of the Department	Signature of the Dean of the Faculty	Signature of the Guide

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KEERTHANA S

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INTRODUCTION

CHAPTER-1

INTRODUCTION

“ We are like integers on this number line universe, some are positive and some are negative”

- YASH MAURYA

1.0 Introduction

Mathematics is that the science and study of quality, structure, space, and change. Mathematicians hunt down patterns, formulate new concepts, and establish truth by rigorous deduction from fitly chosen axioms and definitions. Through abstraction and logical reasoning arithmetic evolved from tally, calculation, mensuration, and also the systematic study of the shapes and motions of physical objects. Sensible arithmetic has been somebody's activity for as way back as written records exist. Today, arithmetic is employed throughout the planet as an important tool in several fields, together with science, engineering, medicine, and also the social sciences. Mathematics, the branch of arithmetic involved with application of mathematical data to different fields, conjures up and makes use of recent mathematical discoveries and typically ends up in the event of entirely new disciplines. Mathematicians conjointly have interaction in math, or arithmetic for its own sake, while not having any application in mind, though sensible applications for what began as math area unit usually discovered later.

Mathematics is that the pillar of organized life for this day. While not numbers and mathematical proof, we tend to cannot resolve any problems in our daily lives. There are times, measurements, rates, wages, tenders, discounts, claims, supplies, jobs, stocks, contracts, taxes, cash exchange, consumption, etc., and within the absence of those sports information, we have got to face confusion and chaos.

Thus, arithmetic has become the companion of man and his helper since the start of human existence on earth. Once man initial wished to answer queries like "How many?" he was fictional scientific discipline. Then pure mathematics was fictional to facilitate calculations, measurements, analysis, and engineering.

The science of pure mathematics emerged once humans wished to find high mountains and stars. Therefore, the information of this text arose and developed once humans felt the requirement and arithmetic are necessary for the long designing of life and conjointly the daily designing of someone.

Although the importance of arithmetic will never be denied, a general concern of addressing scientific discipline exists in students across the globe. Having same that, the majority, these days grapple with the calculations, as they realize them too robust to handle.

1.1 Background of the Study

Mathematics is one in all the foremost vital sciences that can't be distributed with, and also the individual's would like for arithmetic isn't any but the requirement of society. Once finding out interest in arithmetic, this can develop our thinking and scientific tendencies. Mathematics conjointly works to precise the foremost correct and objective things, and it helps us to manage time and set up things, economic science etc.,

Mathematics is associate innate approach to analysis and to achieve an answer to mathematical issues. Mathematics may be a basic subject educated the least bit stages. The conduct of studies and research project needs several skills in sports, that facilitate within the development of studies and progress, as an example, the study of physics or chemistry depends heavily on arithmetic, together with mathematical skills and mathematical matters, and lies the role of arithmetic within the accuracy of conducting social analysis through the statistics branch. It helps arithmetic within the development and refinement of temperament, through organization and accuracy, analysis and investigation and study, and helps to notice. Like different sciences, arithmetic influences civilization's development.

Students' attitudes towards arithmetic education will have a major impact on their engagement with mathematics learning and their ulterior learning and action of the expectations. Students engaged in their learning and have opportunities to resolve fascinating, relevant, and significant issues among a collateral, safe, and comprehensive learning surroundings as lot of doubtless to adopt practices and behaviors that support mathematical thinking. With teacher support and encouragement, students learn that they will apply the talents they acquire in arithmetic to alternative contexts and subjects. Parents will support

their kid's arithmetic success by showing keen importance to the interest in what their kids are learning and by discovering with their children however what's being learned in school may be applied to everyday contexts.

1.2 Mathematics for Visually Impaired Students

The first issue in learning arithmetic is knowing about numbers and easy addition and subtraction. The sequence of teaching and learning the mathematical facts remains identical for each visually impaired students. It's expected that these students can get the ideas of numbers, calculations, size, direction and distance. The teachers managing visually impaired students use educational aids like blocks, cubes, beads, relief graphs, abacus and shapes. The aim is to present the visually impaired students with data related to pure mathematics, easy graphs etc., the visually impaired students want longer energy for understanding mathematical skills. The consecutive nature of arithmetic demands far more from visual impaired students. The requirements of visual impaired students is somehow completely different from general education students. They sometimes want prints of pages in big sizes on the other hand students usually want machines and software system to be sequenced in mathematical ideas and problems. Number lines are basic skill involved in mathematics ; variety lines facilitate students visualize variety sequences and demonstrate ways for a count, comparing, adding, subtracting, multiplying, positive and negative numbers, fractions and more. Tactile number line helps visually impaired students to understand the concepts in more meaningful way. Number lines help the students to tackle the real life problems with more ease where the teachers miss out to teach the visually impaired the concept of number line they face more problems in their future.

1.3 Concept of Integers

Integers was introduced in the year 1563 by Arbermouth Holst. He spend 15 years to develop the concept of integers. Integers are the set of whole numbers and negative numbers. Integers cannot have the fractional part. Therefore, integers can be a positive number, negative number or even zero. we can undergo all arithmetic operations like addition, subtraction, multiplication , division etc, using integers. The symbol used to represent the integers is 'Z'.

In our day to day life we use integers for various activities they help us to computate efficiently in almost every field. It help us to find how many steps we need to achieve our goals. Help us to know whether we are moving forward or backward from our goals. It shows whether the results are in a successful way or we are lacking in it. Integers gives our result in numerical format which can be further processed.

1.3.1 Types of Integers

Integers are classified into 3 types:-

1) Positive Integers
2) Negative Integers
3) Zero

Positive integers

All the numbers which we use to count in our daily life is positive integer. Positive integers are the numbers which are greater than zero. Eg: +2,+5

Negative integers

Negative integers are the numbers which are lesser than zero. Eg: -4, -6

Zero

Zero is neither positive or negative numbers. It is a whole number.

1.3.2 Integers on Number Line

A number line is a visual representation of numbers in a straight line. These lines are used to compare the numbers at equal intervals. Integers can also be represented using number line.

They help us to represent all the three types of integers in a straight line used to compare the greater number smaller numbers etc., through number line we can also perform arithmetic operations like addition, subtraction, multiplication and division .

1.3.3 Graphing of Integers on Number Line

Positive and negative numbers can be represented in the number line by keeping basic rule in our mind they are

- Positive numbers are placed on the right side of 0
- Negative numbers are placed on the left side of 0
- Zero is neither positive nor negative so it is placed at the center to both integers.

1.3.4 Integer Operations on Number Line

The four basic integer operation performed on the number line are

- Addition of integers
- Subtraction of integers
- Multiplication of integers
- Division of integers

Addition of Integers on Number Line

Adding integers is the process of finding sum of two or more numbers where the value might be increasing or decreasing. It depend on the signs of numbers. Adding integer on number line depends on the sign of second number ie., if we add a positive number we need to move right side on the number line, if we add a negative number we need to move towards left side of the number line.

Subtraction of Integers on Number Line

Subtracting a number on Number Line is depend on the subtrahend.to subtract a positive number we move leftside on the Number Line and to subtract the integer we move towards the rightside of the Number Line.

1.4 Need and Importance of the Study

The concept of integer lays the foundation for algebra in mathematics. This helps the student to improve their abstract thinking. So many studies suggests to inculcate integers in grade 3 rather than higher standards. Teacher has a vital role in developing integer concept among students using various methods and strategies. So the strategies help students to learn and understand the abstract ideas including integer calculations. Various model which has been used for teaching integers such as, thermometer, sea level model, directional objects and

debit-credit models etc., rather than these models the other model used for teaching integers is number line model. Number line model is very important to develop among students as it allows them to form a conceptual framework in learning mathematics. This model is otherwise known as directional model.

As number line is a visual representation of numbers in paper sighted children feel easy to learn it and understand the concept quickly. But when we talk about visually impaired students they face problems in visual representations so the concept of number line is more difficult for the student to understand and work on it. Teachers teach the concept of integers to all students in 'n' number of ways by giving aids, various examples, real life situations etc. where it is easy for the sighted and visually impaired to understand. But when the concept of integer is put forward by using number line the teachers skip the concept of teaching integers through number line for visually impaired students because it can create a confusion among them. But skipping the knowledge of number line can create an impact in the future. Because the concept of number line paves a way for solving certain real life problems where the visually impaired students fails to achieve it. Number line is very important which allows the child to have mental calculations and it involves numbers which represents the real life situations. Through number line we can make the child to understand that there exists a number called negative integers and we use them in our day to day activity. It becomes a great tool for the children to develop their mental arithmetic skill which helps to understand the relationship among various types of numbers. Number line has a great advantage to students to understand about the magnitude and the position of numbers and visualize operations. So it is very important to teach number line concept for visually impaired students with certain adaptations they require.

1.5 Statement of the Problem

The problem is stated as "**Developing basic integer for students with visual impairment using Number Line**".

1.6 Definition of Technical Terms

The technical terms in this study are as follows:

1.6.1 Visual Impairment

The World Health Organization (WHO) classifies visual impairment based on two factors: the **visual acuity**, or the clarity of vision, and the **visual fields**, which is the area from which you are able to perceive visual information, while your eyes are in a stationary position and you are looking straight at an object.

According to RPWD Act(2016) :- A person is said to be visually impaired if he/she has any of the following conditions below:

- Total absence of sight
- Visual acuity not exceeding 6/60 or 20/200 (Snellen) in the better eye even with correction lenses; or
- Limitation of the field of vision subtending an angle of 20 degree or worse.

1.6.2 Low Vision

According to RPWD act (2016), low vision means a condition where a person has any of the following conditions namely, visual acuity not exceeding 6/18 or less than 20/60 upto 3/60 or upto 10/200(snellen) in the better eye with best possible corrections.

1.6.3 Congenital Blindness

The term congenital blindness refers to the individual who is born with visual impairment by birth. It can be caused by many factors which includes genetic, infection transmitted by mother during pregnancy.

1.6.4 Acquired Blindness

The term acquired blindness refers to the individual who has acquired blindness later or after birth. It can be due to any brain damage, accidents etc.,

1.6.5 Integer

The term integer is a set of numbers which include positive numbers, negative numbers and zero**.**

1.6.6 Number Line

Number line can be defined as a straight line which represents numbers at equal intervals or segment along its length. It can be extended on both sides of the number line.

1.7 Objectives of the Study

The present study aims:

- To identify children with visual impairment of standard VI to IX.
- To prepare a tool and assess the performance of basic integer using Number Line among visually impaired students through a pre test.
- To give intervention for students on their difficulty level by using tactile number line.
- To make the students to use the basic integer concept in their real life.
- To find out the efficacy of the intervention through a post-test.

1.8 Hypothesis of the Study

The study explore the hypothesis as

- There is no significant difference between the students in terms of basic integer using number line before and after intervention
- There is no significant difference between pre and post-test in Representation of Numbers in integer with respect to standard VI-VII.
- There is no significant difference between pre-test and post-test in Basic Operation in integer with respect to standard VI - VII.
- There is no significant difference between pre-test and post-test in Rules of Integer with respect to standard VI - VII.
- There is no significant difference between pre-test and post-test in Application Sums in integer with respect to standard VI - VII.
- There is no significant difference between pre and post-test in Representation of Numbers in integer with respect to standard VIII - IX.
- There is no significant difference between pre-test and post-test in Basic Operation in integer with respect to standard VIII - IX.

- There is no significant difference between pre-test and post-test in Rules of Integer with respect to standard VIII - IX.
- There is no significant difference between pre-test and post-test in Application Sums in integer with respect to standard VIII - IX.
- There is no significant difference between the post-test in basic integers using number line with respect to Locality, Type of Disability, Onset of Disability, Type of Family, Educational Qualification of Parents, Braille Skill.

1.9 Scope of the Study

- The present study would help us to find the level of visually impaired students in the basic integer concept.
- It help us to understand the various difficulties faced by the students in understanding the number line.
- It gives us an idea whether the number line concept is applicable to visually impaired students.
- Helps to know what are the ways the teacher can use to make the students understand the number line concept.
- Helps to know how number line is used to understand the concept of integers

1.10 Limitations of the Study

- This study was conducted only for girls and not for boys.
- The intervention given to the students only in Tamil medium.
- Sample size is limited due to the pandemic situation.
- This study underwent samples of only students in Trichy blind school.

1.11 Organization of the Study

The study is organized "**Developing basic integer for students with visual impairment using number line**" in five chapters.

- The first chapter presents Introduction, Need and Importance of the Study, Statement of the Problem, Definitions, Objectives, Hypothesis of the Study, Scope of the Study and Limitations of the Study.

- The second chapter includes review of related literature and researchers to the present study.
- The third chapter includes the method of the study undertaken for the present study.
- The fourth chapter presents the detailed analysis on the data collected from the sample.
- The fifth chapter deals the summary of the findings discussion, recommendations, suggestions and conclusion.

REVIEW OF LITERATURE

CHAPTER II

REVIEW OF LITERATURE

CHAPTER-2

LITERATURE REVIEW

2.0 Introduction

Literature review is the foundation for every research Literature review is important for the researcher to identify whether the research is available previously or to understand about the various aspects of the interpretation in the research. It helps us to find the research question of our research which is very important for a successful result. Through review of literature we can adopt appropriate methodology from the existing research in the same field. It can make a researcher to create new ideas from the existing one.

2.1 Definition- Literature Review

According to Fink, Arlene (2014) "A literature review surveys books, scholarly articles, and any other sources relevant to a particular issue, area of research, or theory, and by so doing, provides a description, summary, and critical evaluation of these works in relation to the research problem being investigated. Literature reviews are designed to provide an overview of sources you have explored while researching a particular topic and to demonstrate to your readers how your research fits within a larger field of study."

According to W.R. Borg– "The literature in any field forms the foundation upon which all future work will be built. If we fail to build the foundation of knowledge provided by the review of literature our work is likely to be shallow and naïve and will often duplicate work that has already been done better by someone else."

2.2 Importance of Literature Review

- It helps the research to understand the research gap and frame the research question according to the current situation.
- It help us to know how our research is linked with the existing theory.
- It helps to know the strength and weakness of the research done previously on the same subject and allows to understand whether the concept must be recreated or replace.

- It helps us to identify what are all the possible problems the researcher may face during the research and how could it be solved.
- Through literature review the researcher can save his/her time and focus on the correct aspect of the research problem.

2.3 Purpose of Review

- Place each work in the context of its contribution to understanding the research problem being studied.
- Describe the relationship of each work to the others under consideration.
- Identify new ways to interpret prior research.
- Reveal any gaps that exist in the literature.
- Resolve conflicts amongst seemingly contradictory previous studies.
- Identify areas of prior scholarship to prevent duplication of effort.
- Point the way in fulfilling a need for additional research.
- Locate your own research within the context of existing literature

The literature related to Number Line concept for visually impaired are arranged under the headings as follows:

- **Studies related to teaching mathematics of visually impaired students**
- **Studies related to accessibility in mathematics for students with visual impairment**
- **Studies related to the concept of integer in mathematics**
- **Studies related to the concept of number line for visually impaired students**

STUDIES RELATED TO TEACHING MATHEMATICS OF VISUALLY IMPAIRED STUDENTS

Oyebanji, M. S., & Idiong, U. S. (2021) studied " Challenges of Teaching Mathematics to Students with Visual Impairment". This study aimed at investigating the challenges of teaching mathematics to visual impaired students in school of the blind, a case study of some

selected schools for the visually impaired. Questionnaire and interview were used for data collection from the respondents. The hypotheses in the study were tested using t-test with α-level of 0.05 through SPSS. The study followed a cross-section survey design and involved 80 respondents 20 for the visually impaired students, 10 for the Mathematics teachers, 10 special mathematics teachers, 40 low vision and non-visually impaired students. The findings revealed the visually impaired students receive bursaries from the government and non-government organization; meal, accommodation, and few scholastic materials from their school; extra time during mathematics classes and examination and friend support. However, constraining limitations in the method of instruction assessment used and the instructional materials provided were noted, on the basis of these findings, recommendation towards the better education of the visually impaired student studying mathematics should be encouraged and employment of special mathematics teachers.

van Leendert, A., Doorman, M., Drijvers, P., Pel, J., & van der Steen, J. (2021) studied " Teachers' Skills and Knowledge in Mathematics Education for Braille Readers". Braille readers use a braille display and text-to-speech synthesizer while reading and comprehending mathematical expressions and equations. Teachers need to have technological, pedagogical and content (TPACK) knowledge and skills for exploiting the potential of these devices in mathematics education. They have to understand how the use of assistive technology influences the teaching and learning of mathematics. Therefore, the aim of the current study is to support teachers to better understand the dynamic relation between the different TPACK domains. That is why a professional development course was developed in which five mathematics teachers of braille readers in special secondary education participated. The development of the teachers' TPACK knowledge was analyzed, and course characteristics that helped to develop this knowledge were identified. The results show an increased awareness of the importance of assistive devices, but only a small positive effect in TPACK knowledge and skills. Course activities related to the braille display, the mathematical braille notation and mathematical vocabulary helped to develop TPACK knowledge. However, course activities related to the text-to-speech synthesizer and working in heterogeneous groups did not work out so well. A better understanding of what teaching mathematics to braille readers means is expected to improve their learning.

Klingenberg, O. G., Holkesvik, A. H., & Augestad, L. B. (2020) explored "Digital learning in mathematics for students with severe visual impairment: A systematic review". Mathematical education is currently undergoing significant changes that are driven by technology and digital-based learning. Students with visual impairments (VI) may face different challenges in mathematical education due to a lack of accessible materials designed to support the development of conceptual understanding in mathematics. The aim of the study was to summarize current evidence-based knowledge about e-learning in mathematics among students with severe VI. A systematic review was conducted of articles published from January 2000 to November 2017. A total of 13 publications met the inclusion criteria, of which 12 reported studies with an intervention or an experimental design and one had a cross-sectional design. The number of students with VI varied from three to 16. Four publications reported either ophthalmic diagnoses or World Health Organization's (WHO) definition of vision loss. The mathematical training was reported as lasting from one session to 18 weeks of training. Eight papers reported the use of audio-based applications as learning aids. The authors conclude that interactive e-learning with audio and tactile learning programmes may be a useful resource for students with VI to enhance their mathematical skills. However, there is lack of evidence for how digital technologies improve inclusion potentials and learning in mathematics for students with VI, and hence, there is a need for additional research and more reflection on the subject.

Spinczyk, D., Maćkowski, M., Kempa, W., & Rojewska, K. (2019) explored "Factors influencing the process of learning mathematics among visually impaired and blind people". Effective instruction and comprehension of mathematics are important for achieving academic and professional success but are especially difficult for visually impaired individuals because of the inherent difficulty in managing structural information included in math formulae. An evaluation of an alternative for computer-aided math instruction and comprehension among visually impaired students was developed, and the evaluation included seven detailed categories of factors: behavioral, emotional, cognitive, social, distracting, motivational, and modeling factors. Then, the proposed method was used to compare the alternative teaching method, including problem decomposition and vector knowledge, to the classical teaching method with a teacher. The assessment of the impact of the developed approach on improving the process of teaching mathematics in a group of blind and visually impaired students was

carried out by the completion of a questionnaire prepared by a psychologist. The alternative teaching method achieved significantly better results in six of the seven proposed assessment categories. These experiments extend the knowledge base on the limitations and challenges associated with teaching and learning mathematics among blind people.

