P-ISSN 2664-0422	Pakistan Social Sciences Review	Jul-Sep 2024, Vol. 8, No. 3
O-ISSN 2664-0430	https://doi.org/10.35484/pssr.2024(8-III)64	[800-812]

Pakistan Social Sciences Review
www.pssr.org.pk

RESEARCH PAPER

Investigating Differentiated Instructions for Students with Visual Impairment on Teaching of Maths

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ABSTRACT

Differentiated education necessitates that educators address the diverse needs of students within a classroom setting. In this context, when a teacher modifies their standard instructional approach to cater to a specific individual or group, facilitating their comprehension of a concept while simultaneously fostering a conducive environment for all students, that teacher is differentiating instruction. Objectives of the study were to test the efficacy of using differentiated instruction to teach maths to students with visual impairments. The participants were primary school-aged children with visual impairments attending a Special Education Institution. Thirty students from the Gujranwala district took part in the study. For this study, we used a very simple random sampling method. This study aimed to test the hypothesis that students' performance in Math's will improve with the introduction of differentiated instruction. After three weeks of intervention, students in the experimental group had their lessons differentiated to their individual learning styles while those in the control group continued to receive only traditional, whole-class instruction. The math proficiency and interest of pupils were investigated via the creation of a pre- and post-test. Differentiated instruction has been found to significantly affect students' academic achievement and engagement in the math classroom. There is dire need of differentiated instructions to meet diverse needs of Special needs community.

KEYWORDS Differentiated Instructions, Teaching of Maths, Visually Impaired

Introduction:

When it comes to training, Tomlinson (2001) introduced the concept of differentiated instruction to accommodate all students' needs by tailoring lessons to their individual interests and strengths in terms of content, delivery, and evaluation (Tomlinson). Differentiated practice is a training rationale, he says. The main reason for this is that students have a more positive learning experience when their teachers try to cater to their individual readiness levels, interests, and learning styles. To maximize each student's potential for learning is the primary goal of differentiated instruction (Tomlinson, 2001a, 2001c, 2004c, 2005).

Differentiated instruction is the most talked-about subject in elementary school. A relatively new concept in elementary education is differentiated instruction. This approach tailored pedagogy to meet the needs of individual students. According to Muller (2014), most primary school teachers find it challenging to implement differentiated instruction. All students get the same education because the public uses it (Van de., et.al, 2019). Because every student is treated fairly, some teachers believe in this

kind of instruction. However, many students may not grasp the topic to their full potential if they are required to use the same preparation for all of their classes (Goodnough, 2010). According to Alomran and Al-Shemali (2023), even among students of the same age, there is a significant variation in the degree to which they require guidance and support when learning. Teachers must thus pay close attention to their students' individual needs and preferences when planning lessons for elementary school students (van het., 201). Differentiated instruction is one of primary education's weak spots, according to Reezigt (2012). Teachers should strive to boost each student's learning, and they will be most effective at doing so when they provide differentiated instruction, according to Landrum and McDuffie (2010).

Having good eyesight is crucial to living a full life. In human existence, it is crucial. Thanks to our eyes, we can easily perceive a wide variety of objects and details. Furthermore, visual perception accounts for nearly 75% of our total knowledge. We can't appreciate the world around us if we can't see it, then. The root causes of blindness vary from one nation to another. The causes of vision impairment may be bilateral or post lateral, according to several studies. Both provide a great deal of difficulty for youngsters who are sight challenged. As far as 18 meters, a normal human being may perceive a clear image (Dumanoglu, Y., et.al, 2014).

Visually challenged children have three distinct levels of vision: mild, moderate, and severe. All situations disrupted the eyeball. Numerous studies indicate that blindness induces various psychological issues. That intensifies the effect on visually challenged youngsters. Refractive error is a primary cause of blindness. This results in numerous significant issues in the human eye (Mostafaie, A., et al., 2020). Visually impaired youngsters encounter numerous challenges in educational settings compared to their sighted peers. Visually impaired youngsters exhibit reduced initiative in forming social connections at school compared to their peers with other disabilities. Consequently, people experience pervasive frustration throughout their lives (Papa, L. et al., 2006).