Klingenberg, O. G., Holkesvik, A. H., & Augestad, L. B. (2019) had explored " Research evidence for mathematics education for students with visual impairment: A systematic review ". The aim of the study was to conduct a systematic review in order to synthesize the evidence-based literature on mathematics education among students with visual impairment (VI). Studies were identified through searches of electronic databases (SCOPUS, PubMed, ERIC, and Web of Science). The authors included articles published between 1 January 2000 and 31 October 2017. Eleven publications met the inclusion criteria, and seven studies had observational designs. The studies focused on teachers' attitudes and experiences, the use of abacus, tactile graphics, and the development of mathematical concepts. The results showed that the studies had different aims and methods, and only four studies reported eye disorder diagnoses. The ability to choose suitable teaching strategies that involve individual instructions requires qualified and enthusiastic teachers who allow students to experience a sense of accomplishment and success. Additionally, it is important to gain information on eye disorder diagnoses and possible learning disabilities. The authors conclude that it is to be expected that students with VI but without cognitive disabilities will follow their grade level in mathematics. The findings highlight the need for more randomly controlled, high quality trials in order to obtain more evidence and knowledge of mathematics education among students with VI.

Pratama, A. R., & Saputro, D. R. S. (2018) researched on " Problem solving of student with visual impairment related to mathematical literacy problem". The student with visual impairment, total blind category depends on the sense of touch and hearing in obtaining information. In fact, the two senses can receive information less than 20%. Thus, students with visual impairment of the total blind categories in the learning process must have difficulty, including learning mathematics. This study aims to describe the problem-solving process of the student with visual impairment, total blind category on mathematical literacy issues based on Polya phase. This research using test method similar problems mathematical

literacy in PISA and in-depth interviews. The subject of this study was a student with visual impairment, total blind category. Based on the result of the research, problem-solving related to mathematical literacy based on Polya phase is quite good. In the phase of understanding the problem, the student read about twice by brushing the text and assisted with information through hearing three times. The student with visual impairment in problem-solving based on the Polya phase, devising a plan by summoning knowledge and experience gained previously. At the phase of carrying out the plan, students with visual impairment implement the plan in accordance with pre-made. In the looking back phase, students with visual impairment need to check the answers three times but have not been able to find a way.

Nahar, L., Jaafar, A., & Sulaiman, R. (2017) explored "Mathematics Education and Accessible Technologies for visually impaired students in Bangladesh ". The learning process for the visually impaired students (VIS) is complicated because they are unable to get visual information. A lot of challenges and problems these VIS are facing to get education, especially in studying Mathematics. As a developing country, Bangladesh cannot afford for the costly Mathematics learning tools for VIS. The objective of this study is to analyze the current scenarios of learning Mathematics in different types of blind schools in Bangladesh. A survey is conducted in all three types of schools in order to achieve the objective. The survey was based on questionnaire comprising questions related to Mathematics learning, examination methods and learning difficulties. Survey results shows that they follow Braille system for reading and writing; however, they cannot write in Braille in the final examination. Taylor frame and abacus are the only options for counting numbers.

Bayram, G. İ., Corlu, M. S., Aydın, E., Ortaçtepe, D., & Alapala, B. (2015) conducted "An exploratory study of visually impaired students' perceptions of inclusive mathematics education". The Turkish Disability Act introduced inclusive education to Turkey as a solution to the problems experienced by students with disabilities, including visually impaired students. The main purpose of this study was to explore the challenges faced by visually impaired students learning high school mathematics in inclusive classrooms in Turkey. The data were qualitative, consisting of interviews conducted with three high school graduates; they were analysed using the constant comparison method. In the interviews, students described the effects of various teaching methods on their learning and evaluated the social

aspect (broadly speaking) of inclusive education. The results show that while the social needs of visually impaired Turkish students were adequately met through inclusive education, their academic needs were not, which we speculate to be partly because of mathematics teachers' negative attitudes towards inclusive education.

DePountis, V. M., Pogrund, R. L., Griffin-Shirley, N., & Lan, W. Y. (2015) explored "Technologies used in the study of advanced mathematics by students who are visually impaired in classrooms: Teachers' perspectives". This research examined the perspectives of teachers of students who are visually impaired regarding the use and effectiveness of high-tech assistive technology purported to assist visually impaired students in advanced mathematics. The data for this study were collected via a mixed-methods online survey distributed through professional networks to reach teachers with experience supporting students who are braille readers in advanced mathematics. A device matrix was used to ask participants about three interrelated issues. First, which of the 35 assistive technologies presented did they use to aid students? Second, how was the technology implemented? And third, how did they rate the effectiveness of each device used? Open-response items provided space for additional tools and other feedback. Results conclusively indicated that 20 of the 35 technologies were used; of these, 13 were used regardless of subject. More than half of the participants indicated that the same four technologies were implemented for student information access during class, guided practice, and independent practice. Participants recommended seven technologies not included in the device matrix through the open-response questions.

Figueiras, L., & Arcavi, A. (2014) studied "A touch of mathematics: Coming to our senses by observing the visually impaired" During the last three decades, the impact of visualization processes on the teaching and learning of mathematics has been extensively researched. However, considerably less work has been devoted to haptic processes. In this paper, we describe and analyze the role of haptic processes from data collected in mathematics lessons taught in a school for blind students. The analysis builds upon studies from perception and also from teaching experiences in order to examine the teacher's and the students' hand movements and metaphors when handling solids of revolution and communicating verbally with each other about their insights. We highlight the powerful combination of the visual and

the haptic components of their interactions for the conceptualization of mathematical experiences, and we also note the critical role mathematical language plays in supporting the teaching–learning processes in this context. Finally, we consider important educational implications not only for blind people, but for all students and teachers of mathematics.

Wongkia, W., Naruedomkul, K., & Cercone, N. (2012) conducted a study on "i-Math: Automatic math reader for Thai blind and visually impaired students". They propose an automatic math expression reading system, called i-Math. i-Math is an educational tool, for blind and visually impaired (VI) students, to facilitate access to math materials. Although blind and VI students can access math documents/materials via many channels, e.g., human reader, math Braille codes, and audio (talking) books, these channels have limited availability. i-Math was designed to be an automatic reading aided tool and also a math learning and teaching tool for both students and teachers. i-Math operated with screen reader produce voice output on a computer. i-Math can read math documents aloud. Students can enjoy their newfound ability to read and practice math anytime and anywhere with i-Math while teachers can prepare their classroom handouts, assignments and exercises in audio version conveniently. The evaluation of i-Math was conducted with 78 blind and VI students and six teachers. The evaluation results indicate that math materials can be easily accessible to blind and VI students through i-Math and then, they can independently and comfortably study and practice their mathematics.

STUDIES RELATED TO ACCESSIBILITY IN MATHEMATICS FOR STUDENTS WITH VISUAL IMPAIRMENT

Ahmetovic, D., Bernareggi, C., Bracco, M., Murru, N., Armano, T., & Capietto, A. (2021) explored "LaTeX as an inclusive accessibility instrument for highschool mathematical education". This paper describes the design, implementation and outcomes of a teaching activity in high school setting, aimed at supporting a student with visual impairments in learning Mathematics and promoting inclusive learning involving all other students. The teaching activity was defined following an adoption-centered approach. During the initial needs-finding stage, we explored the available instruments for inclusive access and authoring of mathematical formulae, and we identified the LaTeX typesetting language as the instrument of choice. The use of LaTeX was motivated by the fact that it provides a textual

representation of mathematical content, thus making it accessible through standard assistive technologies, such as Braille displays and screen readers. LaTeX is also widely used in higher education to author scientific documents, and therefore constitutes a useful skill for future education and employment of all students. The students had no difficulties in following the teaching activity, including learning and using LaTeX, and most were eager to apply the acquired skills for authoring lab reports and homework. However, the acceptance of the assistive tool by the student with visual impairments was low. Additionally, most of the other teachers displayed high resistance to change and therefore were not interested in supporting the activity and integrating it with their classes.

Maćkowski, M., Brzoza, P., Meisel, R., Bas, M., & Spinczyk, D. (2020) conducted " Platform for math learning with audio-tactile graphics for visually impaired students". Effective teaching and understanding of Mathematics are essential for achieving success in an academic or professional career, especially in a technical area. In the case of blind or visually impaired people, the limited access to math educational materials is an additional cognitive obstacle that influences various parts of life. Therefore, within the authors' research, a platform that shares graphic math content (charts, geometric figures, etc.) in the audio-tactile form to blind students was developed. The paper intends to present the developed solution and the initial results of teaching math based on the audio-tactile form of presenting the graph math content. The platform developed within the research is not only designed to share the visual information used in mathematics, but it allows the users for independent learning in a step by step way and then evaluation of student's progress made by a teacher or a psychologist. To measure the effectiveness of the proposed platform and learning method, the authors proposed quantitative measures: improvement of learning results, users' feelings (sentiment analysis), assessment of cognitive aspects of test participants. Initial research on the test group indicates better assimilation of math knowledge and improved participants' positive sentiment and their cognitive abilities.

Maćkowski, M., Żabka, M., Kempa, W., Rojewska, K., & Spinczyk, D. (2020) explored "Computer aided math learning as a tool to assess and increase motivation in learning math by visually impaired students". Effective teaching and learning mathematics is important to achieve good results during an academic and professional career. This is especially difficult

for visually impaired students because of difficulties in managing structural information included in maths formulae. The extended multimedia alternative method, including the problem of decomposition and knowledge vector, were presented and compared to the classical teaching method. A qualitative method to evaluate motivation during the process of teaching and learning maths for impaired students, which includes eleven detailed motivators, has been developed. The alternative teaching method offers statistically significant improvements in four of the eleven proposed assessment categories: success in progress – adjusting the difficulties of learning, presentation of the material, approval: group/individual and alternative presentation of mathematic materials. The experiments carried out allowed the authors to increase the knowledge about the limitations and challenges occurring in the process of maths education among visually impaired students and their motivation.

Stone, M. P. (2019) studied "Mathematics Experiences of Students Who Are Blind or Visually Impaired". Historically, researchers studying mathematics education for students with visual impairment (SVI) have faced several challenges. Quantitative researchers are limited by small sample sizes and the need to adapt traditional research instruments for accessibility by SVI. Qualitative research, most often conducted by sighted researchers and relying on the perspectives of sighted educators, suffers from the absence of the voices of the SVI being studied. Overwhelmingly, research on the mathematics education of SVI is explicitly grounded in deficit models of disability, falsely conflating the physical condition of impairment with the social act of disablement. Only in the past decade have critical disability studies researchers brought rehumanizing lenses and emancipatory methodologies to this field of study. Inspired by this emergence of research that repudiates normative definitions of mathematical proficiency and privileges the voices of SVI, this study utilized three methodologically distinct but conceptually unified cases to explore the mathematics experiences of visually impaired students. The first case, a narrative literature review, utilized the lens of critical disability studies to analyze historical and contemporary works of significance. It established the conceptual, theoretical, and methodological groundwork for the second case, an emancipatory study of the accessibility experiences of students enrolled in online and hybrid undergraduate mathematics courses. Data from the second case fueled the third case, an interactive, neo-futurist simulation of inaccessibility faced by SVI seeking

equitable access to mathematics education; it subverted the authority of content-providers as arbiters of accessibility.

Dumkasem, K., Srisingchai, P., & Rattanatamrong, P. (2019) introduced " EyeMath: Increasing Accessibility of Mathematics to Visually Impaired Readers". Mathematics education for visually impaired students is challenging because their learning materials are generally limited to braille books, and audiobooks. In order to increase the chance of learning mathematical content for people with visual impairment, this paper presents the design and development of a cloud-based mobile application called EyeMath, using serverless microservices in Amazon AWS. Users can provide images of page snippets for the application to process and read their content to the users. EyeMath segments an input image into smaller pieces and separates pieces that have only plain text from pieces with mathematical symbols. The mathematical-related pieces are further processed into an Abstract Syntax Tree (AST) and then parsed into Thai sentences. For plain text pieces, EyeMath relies on Tesseract OCR to convert them into text. Finally, results for all pieces are combined together systematically for the device's screen reader program to read aloud. The performance evaluation of the application shows high correctness in reading math content within test images and our usability testing confirms the potential usefulness of the application to visually impaired readers.

Maćkowski, M., Brzoza, P., Żabka, M., & Spinczyk, D. (2018) explored " Multimedia platform for mathematics' interactive learning accessible to blind people". Nowadays, the math learning is an important step in developing professional carriers in technical and economic sciences. Taking into account the barriers the article presents the developed method used for creating interactive steps of decomposed math's exercise solution and alternative description of math formulas accessible for the blind. The elements of proposed methodology: generation of state machine, design and presentation of transition conditions, generating the presentation layer and a typical usage by a blind user are presented. A set of rules for describing mathematical formulas were proposed after consultation with mathematicians and teachers of blind people. The application was developed as web application. The graphical interface of presented application was designed using PHP and JavaScript technologies. The collection of prepared exercises include about 240 prepared exercises from different areas of

mathematics and 60 selected exercises including alternative description layer. About 1000 students and about 40 impaired students, from 6 faculties of the university use this platform during math courses for both self and class learning. The defined rules were used to read aloud mathematical formulas to the visually impaired people with a different level of mathematical knowledge. The results confirmed good understanding of mathematical formulas by using prepared alternative description.

Beal, C. R., & Rosenblum, L. P. (2015) explored " Development of a Math-Learning App for Students with Visual Impairments". The project was conducted to make an online tutoring program for math word problem solving accessible to students with visual impairments (VI). An online survey of teachers of students with VI (TVIs) guided the decision to provide the math content in the form of an iPad app, accompanied by print and braille materials. The app includes audio descriptions of images that illustrate the math problems, an integrated Scratch Pad, options to adjust color and contrast, hints, and videos showing how to solve sample problems. In order to provide access to those needing screen reading technology or screen enlargement, the app utilizes the Apple built-in accessibility features of VoiceOver and Zoom. A study with 19 TVIs and 29 students with VI was conducted to obtain feedback about the app and materials. Comments were generally positive, but both students and teachers reported that the quality of the hints varied and that the videos were not very helpful. Thus, the hints were revised, and narrated videos showing step-by-step solutions were added to each problem. A single subject study is in progress to compare students' performance when using the app and materials with the traditional way they access math materials (print, braille).

Huang, P. H., Chiu, M. C., Hwang, S. L., & Wangan, J. L. (2015) explored that "Investigating e-learning accessibility for visually-impaired students: an experimental study". STEM education has long been recognized as the foundation for national competitiveness and future prosperity. In STEM, mathematics serves as the key to other areas (science, technology and engineering). Existing evidence shows that an integrated curriculum in mathematics enhanced the majority of students' performances on standardized tests. However, many visually-impaired students seem to fail to reach proficiency in mathematics. In this paper, we present a new approach to promote vision-impaired students' overall math performance and enrich their learning experiences. We first investigated student learning difficulties and then

developed a new mathematics curriculum with the integration of the Digital Accessible Information System (DAISY). This curriculum mainly addresses DAISY-compliant electronic textbooks that can be displayed on a Non-Visual Desktop Access (NVDA) screen reader. Finally, we conducted an experiment in order to evaluate the effects of the new teaching approach. The experiment included a four-day pedagogical program and an assessment session. Specifically, the test focused on students' mathematics scores and their NASA-TLX subjective mental workload. The findings showed that the value of the NASA-TLX subjective scales was significant and the student accuracy rate increased. Thus, we conclude that this new method effectively improved vision-impaired students' proficiency in mathematics. The findings showed that the value of the NASA-TLX subjective scales was significant and the student accuracy rate increased. Thus, we conclude that this new method effectively improved vision-impaired students' proficiency in mathematics.

Brzostek-Pawlowska, J., & Mikulowski, D. (2014) reviewed " A concept of mobile technology for remotely supporting mathematical education of the blind". The paper presents a concept of mobile assistive technology enabling teachers to remotely support mathematical education of individual blind students or groups of blind students. Online teachers' support for blind students, who face obstacles to editing and reading mathematical formulae and figures, increases the efficiency of education process. The concept covers above all solutions for increasing the efficiency of synchronous, real-time math-related communication between sighted teacher and blind student who use different interfaces. Support is available regardless of teacher's and student's locations; it is provided via the Internet or otherwise, using local connections such as Wi-Fi or Bluetooth.

Nazemi, A., & Murray, I. (2013) researched " A method to provide accessibility for visual components to vision impaired". Non-textual graphical information (line graphs, bar charts, pie charts, etc.) are increasingly pervasive in digital scientific literatures and business reports which enabling readers to easily acquire the nature of the underlying information . These graphical components are commonly used to present data in an easy-to interpret way. Graphs are frequently used in economics, mathematics and other scientific subjects. In general term data visualization techniques are useless for blind people. Being unable to access graphical information easily is a major obstacle to blind people in pursuing a scientific study and careers

.This paper suggests a method to extract implicit information of Bar chart, Pie chart, Line chart and math's graph components of an electronic document and present them to vision impaired users in audio format. The goal is to provide simple to use, efficient, and available presentation schemes for non textual which can help vision impaired users in comprehending form without needing any further devices or equipments. A software application has been developed based on this research. The output of application is a textual summary of the graphic including the core content of the hypothesized intended message of the graphic designer. The textual summary of the graphic is then conveyed to the user by Text to Speech software .The benefit of this approach is automatic providing the user with the message and knowledge that one would gain from viewing the chart.

STUDIES RELATED TO THE CONCEPT OF INTEGER IN MATHEMATICS

Bryant, D. P., Bryant, B. R., Dougherty, B., Roberts, G., Pfannenstiel, K. H., & Lee, J. (2020) conducted a research on " Mathematics performance on integers of students with mathematics difficulties". The purpose of this study was to report on findings regarding an integer module intervention. We provided the effects of the integers module lessons intervention on the mathematics performance of 7th grade students with mathematics difficulties. We provided an analysis of the mathematics interventionists' and their students' perspectives about the integer module to help explain the findings. A total of 908 students participated in the study and were randomized to one of two conditions. The research design was class-randomized with classes allocated to the treatment or control condition. The analyses showed that the condition predicted students' slope estimate, on average ($\beta = 0.61$, $p = .004$) where students receiving treatment made greater gains than students in the control condition. Regarding the interventionists' and students' perspectives about the integer module lessons, both interventionists and students had overall positive ratings of the intervention components.

Khalid, M., & Embong, Z. (2019) conducted a study on " Sources and possible causes of errors and misconceptions in operations of integers". This research investigated students' sources and causes of errors and misconception in solving routine problems involving addition, subtraction, multiplication, and division of integers. This qualitative study involved observation of eight Year 7 classes and interviews with the respective classroom teachers.

Sixteen Year 7 students who exhibit errors when solving the problems given in the Error Identification Integer Test (EIIT) were also interviewed to probe their thinking. The different types of errors were categorized according to how they were construed. The sources of errors were found to stem from carelessness, poor basic knowledge such as the inability to multiply and divide even the whole numbers, inability to assimilate concepts of integers since they are used to the schema of whole numbers, and rule mix-up which is also the result of surface understanding. Teachers were questioned about common errors and possible reasons for these errors made by their students. The main cause of errors and misconceptions is superficial understanding, which was most probably due to teachers rushing to complete the extensive syllabus, and consequently, students resorted to memorizing rules because of surface understanding. Teaching episodes were found to lack multiple-representation, creativity, as well as cooperative learning and active learning.

Sipayung, T. N., & Anzelina, D. (2019) conducted a study on "analysis of students problem solving skills using a realistic mathematics approach on integers materials". This study aims to describe the problem-solving skills of seventh-grade students of junior high school by using a realistic mathematics approach on integers materials. This study was conducted qualitative descriptive research. The subjects of this study were class VII-B students of Junior High School of Nusantara Lubuk Pakam in the Academic Year of 2018/2019. They were 36 students. The instrument of data collection in this study was conducted by problem-solving skills test which included four indicators consisting of comprehending the problem, making plans, implementing the plan, and re-checking the results obtained. The integers test material consists of (1) The recognizing and comparing integers; (2) the addition and subtraction of integers; and (3) the multiplication and division of integers. The results of the study state that the average overall problem-solving skills of students in integer material increases. This can be seen from the percentage of the average score of the overall problem-solving abilities of students from 3 subtopics on integers material.

Mulbar, U., & Zaki, A. (2018) explored that "Design of realistic mathematics education on elementary school students". This study focuses on developing learning design based on realistic mathematics education. The learning design developed related to the real life of students, so students are expected to enjoy and tend to like mathematics. The results showed

that the realistic mathematics education design consisting of a lesson plan, a teachers guide, a student book, a student worksheet, and mathematics achievement test are in good quality, which meet the criteria of validity, practicality, and effectiveness. Mathematics achievement test as a research instrument meets the criteria of validity, sensitivity, and reliability. In learning process by using realistic mathematics education, the students are more active, have an energy and motivation to learn, so there is a good impact on the improvement of students learning achievement.

Ozdemir, A. S., & Sahal, M. (2018) conducted a research on "The effect of teaching integers through the problem posing approach on students' academic achievement and mathematics attitudes". Throughout history, many changes have occurred in the field of mathematics education. These changes have also occurred concerning special topics that mathematics educators have constantly been searching. The significance of problem posing in mathematics teaching has increased recently with respect to its contributions to the teacher and the student. Thus, the problem posing approach is examined with respect to special topics. The effect of teaching integers through the problem posing approach on sixth grade students' academic achievement and mathematics attitudes. Mixed method, in which quantitative and qualitative research methods are used together, was conducted in the study. While the pre-test post-test control group model constituted the quantitative dimension of the study, the observation method and content analysis of students' work sheets were used for the qualitative dimension. The study groups consisted of a total of 69 participants, 34 of them were in the experimental and 35 of them were in the control group. According to the findings of the study, there was a difference in favor of the experimental group with respect to the academic achievement levels; and there were no significant differences between two groups with respect to the attitudes towards mathematics. The observations indicated that the problem posing approach created a peaceful competition environment, and increased participation in the classroom. In addition, the student work sheets showed that participants' problem posing skills progressed, and they became aware of their mistakes. In conclusion, the problem posing approach had a positive effect on the academic achievement in teaching integers, but it did not have a significant effect on student attitudes towards mathematics.

Schindler, M., Hubmann, S., Nilsson, P., & Bakker, A. (2017) conducted a research on "Sixth-grade students' reasoning on the order relation of integers as influenced by prior experience: an inferentialist analysis". Negative numbers are among the first formalizations students encounter in their mathematics learning that clearly differ from out-of-school experiences. What has not sufficiently been addressed in previous research is the question of how students draw on their prior experiences when reasoning on negative numbers and how they infer from these experiences. This article presents results from an empirical study investigating sixth-grade students' reasoning and inferring from school-based and out-of-school experiences. In particular, it addresses the order relation, which deals with students' very first encounters with negative numbers. Here, students can reason in different ways, depending on the experiences they draw on. We study how students reason before a lesson series and how their reasoning is influenced through this lesson series where the number line and the context debts-and-assets are predominant. For grasping the reasoning's inferential and social nature and conducting in-depth analyses of two students' reasoning, we use an epistemological framework that is based on the philosophical theory of inferentialism. The results illustrate how the students infer their reasoning from out-of-school and from school-based experiences both before and after the lesson series. They reveal interesting phenomena not previously analyzed in the research on the order relation for integers.

Aris, R. M., & Putri, R. I. I. (2017) conducted a research on " Design Study: Integer Subtraction Operation Teaching Learning Using Multimedia in Primary School". This study aims to develop a learning trajectory to help students understand concept of subtraction of integers using multimedia in the fourth grade. This study is thematic integrative learning in Curriculum 2013 PMRI based. The method used is design research consists of three stages; preparing for the experiment, design experiment, retrospective analysis. The studied was conducted on 20 students of grade four The activities of students in this study consisted of six learning trajectories. The first activity asks the students to classify heroism and non-heroism acts, summarize, and classify integers and non-integer. The second activity asks the students to answer the questions in the film given. The third activity asks students to count the remaining gravel in the film. The fourth activity asks students to count remaining spent money in the film. The fifth activity invites students to play rubber seeds in the bag. The last activity asks students to answer the questions in the student worksheet. The media used along the

learning activities are a ruler, rubber seed, student worksheet, money, gravel, and film. The results indicate that the learning trajectory using multimedia help students understand the concept of integer subtraction integer.

Shanty, N. O. (2016) studied that "Investigating students' development of learning integer concept and integer addition". This research aimed at investigating students' development of learning integer concept and integer addition. The investigation was based on analyzing students' works in solving the given mathematical problems in each instructional activity designed based on Realistic Mathematics Education (RME) levels. Design research was chosen to achieve and to contribute in developing a local instruction theory for teaching and learning of integer concept and integer addition. In design research, the Hypothetical Learning Trajectory (HLT) plays important role as a design and research instrument. It was designed in the phase of preliminary design and tested to three students of grade six OASIS International School, Ankara ,Turkey. The result of the experiments showed that temperature in the thermometer context could stimulate students informal knowledge of integer concept. Furthermore, strategies and tools used by the students in comparing and relating two temperatures were gradually be developed into a more formal mathematics. The representation of line inside thermometer which then called the number line could bring the students to the last activity levels, namely rules for adding integer, and became the model for more formal reasoning. Based on these findings, it can be concluded that students' learning integer concept and integer addition developed through RME levels.

Stephan, M., & Akyuz, D. (2012) studied " A proposed instructional theory for integer addition and subtraction". This article presents the results of a 7th-grade classroom teaching experiment that supported students' understanding of integer addition and subtraction. The experiment was conducted to test and revise a hypothetical learning trajectory so as to propose a potential instructional theory for integer addition and subtraction. The instructional sequence, which was based on a financial context, was designed using the Realistic Mathematics Education theory. Additionally, an empty, vertical number line (VNL) is posited as a potentially viable model to support students' organizing their addition and subtraction strategies. Particular emphasis is placed on the mathematical practices that were established in

this setting. These practices indicate that students can successfully draw on their experiences with assets, debts, and net worths to create meaning for integer addition and subtraction.

Akyüz, D., Stephan, M., & Dixon, J. K. (2012) studied " The role of the teacher in supporting imagery in understanding integers". This paper presents the results of a design experiment conducted in a 7th grade mathematics classroom aimed at improving students' understanding of integer concepts and operations. The study particularly focuses on an expert teacher's role in helping students develop meaningful imagery which students can use as a foundation to fold back and rely on as they engage in further mathematical activities. Toulmin's model of argumentation is used as an analytical tool to document when an image becomes taken-as-shared by the classroom community. The results suggest that the practices of the teacher played an important role in students' development of various images in understanding and solving integer problems meaningfully as well as communicating their ideas effectively.

Ünal, Z. A., & Ipek, A. S. (2009) studied " The Effect of Realistic Mathematics Education on 7th Grade Students' Achievements in Multiplication of Integers". Realistic Mathematics Education (RME) is a mathematics education approach found by Hans Freudenthal to find answers to the need to reform the teaching and learning of mathematics and a domain-specific instruction theory for mathematics education. In this research, the effects of realistic mathematics education (RME) were investigated in 7th grade students' achievements on multiplication of integers. The research was carried out with two different groups of the seventh grade pupils of Saltukbey Primary School in Erzurum. Pre and post-test with control group design were applied in the research. In the analysis of the data, mean, standard deviation and the t test in independent groups were used. Results of this study showed that the experiment group carried out RME approach while the control group carried out conventional teaching approach. Furthermore, it was found that there had been a significant difference in favor of experiment group

STUDIES RELATED TO THE CONCEPT OF NUMBER LINE FOR VISUALLY IMPAIRED STUDENTS

Roman, A., & Macawili, M. (2020) explored that " Utilization of Adapted Cartesian Plane for Visually-Impaired Students". This study aims to utilize an adapted Cartesian Plane to teach mathematics topics to visually-impaired students. Utilizing a quasi-experimental design, this research employed a purposive sampling technique. Visually-impaired students in the mainstream served as the subjects of the study. Hypotheses of no significant relationship between the profile of the respondents and their performance in Mathematics; no significant difference between the performance of the respondents in their pretest and posttest; and no significant effect of using Adapted Cartesian Plane to the subjects of the study were tested. The following conclusions were drawn after the analysis: there is no significant relationship between the profile of the respondents and their performance in Mathematics except in terms of their age; there is a significant difference between the pretest and posttest of the respondents; and the degree of effect of using Adapted Cartesian Plane in delivering Mathematics lessons to visually-impaired students is large.

Emerson, R. W., & Anderson, D. L. (2018) studied on " Using description to convey mathematics content in visual images to students who are visually impaired". Because of the preponderance of visual images, many mathematics texts are wholly or largely inaccessible to students who are blind. This study investigated how much description is sufficient to communicate math content in different types of images. Representative math textbooks from grades five, eight, and 11, aligned to the Common Core, were selected. Mutually exclusive and exhaustive image categories were identified. Clear examples of each image category were chosen, and digital files were created containing the examples and surrounding textual material. Files replicated the printed page as closely as possible, and all elements (words, math expressions, and descriptions of images) were readable by JAWS. Forty-four students who are visually impaired (that is, those who are blind or had low vision) listened to the math pages and answered questions related to the content contained in the images. Students answered content-related questions better with more description, but across four description conditions with varying amounts of description the highest correct rate was low (29%). In looking at individual image categories, students had the most correct answers for number lines

(41.0%). Rates of 20% to 33% correct were demonstrated for image categories of shapes, tables, line graphs, bar graphs, and ray diagrams. Correct rates for equations, pie charts, and maps were inconsistent or lower than 15%. Students were positive about math and did not indicate many problems with math texts.

Rosenblum, L. P., Cheng, L., & Beal, C. R. (2018) studied on "Teachers of students with visual impairments share experiences and advice for supporting students in understanding graphics". Knowing how to gather information from graphics and to use that information to solve mathematics problems is an important skill. Prior research indicates that many students with visual impairments face considerable challenges when attempting to locate information in math graphics. Little is known about how teachers of students with visual impairments support their students in acquiring graphics skills. Eleven teachers of visually impaired students participated in focus groups. Sessions were audio-recorded and transcribed. Themes were identified. The teachers described the importance of individualizing instruction for the student, teaching a systematic approach, and ensuring that graphics are clear to them.

2.4 CONCLUSION

The literature reviewed various researches and gave us an insight about the researches done on the concept of mathematics including number line, integers, computer assisted device for maths etc. for visually impaired students. Through this the investigator can have a clear clarity on framing the tool and methodology for delivering the accurate results.

METHODOLOGY

CHAPTER - III

METHODOLOGY

CHAPTER-3

METHODOLOGY

3.0 Introduction

Research is defined as finding out some solution for a problem in a systematic way. It helps us to have brief knowledge of the problem, understand what are all the factors involved for the problem and what are the ways to solve it. Research is an investigation which allows the researcher to have new ideas and facts in any field. Research can be said as movement from unknown to known factors. Research is considered as a systematic way of finding answers for the research questions. It is systematic because it involves a set of procedure to follow to get the accurate result.

Methodology is a framework for research. It is a set of rules and procedures which must be followed in a research for providing accurate result. It helps the researcher to work with research ethics.

Research methodology paves a way for the researcher to understand in which way the research has to be taken. Which includes how to collect samples, which type of research is suitable for the present problem, what type of methods and strategies need to be used for the research. The main purpose of research methodology is to have an explanation for the approach we used in it. So, this will make us a clear outline of the research where we can save our time and resources from deviations.

The methodology for the present study on "**Developing Basic Integer for Students with Visual Impairment Using Number Line"** involves the following steps:

a) Area of Study
b) Selection of method
c) Selection of Samples
d) Variables of the Study
e) Design of the Study
f) Selection of content

g) Selection of tool
h) Tools used for the study
i) Construction of Tool
j) Scoring procedure
k) Reliability and validity
l) Jury opinion
m) Intervention Strategies
n) Data Collection
o) Phases of the Study
p) Conduct of the study
q) Statistical technique used in the study

3.1 Area of Study

For this study the school has been chosen in Trichy. Samples are selected from **Government Girls Higher Secondary School for the Blind, Trichy.**

3.2 Selection of Method

The quasi-experimental method was followed to conduct the study in selected government special school. The investigator explored the students in the school and understood their level of knowledge by having a pretest on the basic integers using Number Line. After knowing where the students has their problem the investigator constructed the tactile Number Line and gave the intervention for the students with visual impairment and evaluated again by using post-test.

3.3 Selection of Samples

Sample is defined as the number of people or objects which are taken from a larger population for measurement. Sample must represent the population and it must allow us to generalize the result for the whole population. The methodology used to sample from a population is depend on the type of research we undergo, it can be random sampling or systematic sampling.

Selection of sample must be done by certain rules and procedures or plans so that they fall as a representative for the whole population. So the researcher must show more attention while selecting the sample. Selection of correct sample can help the researcher to achieve the objective of the study. It also help the researcher to develop a tool according to the type of sample we consider for the study.

By keeping in mind about the time, expenses, utility, and suitability the targeted sample comprised of 32 visually impaired students of standard 6 to 9 were selected using **Purposive Sampling** technique. The sample chosen for the study consisted of 32 female students with visually impaired out of which 9 students from standard 6, 4 from standard 7, 6 from standard 8, 13 from standard 9 as the sample of the presented study before administrating the tool.

Table 3.1

Standard Wise Distribution of the Sample

S.No.	Standard	Number of Students
1.	VI	9
2.	VII	4
3.	VIII	6
4.	IX	13
Total		**32**

3.4 Variables of the Study

Selection of variable is another important aspect of the research. We must choose the correct variables according to the problem question because the variables has a major influences on the result of the research. The present study aims at finding out the

knowledge of integers using Number Line by pretest and gives the intervention for improving their knowledge on integers using Number Line and it will be tested using post-test.

3.4.1 Dependent Variables

The dependent variables included in the study were developing basic integer using number line.

3.4.2 Independent Variables

The independent variables used in the study are Standard, Onset of the Disability, Type of Disability, Locality, Type of Family , Educational Qualification of Parents, Braille skill.

Table 3.2 Independent Variables and Their Levels

S.NO.	VARIABLES	LEVELS
1.	Standard	1) VI-VII
		2) VIII-IX
2.	Onset of the Disability	1) Congenital
		2) Acquired
3.	Type of Disability	1) Total Loss of Sight
		2) Low Vision
4.	Locality	1) Rural
		2) Urban
5.	Type of Family	1) Nuclear
		2) Joint
6.	Educational Qualification of Parents	1) Illiterate
		2) Literate
7.	Braille Skill	1) Good
		2) Poor

3.5 Design of the Study

Great Design Sprouts When Good Research Grows

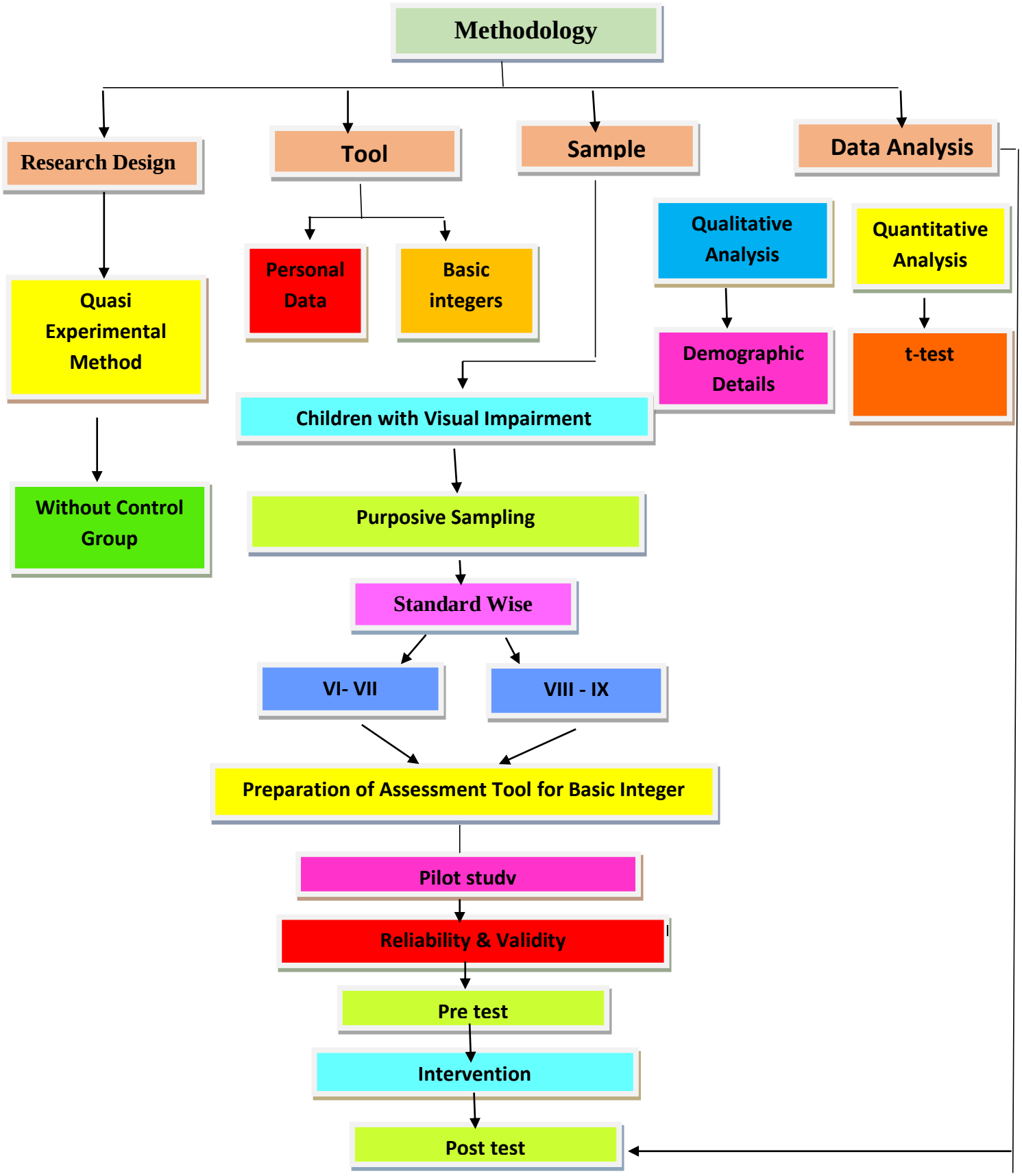
- M. COBANLI

According to Pauline V. Young, a research design is "the logical and systematic planning and directing a piece of research. It gives an outline of the structure and process of the research program. Without such a plan of study, no scientific study is possible." In other words, design indicates how the research is set up, what happens to the subjects and what method of data collection is used. Burns and Grove (2003:195) define a research design as "a blueprint for conducting a study with maximum control over factors that may interfere with the validity of the findings". Parahoo (1997:142) describes a research design as "a plan that describes how, when and where data are to be collected and analysed".