Literature Review

Mathematical proficiency is crucial to human existence. Mathematical competencies encompass pupils' proficiency in arithmetic, fundamental numerical skills, geometry, and graphical abilities. With assistance, visually impaired youngsters can acquire mathematical abilities, perform calculations with diverse numbers, and develop the capability to address everyday mathematical challenges. They might attempt to acquire and manage mathematical data, fundamental numerical skills, and familiarize themselves with various mathematical terminology. We compute the quantities of various items efficiently and expeditiously. Fundamental numerical competencies. Develop the notion of tangible and abstract entities to acquire fundamental numerical competencies. Children employ cognitive and fine motor skills to acquire fundamental numerical competencies (Penner-Wilger et al., 2007).

Visually challenged students encounter numerous academic challenges across all courses due to their loss of vision. Particularly in the field of mathematics. They lack any understanding of fundamental numerical abilities. The absence of mathematical audio resources hinders the demonstration of effective performance in acquiring fundamental numerical abilities. Visually handicapped children utilize a braille slate, which comprises

etched slots in its design. Children with visual impairments can utilize various keys on a math slate to address mathematical issues (Nazemi, Murray, & Mohammadi, 2012).

Assistive technology is crucial in the lives of visually impaired pupils. It particularly has a beneficial effect on the academic results of children with exceptional difficulties. In differentiated instruction, teachers utilize numerous technologies and techniques in special education classrooms. Facilitate pupils' utilization of technology in their academic endeavors to attain elevated educational objectives and enhance their capabilities within the classroom (Hasselbring & Glaser, 2000).

Procedure of Differentiated Instruction

Differentiated education necessitates that educators address the diverse needs of students within a classroom setting. In this context, when a teacher modifies their standard instructional approach to cater to a specific individual or group, facilitating their comprehension of a concept while simultaneously fostering a conducive environment for all students, that teacher is differentiating instruction (Tomlinson, 2000).

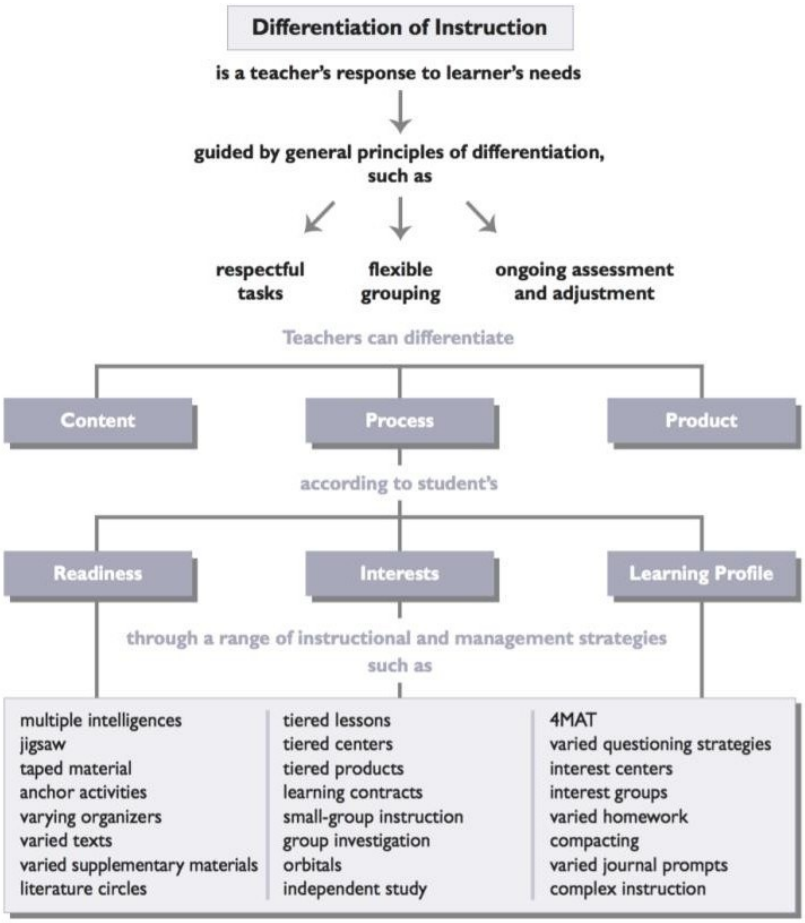

Figure.1 Differentiated Instructions

According to Tomlinson et al. (2003), many educators are unaware of the opportunities available to differentiate their instruction for gifted students. Moreover, although educators are aware of the opportunities, they are occasionally unprepared to utilize them in their classroom. Many primary educators focus primarily on assisting average children, failing to meet the needs of diverse learners (Inspectie van het Onderwijs, 2011; Little, 2010; Tomlinson et al., 2003). Dijkstra et al. (2012) assert that it is

challenging for educators to tailor instruction for each student, thereby necessitating differentiated instruction for optimal student outcomes.

Differentiated Instruction is implemented in the Following Way:

Educators can separate no less than four classroom components considering understudy availability, premium, or learning profile.

These four components are:

Content, Process, Product and Readiness

Content

A teacher can modify the topic he intends to instruct. The content encompasses study concepts, the study's aim, fundamental principles, and additional relevant material pertaining to the subject. The knowledge, skills, and understanding that a teacher aims to impart to students constitute a component of the curriculum. While fundamental concepts, instructional materials, and skills generally remain consistent for all students, it is the teacher's proficiency in facilitating access to the core lesson that is crucial, hence evaluating their capacity for differentiated instruction. It is essential for a teacher to effectively communicate the fundamental concept of a lesson to all pupils while maintaining a balance between content delivery and the varying degrees of comprehension among students. Teachers can implement several ways to distinguish their curriculum, such as utilizing mathematical manipulatives to facilitate student comprehension of concepts. He can utilize texts or narratives at multiple reading levels for enhanced comprehension. Whole-to-part and part-to-whole methodologies may be employed to convey information. Employing a variety of reading partner arrangements to assist and evaluate students engaging with textual resources. Providing supplementary instruction to pupils requiring additional clarification. Utilizing charts, computer simulations, audio recorders, and movies to facilitate comprehensive student comprehension of ideas. (Ashfaq, M., et al., 2022)

Process

The process refers to a student's perception of the fundamental elements and competencies imparted in a subject. The process can also be differentiated. Process can be broadly defined as a successful action that engages numerous students, enabling them to utilize their vital skills to comprehend a concept while maintaining a concentration on learning. An educator can diversify the process by offering pupils varying levels of difficulty for a specific activity, which may also align with their interests. The teacher can provide varying levels of help to either the teacher or the student to address the assigned challenge. The teacher may provide students with the opportunity to articulate their learning from a specific task through various modalities, including creating a sketch, composing a report, or delivering an oral presentation of their process. The process can be categorized as follows:

The educator should implement tiered activities to facilitate learners in cultivating an atmosphere where all individuals possess a uniform degree of comprehension and skills at their own speed. He should furnish them with interest centers to motivate them to investigate subjects of personal significance.

Products

The term 'product' denotes materials that students can utilize to demonstrate their understanding and capabilities acquired through an advanced curriculum. The 'product' in this context may encompass a rigorous paper-and-pencil assessment, their methodology for addressing real-world issues with the knowledge acquired throughout their academic program, or a compilation of their work completed during their studies, among other possibilities. An exemplary product possesses the subsequent attributes:

- It enables students to recognize their acquired knowledge.
- It enhances their comprehension and skill set.
- It facilitates the application of classroom knowledge and skills.
- It encourages student engagement in creative thinking.
- The product can be distinguished as follows:
- Students should be permitted to conceptualize their output while considering fundamental educational principles.
- To motivate learners to articulate their understanding through various means.
- Instruct them to work independently or collaboratively to finalize the product under diverse working conditions.
- Encourage pupils by supplying diverse materials to facilitate the completion of their product.
- By assigning items of varying difficulties to monitor student progress.
- By employing a range of assessment strategies.
- Establish quality criteria that align with the needs of both individual students and the entire class to showcase their products.
- All the aspects necessitate specific traits in students for the proper implementation of differentiated teaching.

Readiness

It is evident that a classroom has numerous individuals, each possessing distinct characteristics, abilities, and attitudes. In this context, ready refers to the student's preparedness for a specific subject or skill being taught. An efficient method for assessing a student's readiness level facilitates the expansion of their knowledge beyond their typical range of familiarity, while new content can be acquired within an enhanced domain.

Material and Methods

The research paradigm was positivism, and a quantitative methodology was employed. This study employed a control group pretest-posttest strategy for data collection.