As the study is to find out the impact of number line in enhancing the knowledge of basic integer of visually impaired. **Quasi-Experimental** method has been used to get the required data in the particular time. Quasi-experimental research is similar to experimental research in that there is manipulation of an independent variable. It differs from experimental research because either there is no control group, no random selection, no random assignment, and/or no active manipulation (Abraham & MacDonald (2011).

The flow chart 3.1 represents the methodology followed in the study

Figure 3.1 Flow Chart Represent the Methodology of the Study



3.6 Selection of the Content

The concept in mathematics, integer plays a major role in our day to day life. The students must need to know about integers to tackle the problems in their daily life activities. So the teachers are the mediators who need to make the students to understand the need and importance of integers. When we come to students with visual impairment the integers are taught by alternative methods rather than using Number Line to avoid complexity among students as they lack in their visual sense. But it's important even for visually impaired to know about integers using Number Line to solve their daily problems. So the content has been chosen in a way to make the students with visual impairment aware of basic concepts involved in integer using Number Line, which can pave way for other concepts related to integers like graph etc.,

3.7 Selection of the Tool

The investigator took much effort to prepare the tool questionnaire for the students with visual impairment. After many consideration about the concept of integer the investigator found the difficulties of students facing in integer and consolidated the content to basics of integers and prepared the questionnaire accordingly. Selection of the research tool is an important factor for the success of a research. Literature review helped the investigator for choosing the correct research tool for the study. The research tool must be valid and reliable.

3.8 Tools used for the Study

Based on the objectives of the study, the investigator selected appropriate tools such as;

Personal data bank was used to collect the information about the subjects such as standard, type of locality, educational qualification of parents, type of family, type of disability, onset of disability and the same personal data bank enclosed in **annexure – I**

Tool for developing basic integers was used to develop basic integers among students with visual impairment using number line. Tool for developing basic integer consisted of domains as listed below and it is enclosed in **annexure – II**

Domains in basic integers

- Representation of numbers in integer
- Basic Operation in integer
- Rules of Integer
- Application Sums in integer

3.9 Construction of Tool

The tool was constructed to assess the knowledge of basic integer concept using Number Line for visually impaired students.

This tool consists of 32 questions under four domains related to the integer concepts in Number Line and it is developed both in Tamil and English languages. Based on this, the investigator developed the tactile number line aid to enhance the knowledge of integers for students. This tool involves basic concepts like placing numbers on Number Line, adding and subtracting integers on Number Line, additive inverse and application oriented problems.

Table 3.3

Construction of Tool

S.No.	Domains of Basic Integer	No. of Questions
1.	Representation of Numbers	8
2.	Basic Operations in Integer	8
3.	Rules of Integer	8
4.	Application Sums in Integer	8

3.10 Scoring Procedure

The scoring procedure used for the tool to evaluate the knowledge of basic integer concept through Number Line had two points namely correct response and incorrect response. If the child attain the correct answer then the question is allotted with the score-1 and if the child attained the wrong answer then the question is allotted with the score-0.

Table 3.4

Scoring Procedure

Basic Integer	Scoring Procedure
Representation Of Numbers	Score '1' for correct response Score'0' for incorrect response
Basic Operations In Integer	Score '1' for correct response Score'0' for incorrect response
Rules of Integer	Score '1' for correct response Score'0' for incorrect response
Application Sums	Score '1' for correct response Score'0' for incorrect response

3.11 Pilot Study

Pilot study was conducted by administering assessment tool for basic integer for 10 visually impaired students of standard VI TO IX. The domains in basic integer were evaluated using rating scale with two points rating. When the task is able to perform a score one was given. If the student is unable to perform score zero was marked .Based on the scores secured by the students the investigator incorporated certain modifications. The modified tool was further scrutinized by expert's namely special educators, teacher educators and professionals working in the field of special education and mathematics. Based on their opinion and ideas the tool was modified and finalized.

3.12 Reliability and Validity

The Cronbach's Alpha Coefficient was used to analyze the pre and post test scores, the reliability of the assessment tool 'α' value was found to be 0.734.

The reliability coefficients clearly indicate that the tool used was reliable. The process of pilot study took one month. However the investigator sought the opinion from experts. They opined that the tool is valid and reliable.

3.13 Jury opinion

The investigator prepare the checklist to evaluate the students knowledge of integers using Number Line. The constructed tool was given to a group of experts in the field of special education to evaluate the questionnaire based on their guidance, opinion and suggestions, the necessary modifications were made in the tool.

3.14 Intervention Strategies

Tactile Number Line aid was used as the medium of instruction for providing intervention for developing basic integer concept among students with visual impairment. More illustration was given by the investigator for the students to understand about Number Line and basic integer concept. The tactile Number Line helped the students to understand to concept with ease and it made them to learn without any confusion among positive and negative numbers. Number Line aid was given to each individual of the sample where it allowed them to use and learn integers in their own space and it was easy for them to work on homework. The aid made the students to answer the questions with easy understanding and it provided immediate feedback for the investigator. It helped the students to improve their scores in the test.

3.14.1 Materials Used in Intervention

- Tactile Number Line
- Braille slate and stylus
- Taylor frame
- Tactile aids for integers

3.14.2 Skills Taught During the Intervention Period

- Understanding about various numbers
- Knowing the relationship between positive and negative numbers
- Addition and subtraction of integers using Number Line
- Rules of Integer of integers.
- Hand movements in the Number Line and number position on the Number Line.

3.15 Data Collection

After selecting the samples for the study, the investigator visited the school and met the students in person in their class and rapport has established before administering the tool. The evaluation tool was used to identify the current knowledge of the students on basic integers using Number Line.

3.16 Phases of the Study

The study was carried in the following phases.

Phase – I

In the first phase the investigator identified the students with visual impairment of standard 6 to 9. Purposive sampling technique was used for this process to collect samples.

Phase – II

Assessment of current knowledge of integers through Number Line using evaluation tool. Pre-test has been conducted with collection of basic data of the students individually. The investigator understood at what level the students are being in the integer concept and they are to be grouped for the next phase. The students are group on basis of the marks they obtained in pre-test.

Phase – III

After grouping the students in this phase the intervention was given according to the knowledge of the students by using the intervention tool (tactile Number Line) to develop their concepts of integer.

Phase – IV

Post-test was given to the students after the intervention period to evaluate the effectiveness of the tactile Number Line in integers for students of standard 6 to 9.

Phase –V

After collecting the pre-test and post test data, the investigator putforward the data in statistical analysis to know the efficacy of the intervention tool for developing the knowledge of basic integer concept through Number Line for the students with visual impairment before and after intervention.

3.17 Conduct of the Study

After identification of students with visual impairment the pre-test was conducted to identify the current knowledge of integers among the samples. Intervention was given by using the tactile Number Line aid to the students individually. The intervention was given for a period of 20 days. Then the post-test has been conducted using the evaluation tool. Then the result was analyzed to show the impact of the tactile Number Line for developing the basic integer concept among students with visual impairment.

3.18 Statistical Technique Used in the Study

The obtained data has been analyzed by using appropriate statistical techniques. The investigator used qualitative procedure and quantitative procedure to analyze the data. To study the effect of Standard, Locality, Type of Family, Educational qualification of Parents, Type of Disability, Onset of Disability, Braille Skill on developing basic integer for students with visual impairment using Number Line the following was used:

- Mean

- Standard deviation
- Test of significant ‘t’ test

The formula used to analyses the data are as follow

Mean

The mean is the arithmetical that is obtained by adding all scores X (Mean) in distribution and dividing by the number of scores.

$$\text{Mean} = A + \frac{\Sigma f d^2}{N} \times C$$

Standard Deviation

Standard deviation is defined as the square-root of the average of square of deviation, when such deviations for the values of individual items in a series are obtained from the arithmetic average. The most widely used measure of dispersion of the series and commonly denoted by the symbol “σ” (pronounced as sigma).

The formula is

$$\text{S.D} = \sqrt{\frac{\Sigma f d^2}{N} - \left(\frac{\Sigma f d}{N}\right)^2} \times C$$

Where,

f – frequency corresponding to the observation

N- summation of frequency

C- common factor chosen

d- deviation of the item

Test of Significance

A t-test is an analysis of two populations means through the use of statistical examination; a t-test with two samples is commonly used with small sample sizes, testing the

difference between the samples when the variances of two normal distributions are not known.

The formula is,

- **Independent t-test**

$$t = \frac{m1 - m2}{\sqrt{\frac{var1}{n1} + \frac{var2}{n2}}}$$

where,

m1 and m2- average values of each sample set.

Var1 and var2 – variance of each sample set.

N1 and n2 – number of records in each sample set.

- **Paired t-test**

$$t = \frac{m1 - m2}{\frac{s(diff)}{\sqrt{n}}}$$

where,

m1 and m2 –The average values of each of the sample sets

s(diff) - The standard deviation of the differences of the paired data values

n - The sample size (the number of paired differences)

3.19 Conclusion

The method, sampling procedure, tool, variables selected and administration of pre and post-test have been clearly described in this chapter. It can help the investigator for continuing with analysis and interpretation to find out the results of the study.

RESULTS AND DISCUSSION

CHAPTER - IV

RESULTS AND DISCUSSION

CHAPTER –IV

RESULTS AND DISCUSSION

4.0 Introduction

This section presents the results of the examination led in the subject "Developing basic integer for students with visual impairment using number line".

Data Analysis is not only the response to specific inquiries however it gives the bearings for future purposes. For the examination study to be significant the information gathered is to be broken down and deciphered from multiple points of view as would be significant. Analysis of data involves a number of closely related operations that are performed with the purpose of summarizing the collected data and organizing them in such a manner that they will yield answer to research question. Some scholars are of the opinion that processing of data is one under analysis of data (Bhandarkar, 2005).

Investigation is an ongoing procedure from the initiation to the end that is from the choice of the issue, in the assurance of the strategies and in deciphering and reaching determination from the gathered information. As per Mc Milan Schumacher (1989), examination is a methodical procedure of choosing, classifying, and looking at, integrating and deciphering to give clarifications of the single wonder of intrigue.

Interpretation is the point-by-point request of methodical assessment. A cautious assessment or study is done so as to find realities. Analysis and Interpretation of the gathered information is a significant advance during the time spent an exploration report. Best (2003) says that "Investigation of information is the core of the research report."

4.1 Objectives

The main aim of result and discussion are:-

- → Help to analyze the data collected from the samples.
- → Help to analyze the data collected from interviews.
- → To analyze the problem stated and find possible solutions.

→ To undergo indepth knowledge about the problem stated.

→ To know what are all the factors involved and affects the problem.

→ To understand the significance level of the result.

4.2 Section-I : Qualitative Analysis

4.2.1 Background information of the selected sample

4.3 Section-II: Quantitative Analysis

4.3.1 Comparison of Pre and Post-Test Scores of Basic Integer Using Number Line.

4.3.2 Comparison of Pre and Post-Test Scores of Representation of Numbers in Integer with respect to Standard VI – VII.

4.3.3 Comparison of Pre and Post-Test Scores of Basic Operations in Integer with respect to Standard VI – VII

4.3.4 Comparison of Pre and Post-Test Scores of Rules of Integer with respect to Standard VI – VII

4.3.5 Comparison of Pre and Post-Test Scores of Application Sums in Integer with respect to Standard VI – VII

4.3.6 Comparison of Pre and Post-Test Scores of Representation of Number in Integer with respect to Standard VIII – IX

4.3.7 Comparison of Pre and Post-Test Scores of Basic Operation in Integer with respect to Standard VIII - IX

4.3.8 Comparison of Pre and Post-Test Scores of Rules of Integer with respect to Standard VIII - IX

4.3.9 Comparison of Pre and Post-Test Scores of Application Sums in Integer with respect to Standard VIII - IX

4.3.10 Comparison of Post-Test Scores of Basic Integer Using Number line with respect to Type of Disability

4.3.11 Comparison of Post-Test Scores of Basic Integer Using Number line with respect to Onset of Disability

4.3.12 Comparison of Post-Test Scores of Basic Integer Using Number line with respect to Locality.

4.3.13 Comparison of Post-Test Scores of Basic Integer Using Number line with respect to Type of Family.

4.3.14 Comparison of Post-Test Scores of Basic Integer Using Number line with respect to Educational Qualification of Parents.

4.3.15 Comparison of Post-Test Scores of Basic Integer Using Number line with respect to Braille Skill.

4.4 Overall Mean Scores

4.2 SECTION-I: QUALITATIVE ANALYSIS

This section contains the qualitative information about the overall percentage of basic integer using number line among the selected sample. These data were analyzed and interpreted in the following :

Background Information of the Selected Sample

Table:- 4.2.1 Background Information of the Selected Sample

Particulars	Categories	No. Of Samples	Percentage (%)
Standard	VI-VII	11	34
	VIII-IX	21	66
Locality	Rural	20	63
	Urban	12	37
Onset of Disability	Congenital	21	66
	Acquired	11	34
Type of Disability	Total Loss of Sight	23	72
	Low vision	9	28
Type of Family	Nuclear	17	53
	Joint	15	47
Parents Educational Qualification	Illiterate	19	59
	Literate	13	41
Braille skill	Good	17	53
	Poor	15	47

From the above table we can find that the investigator had divided each variable into groups. The investigator collected the information of the samples like Grade, Locality , Onset of Disability, Type of Disability, Type of Family, Educational Qualification of Parents, Braille Skill. These information were gathered and converted into quantitatively in the Table 4.2.1.

Table 4.2.1 provides the information that the selected sample based on Standard consists of 32 students. Where out of 32, 11 are from standard VI-VII (i.e.,34%) and 21 from standard VIII-IX (i.e., 66%) . More number of students from standard VIII- IX taken for this study are higher than standard VI-VII.

It is observed that when the students are compared based on their locality out of 32, 20 were from rural (i.e., 63 %) and 12 were from urban (i.e.,37%) . Students from rural area more than the urban area.

When comparison of students done on the basis of onset of disability it has been shown that out of 32, 21 were visually impaired by birth (i.e.,66%) and 11 were visually impaired due to some cause after birth (i.e.,34%) . The students who are congenital visually impaired are more in number when compared to students with acquired visually impaired.

It is noted that when students compared with the type of disability students with total loss of sight are 23 from the sample (i.e.,72 %) and students with low vision are 9 from the sample (i.e.,28 %). The students with total loss of sight are higher when compared to students with low vision.

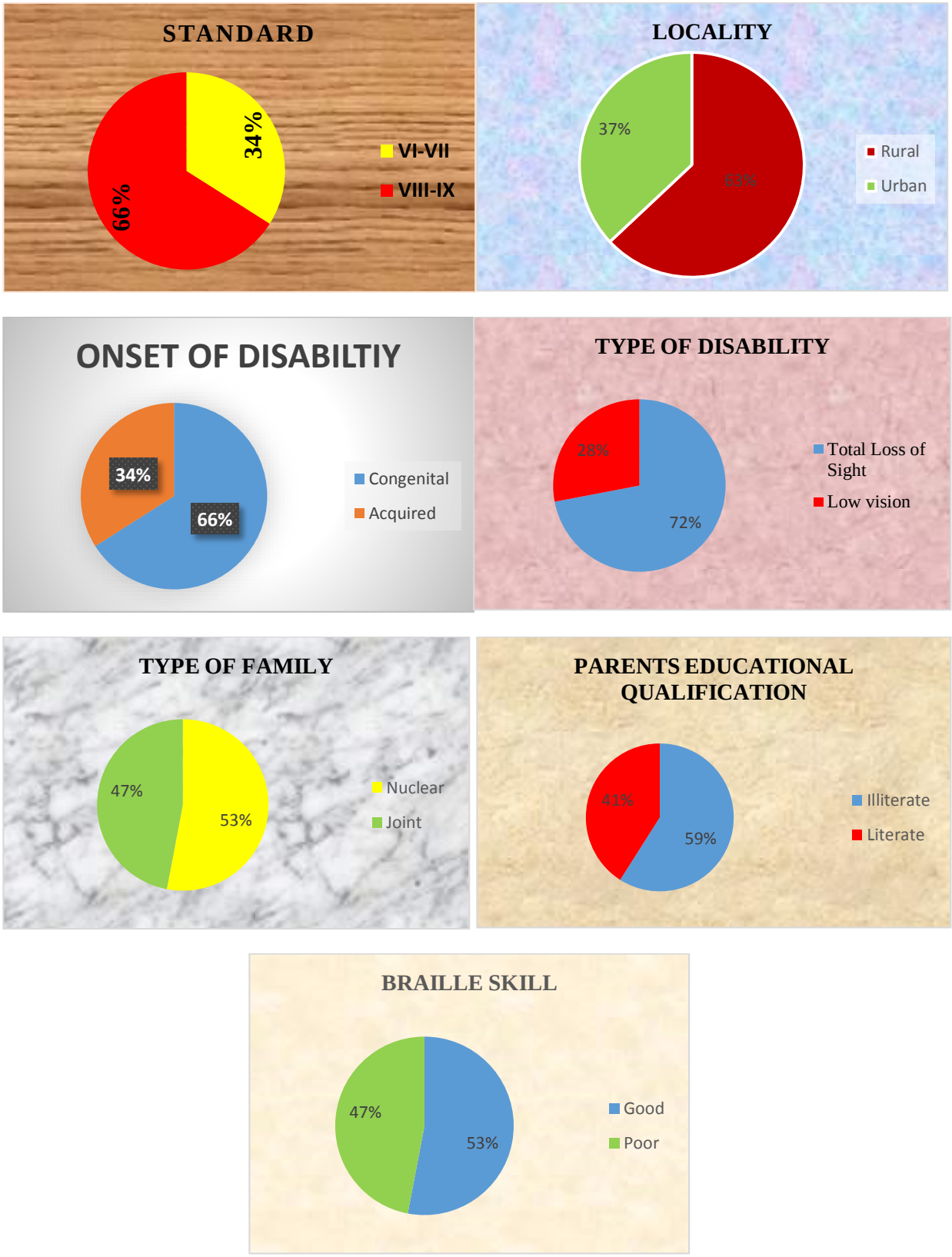
Undergoing the analysis based on the type of family of the selected samples it is evident that out of 32, 17 students are from nuclear family (i.e.,53 %) and 15 are from joint family (i.e.,47 %).The students who live in nuclear family are more than the students living in joint family.

According to the educational qualification of parents out of 32, 19 students parents were illiterate (i.e.,59%) and 13 students parents were literate (i.e.,41 %).Therefore, most of the visually impaired students parents are illiterate.

While segregating students based on the braille skills previously acquired out of 32 students 17 had good braille level (i.e.,53 %) and 15 comes under poor braille skill category (i.e.,47%). The students with good braille skill are higher when compared to students with poor braille skill.

The above information was very helpful for the investigator to analyse the data in qualitative analysis to identify the impact of using number line to develop basic integer among students with visual impairment.

Figure:- 4.2.1 Background Information of the Selected Sample



4.3 SECTION-II: QUANTITATIVE ANALYSIS

In order to study the significant difference between two or more than two groups of samples, qualitative analysis is useful and it is used by the investigator to determine the significance of the study conducted on students with Visual Impairment . The t – test is useful in determining significance difference which is of such magnitude that it cannot be attributed to chance factors sampling variations. Wherever two groups are involved in a variable, t-test has been applied. This part is confined to study the significance difference in developing basic integer using number line of selected students.

4.3.1 Comparison of Pre and Post-Test Scores of Basic Integer Using Number Line

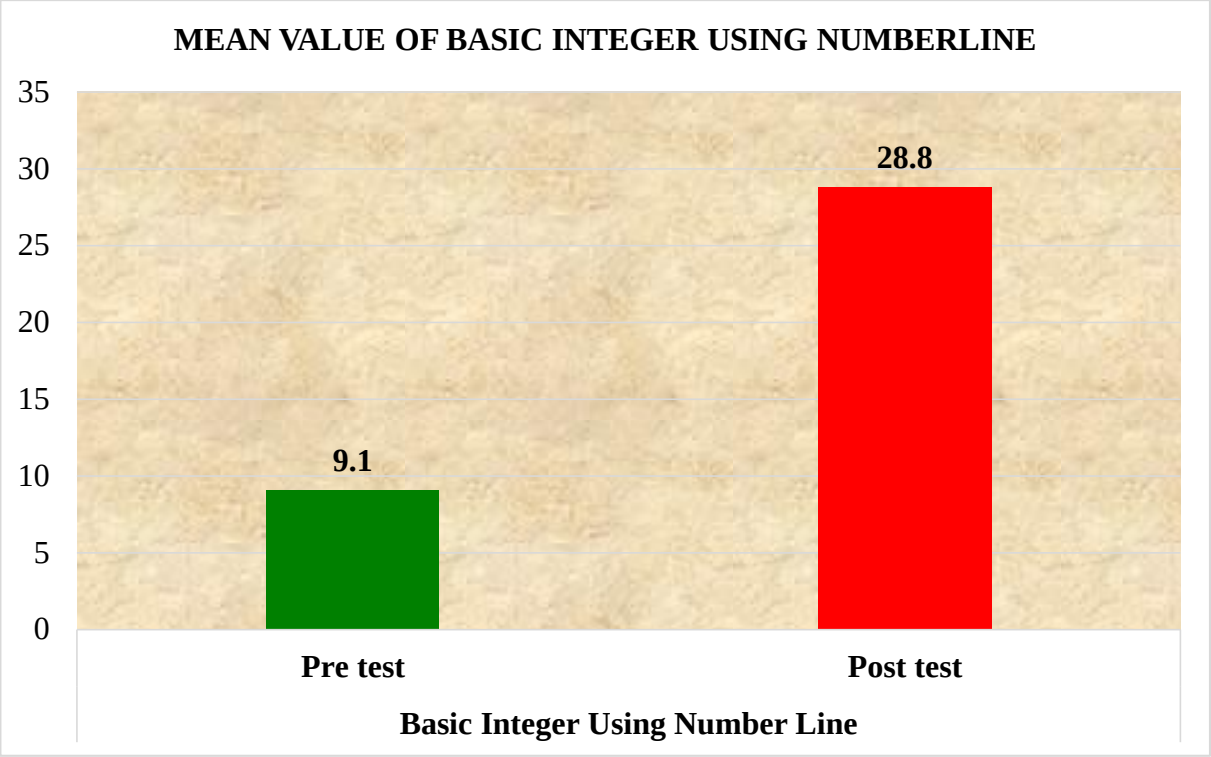
Table:- 4.3.1 Comparison of Pre and Post-Test Scores of Basic Integer Using Number Line

PARTICULARS	N	TESTING	DF	MEAN VALUE	SD	t-VALUE
Basic Integer Using Number Line	32	Pre test	31	9.10	1.242	- 43.516*
		Post test		28.80	2.605	

***Significant at 0.05 level**

The above table revealed that the t- value of the students when compared their pre and post-test in basic integer using number line is 43.516. This value is significant at 0.05 with respect to using number line to develop basic integer among students with visual impairment. Therefore, the stated hypothesis " there is no significant difference between the students in terms of basic integer using number line before and after intervention" is rejected. Stating that the number line had made a significant impact on students with visual impairment in learning basic integer.

Figure:- 4.3.1 Comparison of Pre and Post-Test Scores of Basic Integer Using Number Line



4.3.2 Comparison of Pre and Post-Test Scores of Representation of Numbers in Integer With Respect to Standard VI - VII

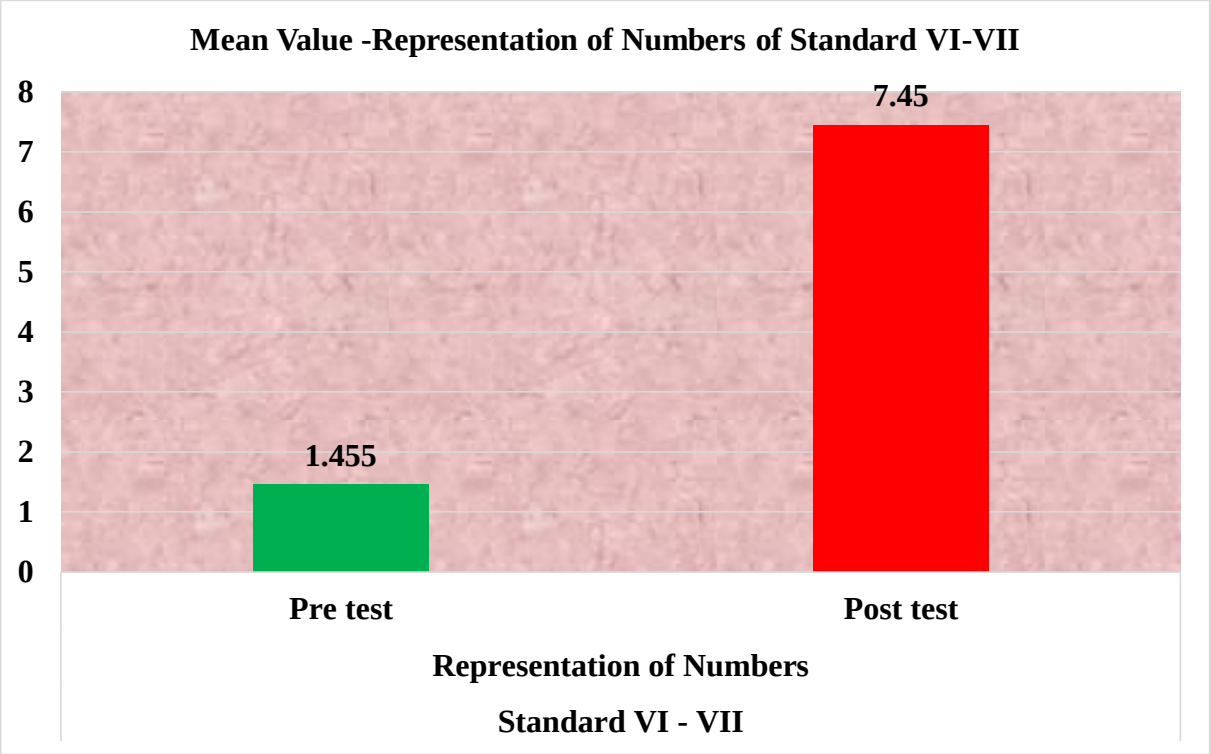
Table:- 4.3.2 Comparison of Pre and Post-Test Scores of Representation of Numbers in Integer With Respect to Standard VI - VII

VARIABLE	DOMAIN	N	TESTING	DF	MEAN VALUE	SD	t-VALUE
Standard VI – VII	Representation of Numbers	11	Pre test	10	1.455	0.5222	-14.832*
			Post test		7.45	0.934	

***Significant at 0.01 level**

The above table revealed that the t- value of the students of standard VI -VII in representation of numbers is 14.832. This value is significant at 0.01 with respect to using number line to develop representation of numbers among students with visual impairment based on their standard VI -VII. Therefore, the stated hypothesis " there is no significant difference between pre and post-test in Representation of Numbers in integer with respect to standard VI-VII" is rejected. Stating that the number line had made a significant impact on students in representation of numbers in integers. The performance of the students improved due to the use of tactile number line aid during the intervention which helped the visually impaired students to have a clear view about the positive numbers, negative numbers and zero. And also students feel easy to understand the position of numbers and their places by using number line.

Figure:- 4.3.2 Comparison of Pre and Post-Test Scores of Representation of Numbers in Integer With Respect to Standard VI - VII



4.3.3 Comparison of Pre and Post-Test Scores of Basic Operations in Integer With Respect to Standard VI - VII

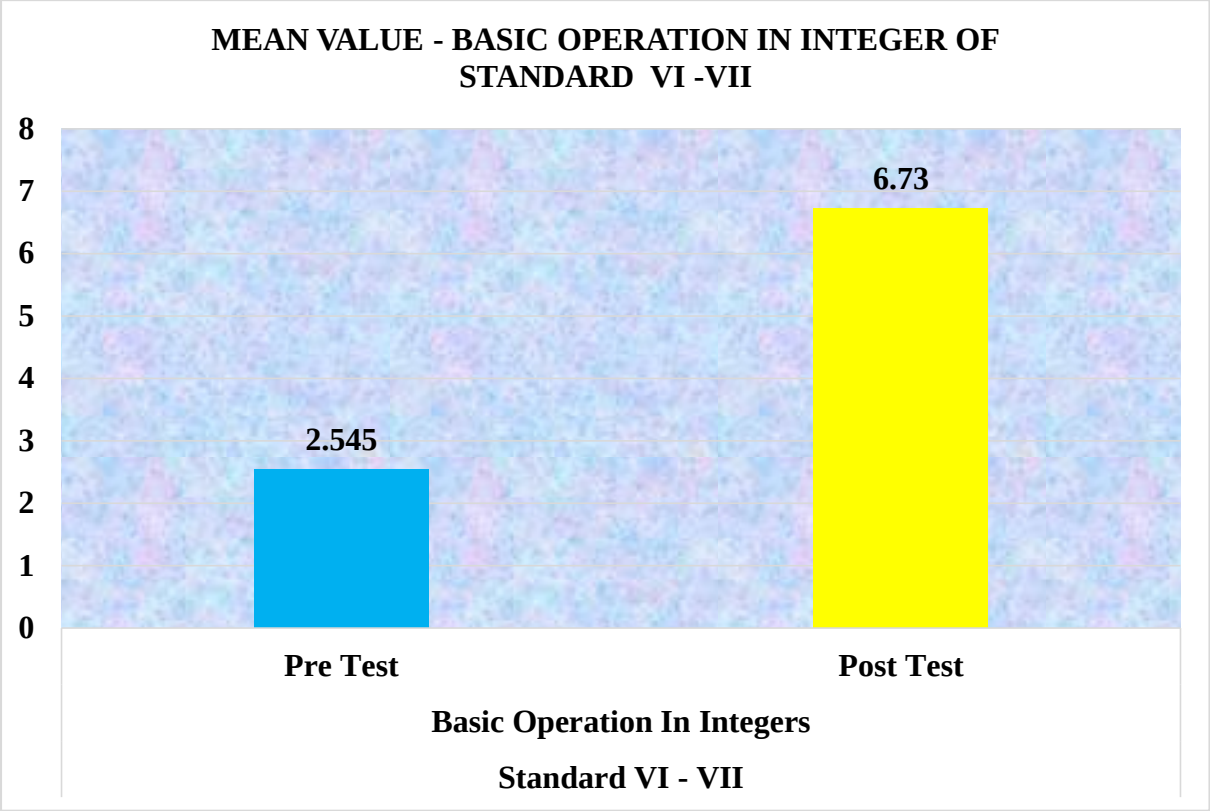
Table:- 4.3.3 Comparison of Pre and Post-Test Scores of Basic Operations in Integer With Respect to Standard VI - VII

VARIABLE	DOMAIN	N	TESTING	DF	MEAN VALUE	SD	t-VALUE
Standard VI - VII	Basic Operation In Integers	11	Pre Test	10	2.545	0.6876	-15.872*
			Post Test		6.73	0.905	

***Significant at 0.01 level**

The above table revealed that the t- value of the students of standard VI -VII in Basic Operation in integer is 15.872. This value is significant at 0.01 with respect to using number line to develop Basic Operation in integer among students with visual impairment based on their standard VI -VII. Therefore, the stated hypothesis " there is no significant difference between pre and post-test in Basic Operation in integer with respect to standard VI-VII" is rejected. Stating that the number line had made a significant impact on students in Basic Operation on integer. Students are given more problem oriented examples during intervention which helped them to perform well in post-test when compared to pre-test.

Figure:-4.3.3 Comparison of Pre and Post-Test Scores of Basic Operations in Integer With Respect to Standard VI – VII



4.3.4 Comparison of Pre and Post-Test Scores of Rules of Integer With Respect to Standard VI - VII

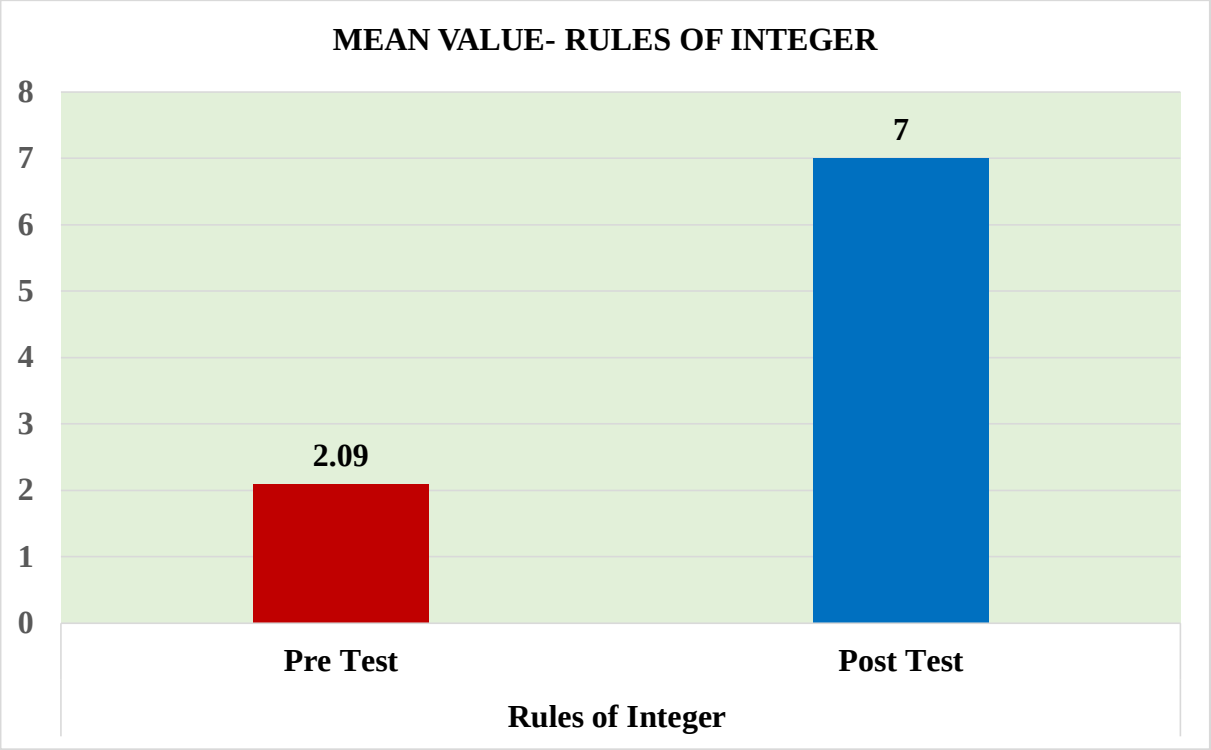
Table:- 4.3.4 Comparison of Pre and Post-Test Scores of Rules of Integer With Respect to Standard VI - VII

VARIABLE	DOMAIN	N	TESTING	DF	MEAN VALUE	SD	t-VALUE
Standard VI - VII	Rules of Integer	11	Pre Test	10	2.09	1.446	-9.925*
			Post Test		7.00	0.775	

***Significant at 0.01 level**

The above table depicts that the t- value of the students of standard VI -VII in Rules of integer is 9.925. This value is significant at 0.01 with respect to using number line to develop Rules of Integer in integer among students with visual impairment based on their standard VI -VII. Therefore, the stated hypothesis " there is no significant difference between pre and post-test in Rules of Integer in integer with respect to standard VI-VII" is rejected. Stating that the number line had made a significant impact on students in Rules of Integer. This result may be due to the use of number line with more life oriented examples based on Rules of Integer given during intervention on Rules of Integer.

Figure:- 4.3.4 Comparison of Pre and Post-Test Scores of Rules of Integer in Integer With Respect to Standard VI – VII



4.3.5 Comparison of Pre and Post-Test Scores of Application Sums in Integer With Respect to Standard VI – VII

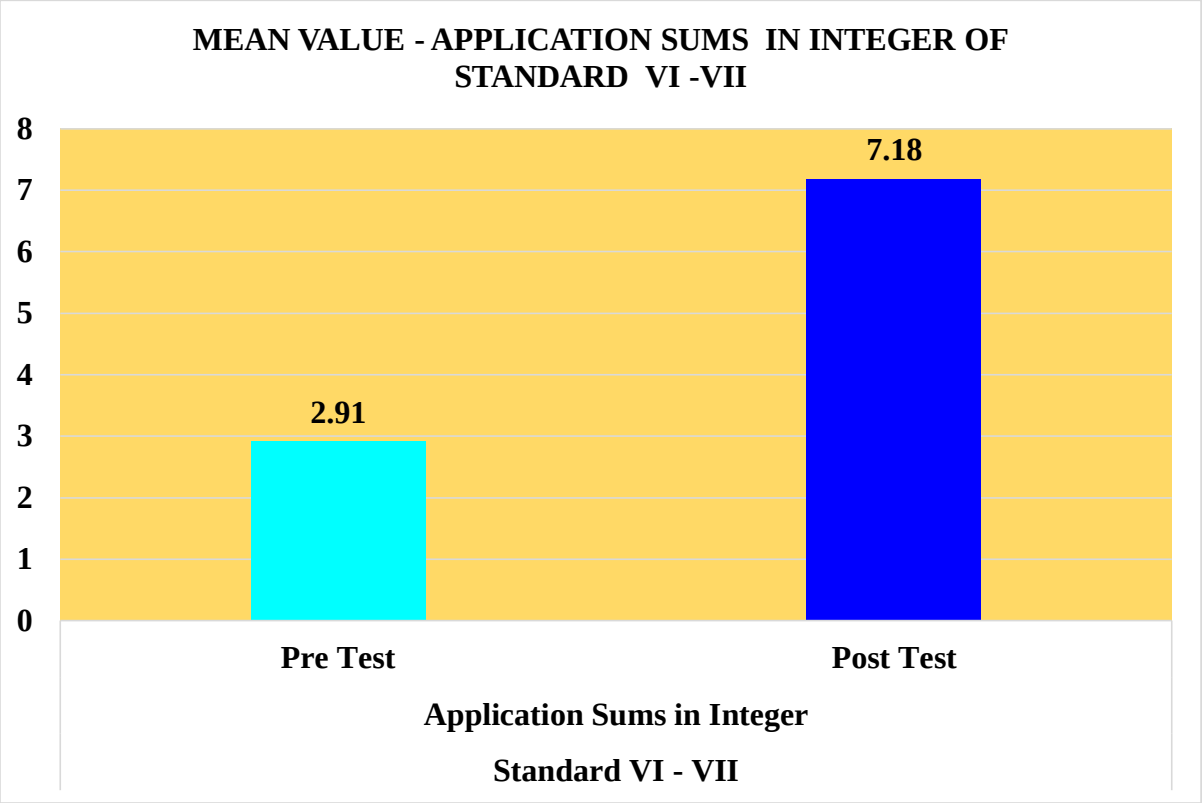
Table:-4.3.5 Comparison of Pre and Post-Test Scores of Application Sums in Integer With Respect to Standard VI - VII

VARIABLE	DOMAIN	N	TESTING	DF	MEAN VALUE	SD	t-VALUE
Standard VI - VII	Application Sums	11	Pre Test	10	2.91	1.136	-11.900*
			Post Test		7.18	0.982	

***Significant at 0.01 level**

The above table depicts that the t- value of the students of standard VI -VII in Application Sums is11.900. This value is significant at 0.01 with respect to using number line to develop Application Sums in integer among students with visual impairment based on their standard VI -VII. Therefore, the stated hypothesis " there is no significant difference between pre and post-test in Application Sums in integer with respect to standard VI-VII" is rejected. Stating that the number line had made a significant impact on students in Application Sums . The result is a cause of more practice of sums using number line given during intervention on Application Sums .

Figure:-4.3.5 Comparison of Pre and Post-Test Scores of Application Sums in Integer With Respect to Standard VI – VII



4.3.6 Comparison of Pre and Post-Test Scores of Representation of Numbers in Integer With Respect to Standard VIII - IX

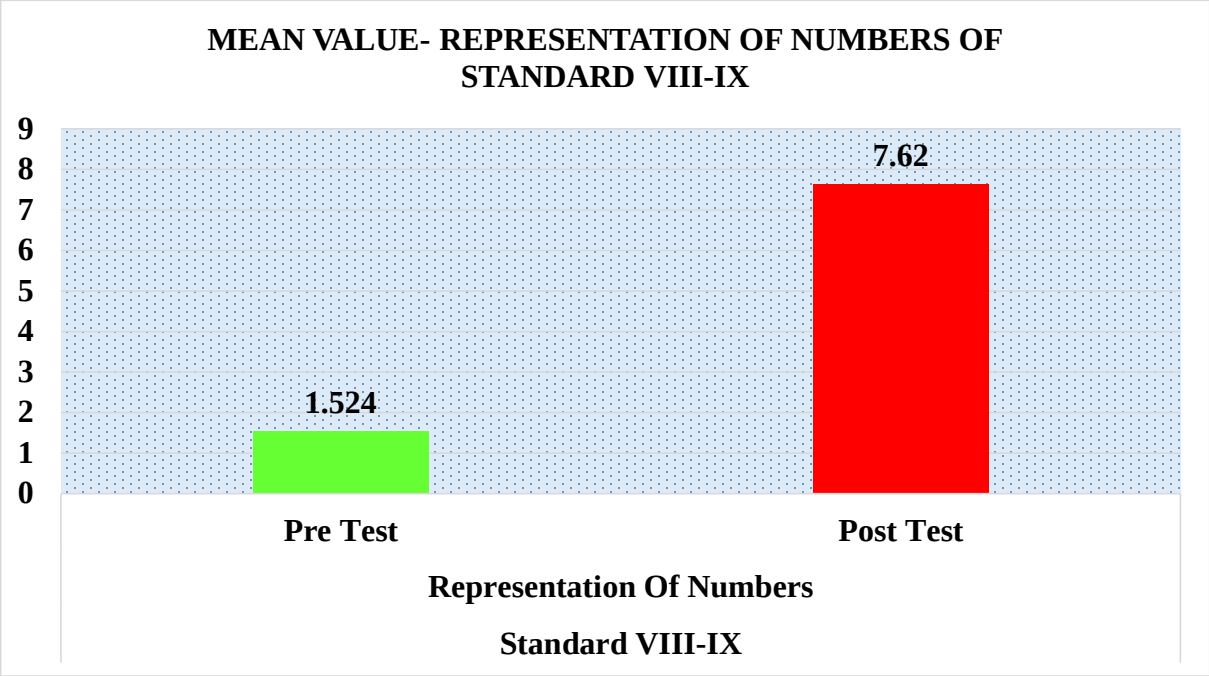
Table:- 4.3.6 Comparison of Pre and Post-Test Scores of Representation of Numbers in Integer With Respect to Standard VIII - IX

VARIABLE	DOMAIN	N	TESTING	DF	MEAN VALUE	SD	t-VALUE
Standard VIII - IX	Representation Of Numbers	21	Pre Test	20	1.524	0.9808	-23.687*
			Post Test		7.62	0.740	

***Significant at 0.01 level**

The above table revealed that the t- value of the students of standard VIII-IX in representation of numbers is 23.687 . This value is significant at 0.01 with respect to using number line to develop representation of numbers among students with visual impairment based on their standard VIII-IX. Therefore, the stated hypothesis " there is no significant difference between pre and post-test in Representation of Numbers in integer with respect to standard VIII-IX " is rejected. Stating that the number line had made a significant impact on students in representation of numbers in integers. This can be due to the exposure of number system and its application during intervention.

Figure:- 4.3.6 Comparison of Pre and Post-Test Scores of Representation of Numbers in Integer With Respect to Standard VIII – IX



4.3.7 Comparison of Pre and Post-Test Scores of Basic Operation in Integer With Respect to Standard VIII – IX

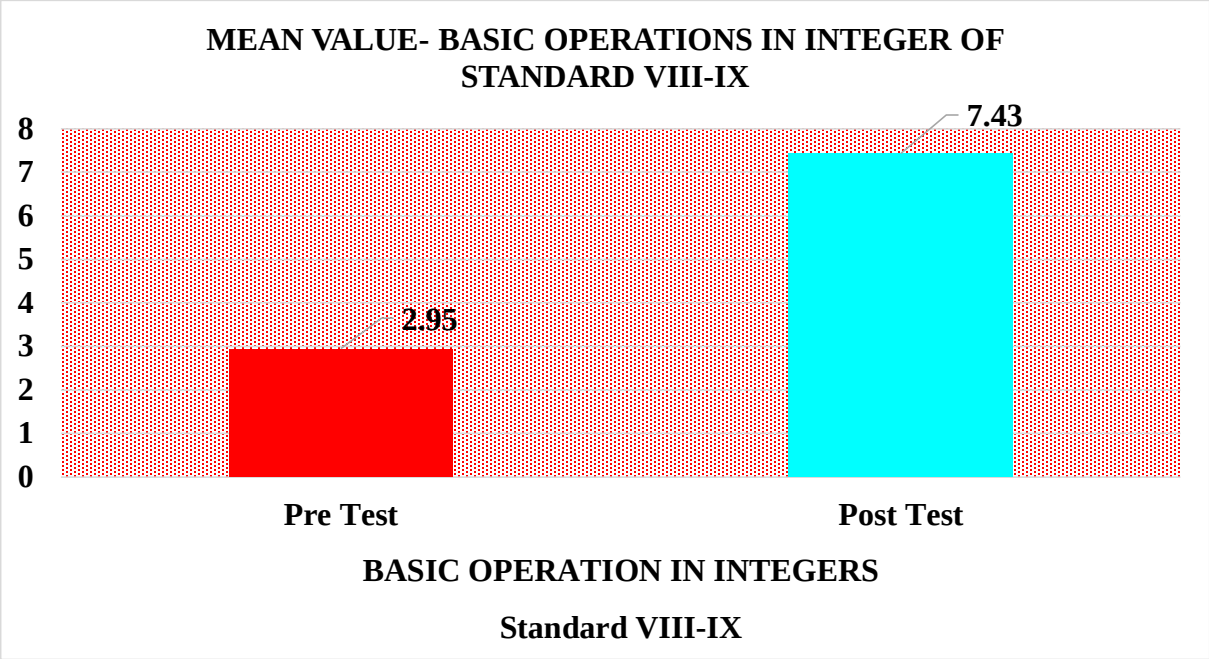
Table:-4.3.7 Comparison of Pre and Post-Test Scores of Basic Operation in Integer With Respect to Standard VIII - IX

VARIABLE	DOMAIN	N	TESTING	DF	MEAN VALUE	SD	t-VALUE
Standard VIII - IX	Basic Operation in Integers	21	Pre Test	20	2.95	0.590	-22.095*
			Post Test		7.43	0.676	

***Significant at 0.01 level**

The above table revealed that the t- value of the students of standard VIII-IX in Basic Operation in integer is 22.095. This value is significant at 0.01 with respect to using number line to develop Basic Operation in integer among students with visual impairment based on their standard VIII-IX. Therefore, the stated hypothesis " there is no significant difference between pre and post-test in Basic operation in integer with respect to standard VIII-IX " is rejected. Stating that the number line had made a significant impact on students in Basic Operation on integer. During intervention the students are given practice with more life oriented examples which helped them to perform well in post test.

Figure:- 4.3.7 Comparison of Pre and Post-Test Scores of Basic Operation in Integer With Respect to Standard VIII – IX



4.3.8 Comparison of Pre and Post-Test Scores of Rules of Integer in Integer With Respect to Standard VIII - IX

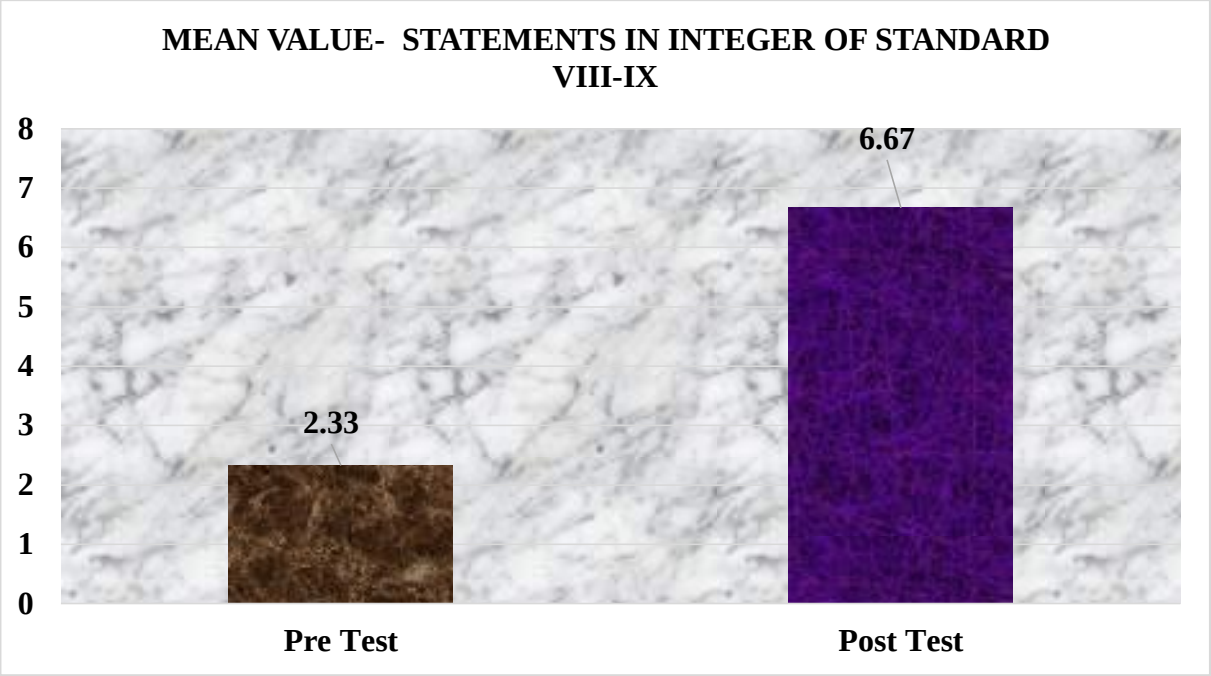
Table:- 4.3.8 Comparison of Pre and Post-Test Scores of Rules of Integer With Respect to Standard VIII - IX

VARIABLE	DOMAIN	N	TESTING	DF	MEAN VALUE	SD	t - VALUE
Standard VIII – IX	Rules of Integer	21	Pre Test	20	2.33	0.577	-19.535*
			Post Test		6.67	1.065	

***Significant at 0.01 level**

The above table depicts that the t- value of the students of standard VIII - IX in Rules of Integer is19.533. This value is significant at 0.01 with respect to using number line to develop Rules of Integer among students with visual impairment based on their standard VIII - IX. Therefore, the stated hypothesis " there is no significant difference between pre and post-test in Rules of Integer with respect to standard VIII-IX " is rejected. Stating that the number line had made a significant impact on students in Rules of Integer. This result can be due to the use of number line with regular practice of sums based on Rules of Integer given during intervention on Rules of Integer.

Figure:- 4.3.8 Comparison of Pre and Post-Test Scores of Rules of Integer With Respect to Standard VIII - IX



4.3.9 Comparison of Pre and Post-Test Scores of Application Sums in Integer With Respect to Standard VIII - IX

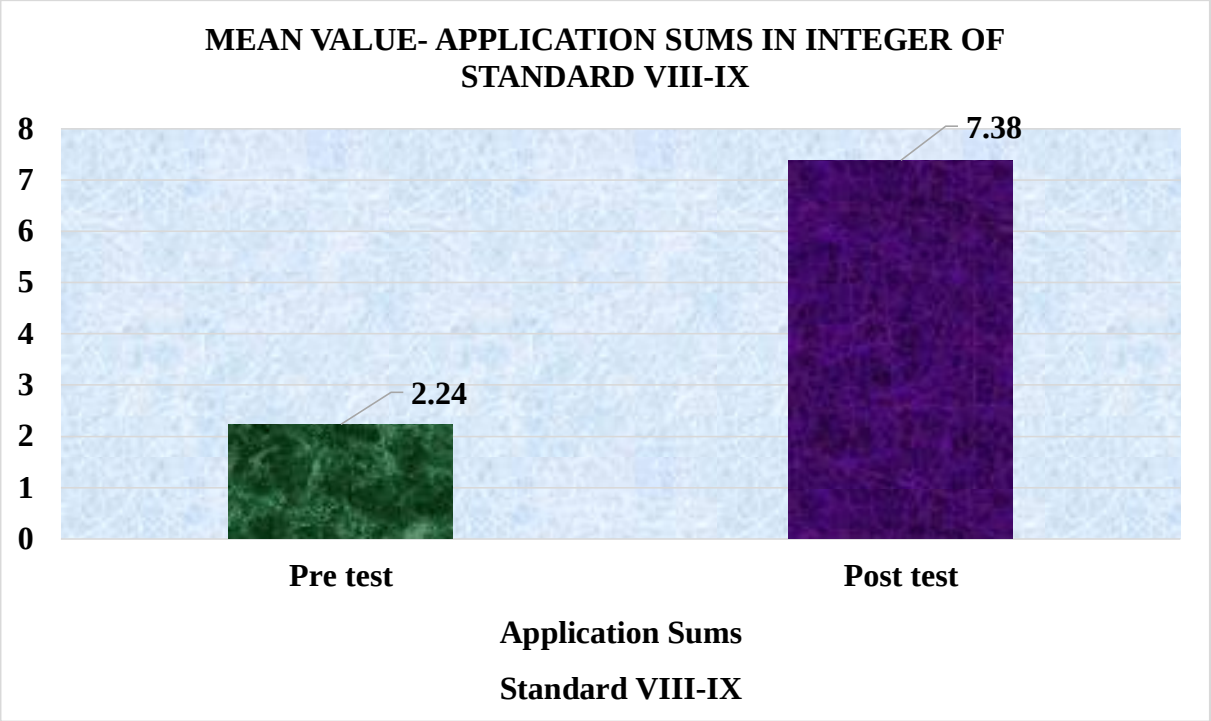
Table:- 4.3.9 Comparison of Pre and Post-Test Scores of Application Sums in Integer With Respect to Standard VIII - IX.

VARIABLE	DOMAIN	N	TESTING	DF	MEAN VALUE	SD	t-VALUE
Standard VIII - IX	Application Sums	21	Pre test	20	2.24	0.436	-19.718*
			Post test		7.38	0.973	

***Significant at 0.01 level**

The above table depicts that the t- value of the students of standard VIII - IX in Application Sums is 19.718. This value is significant at 0.01 with respect to using number line to develop Application Sums in integer among students with visual impairment based on their standard VIII - IX. Therefore, the stated hypothesis " there is no significant difference between pre and post-test in Application Sums in integer with respect to standard VIII-IX " is rejected. Stating that the number line had made a significant impact on students in Application Sums. This result may be due to the use of number line with more examples given during intervention on Application based Sums.

Figure:- 4.3.9 Comparison of Pre and Post-Test Scores of Application Sums in Integer With Respect to Standard VIII – IX



4.3.10 Comparison of Post-Test Scores of Basic Integer Using Number line With Respect to Type of Disability

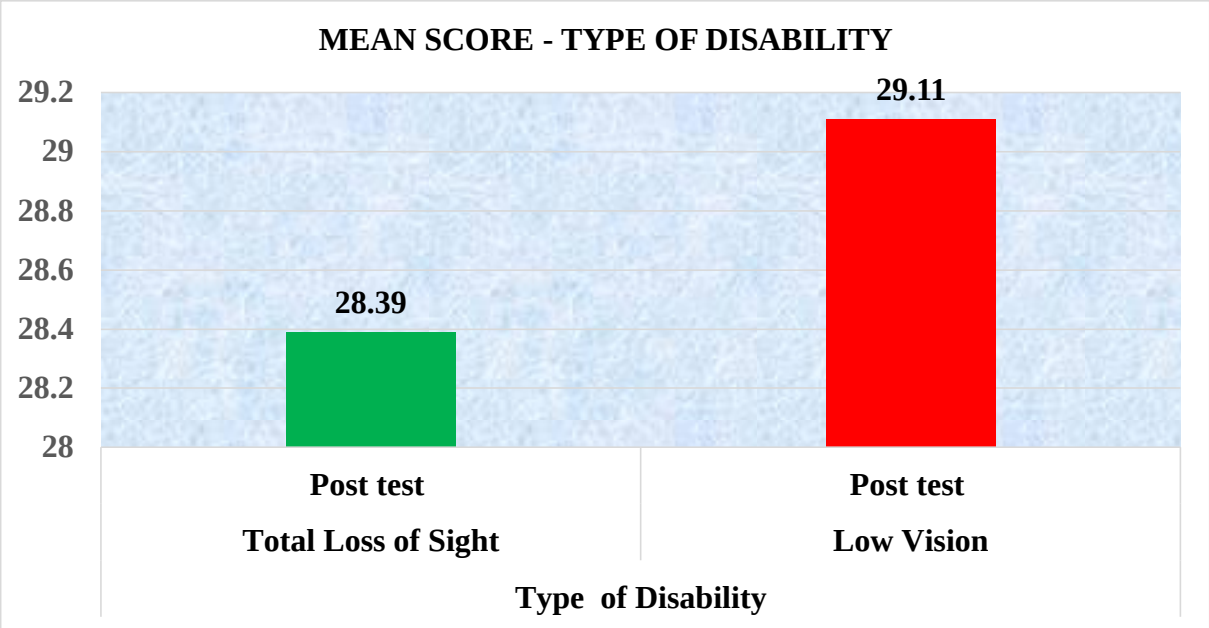
Table:- 4.3.10 Comparison of Post-Test Scores of Basic Integer Using Number line With Respect to Type of Disability

VARIABLES	PARTICULARS	N	TESTING	DF	MEAN	S.D	t-VALUE
Type of Disability	Total Loss of Sight	23	Post test	22	28.39	3.201	-0.605^{NS}
	Low Vision	9	Post test	8	29.11	2.472	

NS - Not Significant

The above table revealed that the t- value of the students at the type of disability namely total loss of sight and low vision. These values are not significant with respect to using Number Line to develop basic integer among students with visual impairment. So, the stated hypothesis "there is no significant difference between the post-test in basic integers using number line with respect to Type of Disability" is accepted. Although while comparing the mean scores, the students with low vision performed well when compared to total loss of sight students because the low vision students can visualize the number line so it would be easier for them to understand the difference between the numbers when compared to students who has total loss of sight.

Figure:- 4.3.10 Comparison of Post-Test Scores of Basic Integer Using Number line With Respect to Type of Disability



4.3.11 Comparison of Post-Test Scores of Basic Integer Using Number line With Respect to Onset of Disability

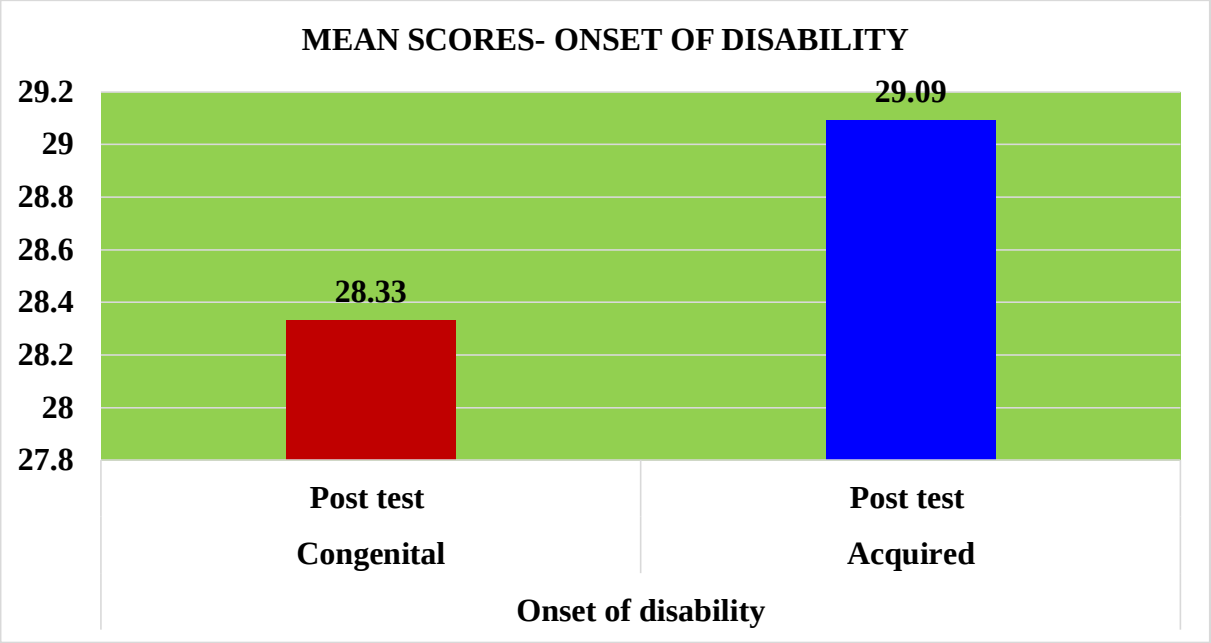
Table:-4.3.11 Comparison of Post-Test Scores of Basic Integer Using Number line With Respect to Onset of Disability.

VARIABLES	PARTICULARS	N	TESTING	DF	MEAN	S.D	t-VALUE
Onset of disability	Congenital	21	Post test	20	28.33	2.955	- 0.674^{NS}
	Acquired	11	Post test	11	29.09	3.145	

NS - Not Significant

The above table revealed that the t- value of the students at the onset of disability namely congenital and acquired. These values are not significant with respect to using number line to develop basic integer among students with visual impairment. So, the stated hypothesis "there is no significant difference between the post-test in basic integers using number line with respect to Onset of Disability" is accepted. By comparing the mean scores, the students who are acquired visually impaired have performed better when compared to congenital visually impaired it can be due to the exposure of the acquired visually impaired students is high when compare to the students who lost their vision at birth.

Figure:- 4.3.11 Comparison of Post-Test Scores of Basic Integer Using Number line With Respect to Onset of Disability



4.3.12 Comparison of Post-Test Scores of Basic Integer Using Number line With Respect to Locality.

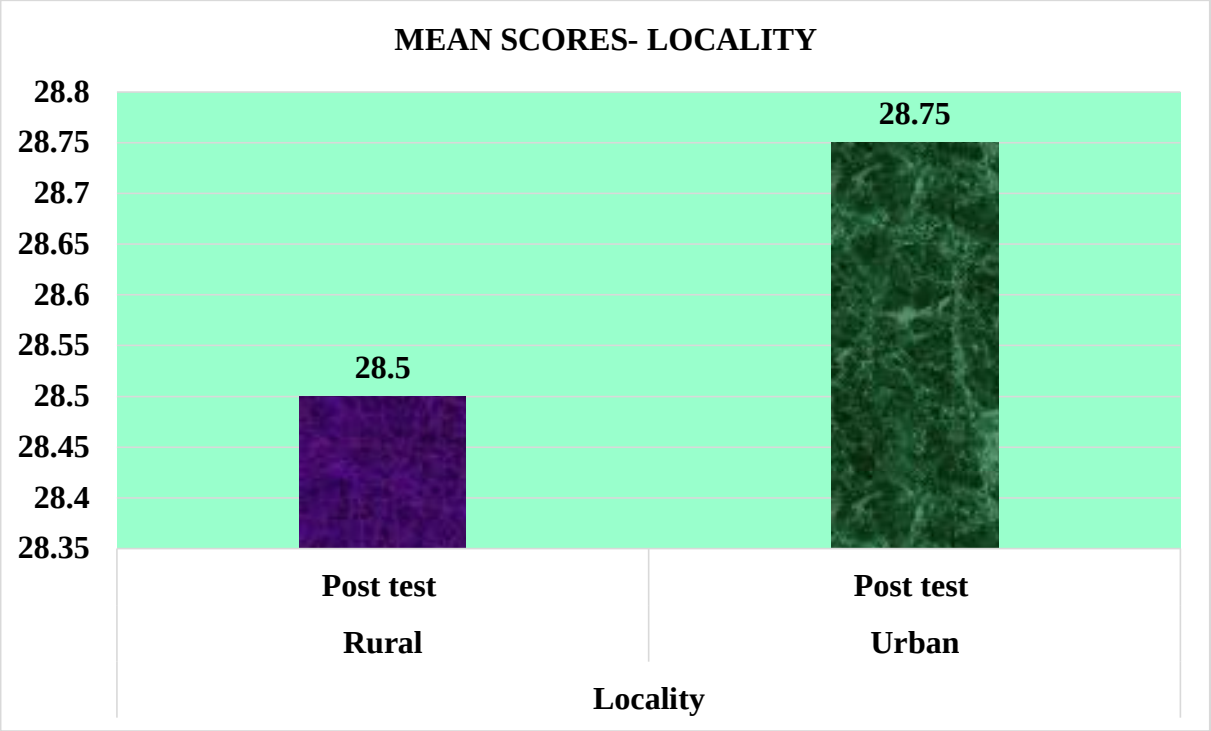
Table:- 4.3.12 Comparison of Post-Test Scores of Basic Integer Using Number line With Respect to Locality.

Variables	Particulars	N	TESTING	Df	Mean	S.D	t- value
Locality	Rural	20	Post test	19	28.50	2.743	- 0.225^{NS}
	Urban	12	Post test	11	28.75	3.495	

NS - Not Significant

The above table revealed that the t- value of the students at the type of locality namely rural and urban. These values are not significant with respect to using number line to develop basic integer among students with visual impairment. So, the stated hypothesis "there is no significant difference between the post-test in basic integers using number line with respect to Locality" is accepted .when considering mean scores, the students in urban area performed well when compared to students in rural area because students in urban area get lot of exposure and experience compared to rural area.

Figure:- 4.3.12 Comparison of Post-Test Scores of Basic Integer Using Number line With Respect to Locality



4.3.13 Comparison of Post-Test Scores of Basic Integer Using Number line With Respect to Type of Family.

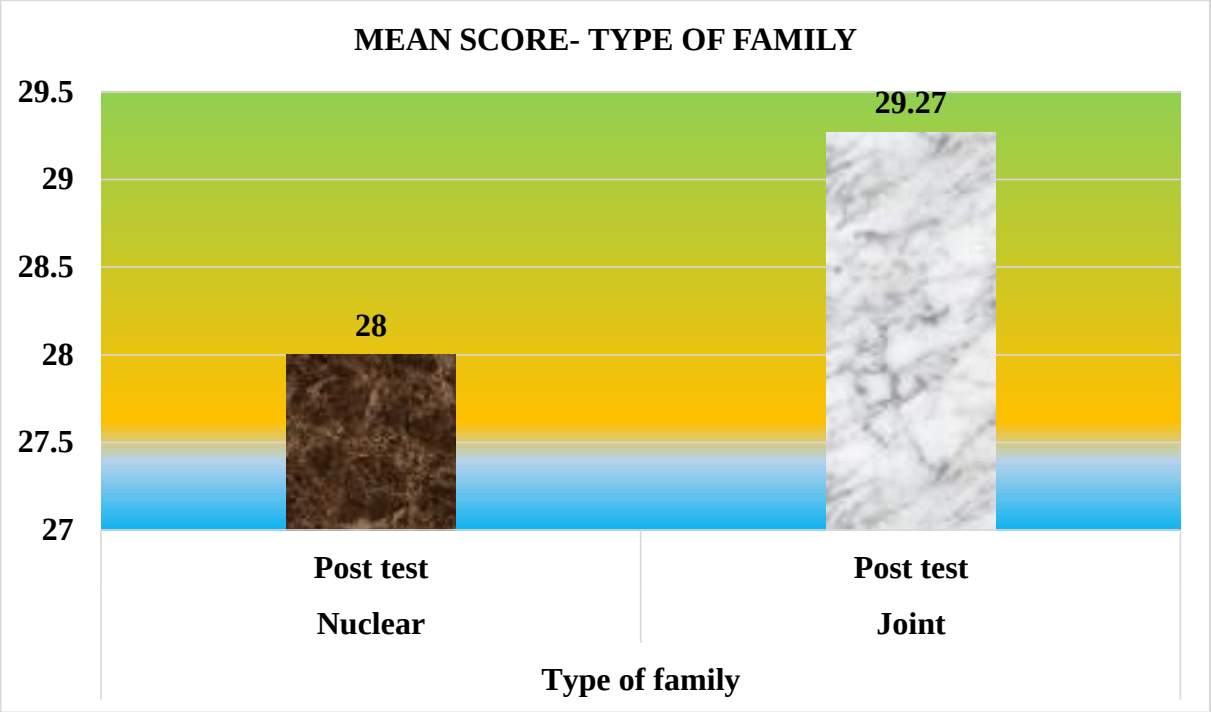
Table:- 4.3.13 Comparison of Post-Test Scores of Basic Integer Using Number line With Respect to Type of Family

Variables	Particulars	N	TESTING	Df	Mean	S.D	t- value
Type of family	Nuclear	17	Post test	16	28.00	3.536	- 1.203^{NS}
	Joint	15	Post test	12	29.27	2.154	

NS - Not Significant

The above table revealed that the t- value of the students at the type of family namely nuclear and joint . These values are not significant with respect to using number line to develop basic integer among students with visual impairment. So, the stated hypothesis "there is no significant difference between the post-test in basic integers using number line with respect to Type of Family" is accepted . While analyzing mean scores, the students in joint family performed well when compared to students in nuclear family because students in joint family can experience more life oriented practice which is related to integer when compared to students in nuclear family.

Figure:- 4.3.13 Comparison of Post-Test Scores of Basic Integer Using Number line With Respect to Type of Family



4.3.14 Comparison of Post-Test Scores of Basic Integer Using Number line With Respect to Educational Qualification of Parents

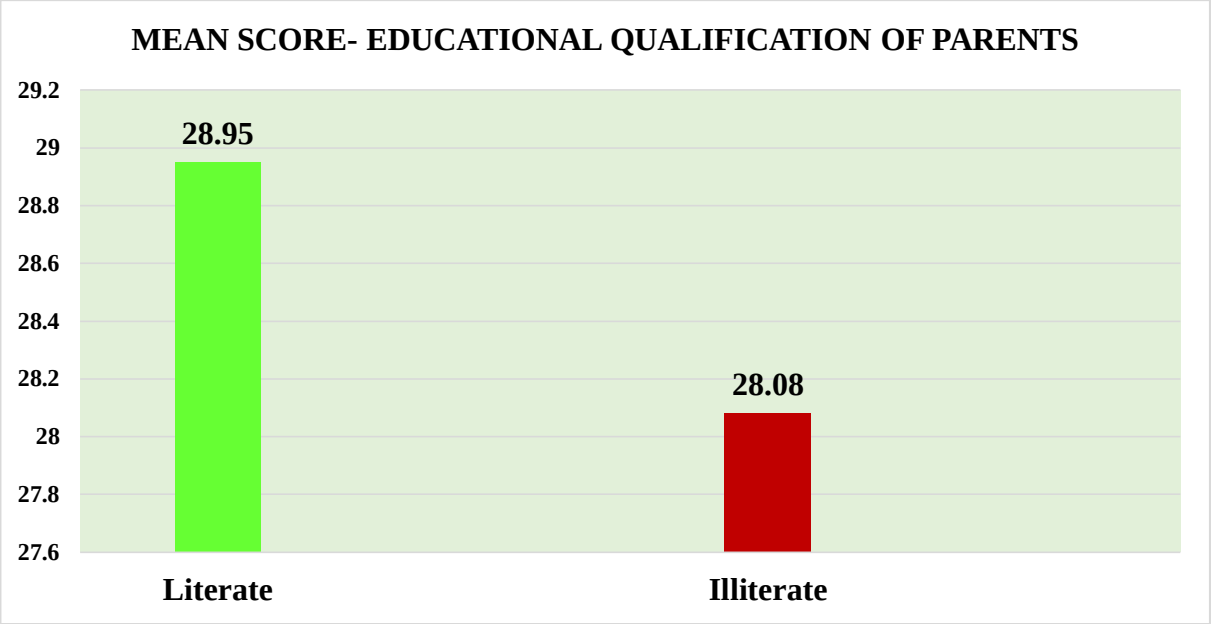
Table:- 4.3.14 Comparison of Post-Test Scores of Basic Integer Using Number line With Respect to Educational Qualification of Parents

Variables	Particulars	N	TESTING	Df	Mean	S.D	t- value
Education Qualification of parents	Literate	13	Post test	18	28.95	2.877	0.803^{NS}
	Illiterate	19	Post test	12	28.08	3.201	

NS - Not Significant

The above table revealed the t- value of the students based on their parents educational qualification . These values are not significant with respect to using number line to develop basic integer among students with visual impairment. So, the stated hypothesis "there is no significant difference between the post-test in basic integers using number line with respect to Educational Qualification of Parents" is accepted . Although while comparing the students whose parents are literate performed higher when compared to the students whose parents are illiterate because the literate parents may guide the students in their academic session while the illiterate parents may fail to do.

Figure:- 4.3.14 Comparison of Post-Test Scores of Basic Integer Using Number line With Respect to Educational Qualification of Parents



4.3.15 Comparison of Post-Test Scores of Basic Integer Using Number line With Respect to Braille Skill.

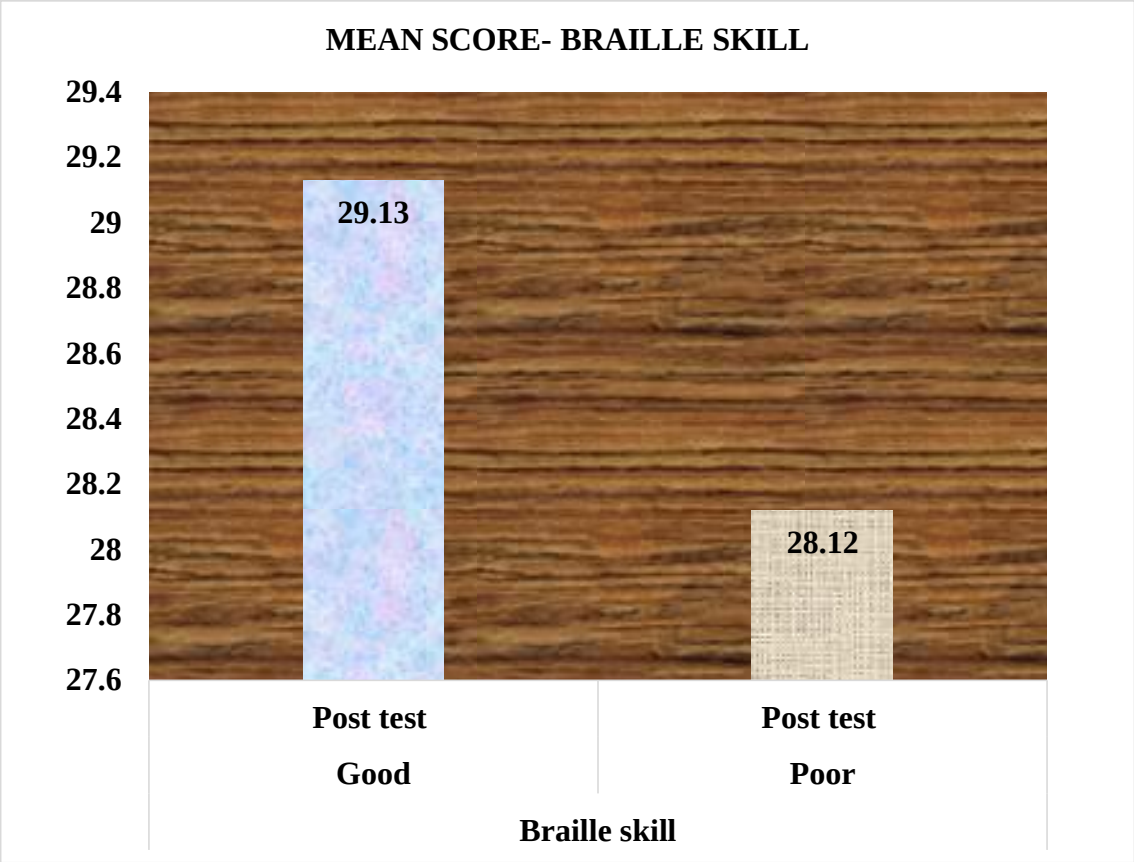
Table:- 4.3.15 Comparison of Post-Test Scores of Basic Integer Using Number line With Respect to Braille Skill

Variables	Particulars	N	TESTING	Df	Mean	S.D	t- value
Braille skill	Good	17	Post test	16	29.13	3.389	-0.957^{NS}
	Poor	15	Post test	14	28.12	2.475	

NS - Not Significant

The above table revealed the t- value of the students based on their braille skill . These values are not significant with respect to using number line to develop basic integer among students with visual impairment. So, the stated hypothesis "there is no significant difference between the post-test in basic integers using number line with respect to Braille Skill' is accepted. While comparing the mean scores, the students who have good braille skill performed higher than the students who has poor braille skill. As the tactile number line consist of braille code for indicating positive numbers, negative numbers and zero it would be easier for the students to learn better if they know to read braille.

Figure:- 4.3.15 Comparison of Post-Test Scores of Basic Integer Using Number line With Respect to Braille Skill



4.4 Overall Mean Scores

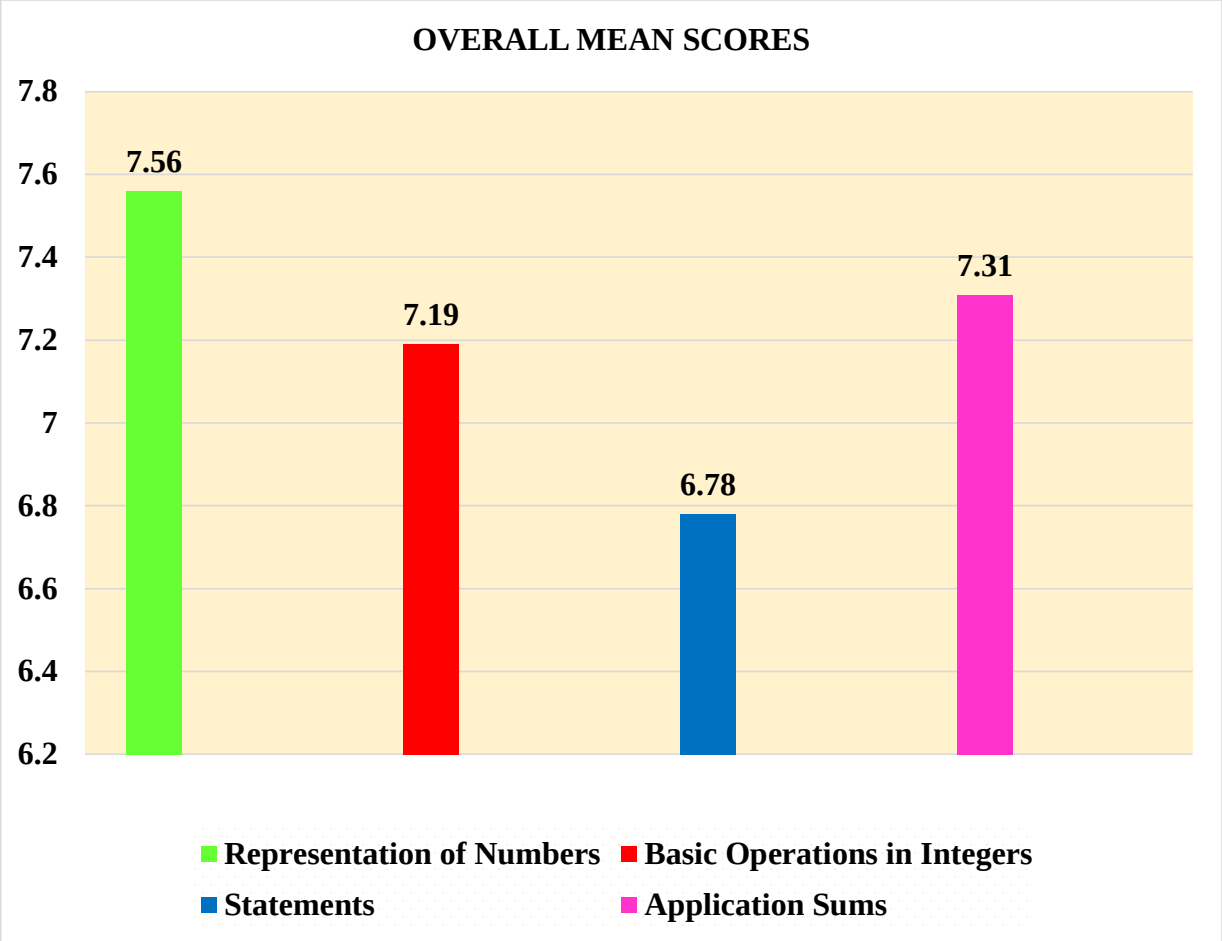
Table:- 4.4 Overall Mean Score

DOMAIN	N	TESTING	DF	MEAN VALUE	SD	t- value
Representation of Numbers	32	Pre test	31	1.500	0.8424	-28.192*
		Post Test		7.56	0.801	
Basic Operations in Integers		Pre test		2.813	0.6445	-27.288*
		Post Test		7.19	0.821	
Rules of Integer		Pre test		2.25	0.950	-20.189*
		Post Test		6.78	0.975	
Application Sums		Pre test		2.47	0.803	-21.970*
		Post Test		7.31	0.965	

*significant at 0.01 level

From the above table, while comparing the domains in basic integer it shows that students gave their highest performance in representation of numbers. The students showed average performance in application sums and basic operations in integer. In basic integer students have more difficulties in understanding the rules of integers where more concentration must be given.

Figure:- 4.4. Overall Mean Score



4.5 Conclusion

The finding of the study summarized in the next chapter.

SUMMARY AND CONCLUSION

CHAPTER - V

SUMMARY AND CONCLUSION

CHAPTER - V

SUMMARY AND CONCLUSION

5.0 Introduction

The summary and findings of this chapter is the most broadly comprehend part of the study because it recapitulates the information that has been presented in the previous sections of the report. The conclusion of the study is drawn from the results of the research and investigation on "Questionnaire for assessing integers using number line". Moreover, suggestions were enlisted based on the findings and conclusion of the study.

5.1 Statement of the Problem

The problem is stated as "**Developing Basic Integer for Students with Visual Impairment Using Number Line".**

5.2 Objectives of the Study

The present study aims at:

- To identify children with visual impairment of standard VI to IX.
- To prepare a tool and assess the performance of basic integer using Number Line among visually impaired students through a pre test.
- To give intervention for students on their difficulty level by using tactile number line.
- To make the students to use the basic integer concept in their real life.
- To find out the efficacy of the intervention through a post-test.

5.3 Methodology

The present study was carried out using a descriptive survey method. Since the investigation focused on children with Visual Impairment based on the standard VI-IX and as the sample were residing at Trichy.

Purposive sampling method was adopted for selecting the required sample. The sample of the study included a total of 32 Children with Visual Impairment, enrolled in special school.

The samples were further classified on the basis of their standard in which they are studying i.e. VI-IX standard. The main independent variables were., Standard, Locality, Onset of Disability, Type of Disability, Type of Family, Parents Qualification, Braille Skill.

The investigator developed an interview schedule to elicit information to collect the required data from the class teachers of the respective sample. Data gathering tool namely "Questionnaire for assessing integers using number line" was used to quantify the variables.

The tool was taken for the study, "questionnaire for assessing integers using number line". This tool consists of 32 questions under four domains, each domain consists of 8 questions on the basis of integers in both Tamil and English language. Based on that, the investigator developed the tool for identifying the basic integer among children with Visual impairment.

The questionnaire consists of 32 items which is used to assess the level of the child in basic integer. Each question consist of two options with relevant option the child will choose the appropriate option for the question as the correct answer.

Maximum time taken to assess the assessment tool for basic integer of each sample was 30 minutes. Assessment enabled the investigator to score the individual sample on the basis of their performance in the given activity provided the instructions (through Verbal).

Statistics such as: table will be created for the relevant sample data Further, percentage has been calculated to Analyze &interpret the results and the graphs were plot by the reference of the table.

5.4 Major Findings

The Major findings of the study Includes:

- → Analysing the standard of the selected samples, it was observed that 34% of the students were VI-VII standard, 66% of students were VIII-IX standard respectively.
- → Among the selected samples, it was observed that 63 % of the students were rural , 37% of students were urban respectively.
- → It was found that 66 percent of the selected samples comes under congenital, 34 percent of the selected samples comes under acquired.
- → It was revealed that 72 percent of the selected samples were total loss of sight and remaining 28 percent of the selected samples were low vision.
- → Analysing the type of family of the selected samples, it was revealed that 53 percent of them were from nuclear family while 47 percent of them were from joint family.
- → It was found that 59% of the selected samples parents were illiterate and 41% of selected samples were literate.
- → There is a significant difference between pre and post-test in representation of numbers in integers of VI - VII standard students.
- → There is a significant difference between pre and post-test in Basic Operations in integers of VI - VII standard students.
- → There is a significant difference between pre and post-test in Rules of Integer in integers of students in standard VI - VII.
- → There is a significant difference between pre and post-test in Application Sums in integers of students in standard VI - VII.
- → There is a significant difference between pre and post-test in representation of numbers in integers of students in standard VIII - IX

→ There is a significant difference between pre and post-test in Basic Operation in integers of students in standard VIII - IX

→ There is a significant difference between pre and post-test in Rules of Integer in integers of students in standard VIII - IX

→ There is a significant difference between pre and post-test in Application Sums in integers of students in standard VIII - IX.

→ There is a no significant difference between the post-test in the basic integer using number line in the onset of disability.

→ The students who have lost their vision during the lifestyle performed well in basic integer using number line when compared to students who loss their vision at birth because the exposure of the students get who lost their vision later is high when compare to the students who lost their vision at birth.

→ There is a no significant difference between the post-test in the basic integer using number line in the type of disability.

→ The students with low vision performed well when compared to total loss of sight students because the low vision students can visualize the number line so it would be easier for them to understand the difference between the numbers when compared to students who has total loss of sight.

→ There is a no significant difference between the post-test in the basic integer using number line in the locality.

→ The students in urban area performed well when compared to students in rural area because students in urban area get lot of exposure and experience compared to rural area.

→ There is a no significant difference between the post-test in the basic integer using number line in the type of family.

→ The students in joint family performed well when compared to students in nuclear family because students in joint can get exposure of integer based on real life experience.

→ There is a no significant difference between the post-test in the basic integer using number line in the educational qualification of parents.

→ The students whose parents are literate performed higher when compared to the students whose parents are illiterate because the literate parents may guide the students in their academic session while the illiterate parents may fail to do.

→ There is a no significant difference between the post-test in the basic integer using number line in the braille skill.

→ The students who have good braille skill performed higher than the students who has poor braille skill. As the tactile number line consist of braille code for indicating positive numbers, negative numbers and zero it would be easier for the students to learn better if they know to read braille.

→ The students showed best performance in representation of numbers compared to other domains. The students faced more difficulty in the concept of Rules of Integer included in integer as it can be an abstract concept for students with visually impaired.

5.5 Suggestions

Undergoing this study, the investigator has come up with certain suggestions for future research in basic integer using number line among students with visual impairment.

- Basic integer can be taught using number line with other forms like software , apps etc., rather than tactile.
- The study can carry out with both the gender.
- This research can extend to assess children with visual impairment and associated disabilities.
- The research can be modified with various concepts included in integer and assess the students with visual impairment.

5.6 Recommendations

❖ Research can be conduct to identify the difficulties faced by the teachers while teaching integer using number line among students with visual impairment.

- ❖ Various tactile aids must be provided for the children with visual impairment while training the students in integer according to the level and requirement of the child.
- ❖ The same study may be replicated on larger sample.
- ❖ Create an awareness on the importance of usage of integer in our daily life to the students with visual impairment.
- ❖ Students with Visual Impairment can be provided with more opportunities for learning basic integer using number line in a beneficial and useful manner.

5.7 Limitations of the Study

- ♦ Sample size is limited due to poor enrolment of Children with visual impairment in special school (covid-19)
- ♦ The study is conducted only in Trichy.
- ♦ The study is conducted only for females.

5.8 Conclusion

The present study reveals the performance of the visually impaired students in basic integer using number line. These children lack in their mathematical skill specifically in integers and number line. Knowledge of Integer is essential for our day to day activity to solve our life oriented problems. Identifying the child's knowledge in integer and number line as soon as possible can reduce the difficulty level in mathematics and it can help them to sort out the problems in real life with ease. From the above results it is shown that the intervention has made the students to perform better in basic integer. Tactile Number line helped the visually impaired students to understand the abstract concepts with ease. Tactile number line made the students to easily access the positive as well as the negative numbers and made the students to understand the difference between them.

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APPENDICES

APPENDIX-1

QUESTIONNAIRE FOR ASSESSING BASIC INTEGERS USING NUMBER LINE

Personal Data Sheet

Name of the Student	:
Standard	:
DOB & Age	:
Gender	: Male / Female
Name of the School	:
Address	:
Locality	: Rural / Urban
Type of School	: Special School/ Inclusive
Medium	: English / Tamil
Nature of Disability	: VI/ LV/ OTHERS
Level of Impairment	:
Mode of Learning	:
Type of Device Used by the Student	:
Educational Qualification of Parents	: Literate/ Illiterate
Braille Skill	: Good/ Poor

APPENDIX- 2

QUESTIONNAIRE FOR ASSESSING BASIC INTEGERS USING NUMBER LINE

Assessment Tool

(English Medium)

1) In the number line, we represent the numbers on left of 0 with symbol_____.
   a) +
   b) -
2) In the number line, we represent the numbers on right of 0 with symbol_____.
   a) +
   b) -
3) In the number line, the numbers on the left of 0 are_____.
   a) Increasing
   b) Decreasing
4) In the number line, the numbers on the right of 0 are _____.
   a) Increasing
   b) Decreasing
5) In number line, the numbers on left of 0 are called as _____.
   a) Positive integers
   b) Negative integers
6) In number line, the numbers on right of 0 are called as_____.
   a) Positive integers
   b) Negative integers
7) Negative integers are _____.
   a) Greater than 0
   b) Lesser than 0
8) Positive integers are _____.
   a) Greater than 0
   b) Lesser than 0

9) Zero is neither _____.

a) Positive

b) Positive nor Negative

10) Every positive integer is _____ than the negative integer.

a) Lesser

b) Greater

11) 0 is greater than positive integer.

a) True

b) False

12) 0 is lesser than _____ integer.

a) Positive

b) Negative

13) Sum of two positive integers is always _____.

a) Positive

b) Negative

14) Sum of two negative integers is always_____.

a) Positive

b) Negative

15) Sum of a positive integer and a negative integer is either_____.

a) Positive or Negative

b) Positive or Negative or Zero

16) -5 is on the right side of _____ on number line.

a) – 4

b) – 6

17) 10 is on the _____ side of -4 on the number line.

a) Right

b) Left

18) -1 is on the _____ side of -4 on the number line.

a) Right

b) Left

19) +15 is on the right side of +5 on the number line.

a) True

b) False

20) -11 is on the right side of -5 on the number line.

a) True

b) False

21) Additive inverse of +4 is _____.

a) -4

b) 4

22) Additive inverse of -5 is _____.

a) 5

b) +5

23) Additive inverse of +10 is _____.

a) – 10

b) 10

24) Additive inverse of -15 is _____.

a) 15

b) + 15

25) Sum of the integers and its additive inverse is always _____.

a) 1

b) 0

26) 4 is the _____ of 3.

a) Successor

b) Predecessor

27) 10 is the _____ of 11

a) Successor

b) Predecessor

28) 0 is the predecessor of _____.

a) +1

b) -1

29) -1 is the predecessor of _____.

a) 0

b) -2

30) -1 is _____ -5.

a) Lesser than

b) Greater than

31) -12 is _____than -5.

a) Lesser than

b) Greater than

32) -15 is greater than -17.

a) True

b) False

QUESTIONNAIRE FOR ASSESSING BASIC INTEGERS USING NUMBER LINE

Assessment Tool

(Tamil Medium)

1. **எண் வரிசையில், 0 க்கு இடதுபுறத்தில் உள்ள எண்களை _____ குறியீட்டுடன் குறிப்பிடுகிறோம்.**

   அ) +

   ஆ) -

2. **எண் வரிசையில், 0 க்கு வலது புறத்தில் உள்ள எண்களை _____ குறியீட்டுடன் குறிப்பிடுகிறோம்**

   அ) +

   ஆ) -

3. **எண் வரிசையில், 0 இன் இடதுபுறத்தில் உள்ள எண்கள்_____**

   அ) அதிகரிக்கும்

   ஆ) குறையும்

4. **எண் வரிசையில், 0 இன் வலதுபுறத்தில் உள்ள எண்கள்_____**

   அ) அதிகரிக்கும்

   ஆ) குறையும்

5. **எண் வரிசையில், 0 க்கு இடதுபுறத்தில் உள்ள எண்களை எவ்வாறு அழைக்கப்படுகின்றன.**

   அ) நேர்மறை எண்கள்

   ஆ) எதிர்மறை எண்கள்

6. எண் வரிசையில், 0 க்கு வலதுபுறத்தில் உள்ள எண்களை எவ்வாறு அழைக்கப்படுகின்றன.

அ) நேர்மறை எண்கள்
ஆ) எதிர்மறை எண்கள்

7. எதிர்மறை முழு எண்கள் _____

அ) >0
ஆ)<0

8. நேர்மறை முழு எண்கள் _____

அ) >0
ஆ)<0

9. பூஜ்யம் என்பது _____

அ) நேர்மறை எண்கள் அல்லது எதிர்மறை எண்கள்
ஆ) எதுவும் இல்லை

10. ஒவ்வொரு நேர்மறை முழு எண்ணும் எதிர்மறை முழு எண்ணை விட _____ ஆக இருக்கும்

அ) சிறியது
ஆ) பெரியது

11. 0 ஆனது நேர்மறை முழு எண்ணை விட அதிகம் .

அ) சரி
ஆ) தவறு

12. 0 என்பது _____ எண்ணைக் விட சிறியது.

அ) நேர்மறை
ஆ) எதிர்மறை

13. இரண்டு நேர்மறை முழு எண்களின் கூட்டுத்தொகை எப்போதும் _____

அ) நேர்மறை எண்கள்
ஆ) எதிர்மறை எண்கள்

14. இரண்டு எதிர்மறை முழு எண்களின் கூட்டுத்தொகை எப்போதும் _____

அ) நேர்மறை எண்கள்
ஆ) எதிர்மறை எண்கள்

15. நேர்மறை முழு எண் மற்றும் எதிர்மறை முழு எண் ஆகியவற்றின் கூட்டுத்தொகை_____

அ) நேர்மறை அல்லது எதிர்மறை
ஆ) நேர்மறை அல்லது எதிர்மறை அல்லது பூஜியம்

16. -5 என்பது எண் கோட்டில் _____ எண்ணின் வலது பக்கத்தில் உள்ளது.

அ) -4
ஆ) -6

17. எண் வரிசையில் -4 இன் _____ பக்கத்தில் 7 உள்ளது.

அ) இடது
ஆ) வடது

18. -1 என்பது எண் வரிசையில் -4 இன் _____ பக்கத்தில் உள்ளது.

அ) இடது

ஆ) வடது

19. +7 என்பது எண் வரிசையில் +5 இன் வலது பக்கத்தில் உள்ளது.

அ) சரி

ஆ) தவறு

20. -7 எண் வரிசையில் -5 இன் வலது பக்கத்தில் உள்ளது.

அ) சரி

ஆ) தவறு

21. +4 இன் தலைகீழ் சேர்க்கை _____

அ) 4

ஆ) -4

22. -5 இன் தலைகீழ் சேர்க்கை _____

அ) 5

ஆ) +5

23. +1 இன் தலைகீழ் சேர்க்கை _____

அ) -1

ஆ) 1

24. -7 இன் தலைகீழ் சேர்க்கை _____

அ) 7

ஆ) +7

25. முழு எண்களின் கூட்டுத்தொகை மற்றும் அதன் சேர்க்கையின் தலைகீழ் எப்போதும் _____

அ) 1

ஆ) 0

26. 4 என்பது 3 இன் முன்னி ஆகும்

அ) சரி

ஆ) தவறு

27. 6 என்பது 7 இன் முன்னி ஆகும்

அ) சரி

ஆ) தவறு

28. 0 என்பது _____ இன் முன்னி.

அ) +1

ஆ) -1

29. -1 என்பது _____ இன் முன்னி

அ) 0

ஆ) -2

30. -1 என்பது _____ -5

அ) சிறியது

ஆ) பெரியது

31. -7 என்பது _____ -5

அ) சிறியது

ஆ) பெரியது

32. -5 ஆனது -7 ஐ விட பெரியது.

அ) சரி

ஆ) தவறு