Research Design

This study employed a pretest-posttest control group design as its research methodology. This design involved a control group and an experimental group. The experimental group received training utilizing differentiated methods, while the control group was taught using standard techniques. Following instruction, the experimental group was assessed prior to and after treatment exposure, while the control group was evaluated at the same two intervals without undergoing the experimental treatment.

Delivery of Contents

The teacher will employ the lecture and demonstration pedagogical approach. The teacher will utilize assistive mobile phone technology to present addition problems with numbers from 1 to 10. The addition questions will be sourced from YouTube technology. The teacher will play them some entertaining audio samples. teacher will utilize assistive mobile phone technology to present subtraction problems with integers from 1 to 10. These subtraction questions will be sourced from YouTube technology. The teacher will play them several entertaining audio clips. These selected clips instruct them on

The teacher will employ the lecture and demonstration pedagogical approach. The teacher will utilize assistive mobile phone technology to present multiplication questions with integers from 1 to 10. These multiple-choice questions will be derived from YouTube technology. The teacher will play them several entertaining audio clips. These selected clips instruct them on how to resolve subtraction problems. The teacher will collectively listen to the following topic utilizing a mobile phone.

The teacher will employ the lecture and drill teaching methodology. The teacher will utilize a talking calculator to explain multiplication problems involving numbers from 11 to 20. These multiplication questions will be utilized through the keystrokes of talking calculator technology. The teacher will indicate the placement of the numbers by touch, following which they will attempt to solve multiplication problems.

The teacher will employ the lecture and drill pedagogical approach. The teacher will utilize a talking calculator to elucidate the concept of division problems with numbers from 11 to 20. These division problems will be addressed using the keys of talking calculator technology. The teacher will indicate the placement of the numbers by touch, following which they will attempt to solve division problems sequentially.

Population and Sample

Students from Gujranwala District who are visually challenged and enrolled in primary school made up the study's population. Participants in the study were visually impaired children from the Gujranwala area. In the Gujranwala area, there were around fifteen students enrolled in special education programs. Approximately 1,394 pupils enrolled in the Gujranwala district. Here at the government institute for the visually impaired, we have sixty students. Twenty third graders served as the sample for this investigation. At the Government Institute for the Blind in Gujranwala, 15 pupils served as controls and 15 as experimental subjects from third grade.

Delimitations of the Study

This study was delimited to only:

• Math subject • Class three

• Primary level students teaching in Government Specia education Institute at District Gujranwala.

Procedure

The experimental study's sample size was 30 students. After taking an exam, the students were evenly divided into two groups. The two groups were to be categorized as an experimental group and a control group, respectively. Both groups were given a pre-test. After that, for two weeks, the control group received regular training while the experimental group received differentiated instruction. The experimental group of students had their own unique set of learning demands considered while designing their activities, homework, and assignments. A post-test was administered to both groups following four weeks of continuous instruction. There was a statistically significant difference in how well the two groups performed on the post-test. The experimental group outperformed the control group by a significant margin.

Results and Discussion

Table 1
Results of paired sample t-test to compare the students' performance of pre-test and post-test of level 2 counting from 11 to 20.

Sr.No	Variable	Mean Marks Pre-test	Mean Marks Post-test	Mean Difference	t-test	Significance
1	Counting 11- 20	00.00	42.50	-42.500	-19.007	.000

Table 1 shows the results of paired sample t-test to compare the students' performance of pre-test and post-test of level 2 counting from 11 to 20. The value of t-test (-19.007) is significant at the level of 0.5. It shows significant differences in the visually impaired students' performance in level 2 pre-test of counting from 11 to 20. The mean difference (-42.500) shows that the visually impaired students performed significantly better in post-test (M= 42.50) than the pre-test (M= 00.00).

Table 2.
Results of paired sample t-test to compare the students' performance of pre-test and post-test of level 2 addition questions from 11 to 20.

Sr.No	Variable	Mean Marks pre-test	Mean Marks post-test	Mean Difference	t-test	Significance
1	Addition questions 11- 20	00.00	40.38	-40.375	-13.735	.000

Table 2 shows the results of paired sample t-test to compare the students' performance of pre-test and post-test of level 2 addition questions from 11 to 20. The value of t-test (-13.735) is significant at the level of 0.5. It shows significant differences in the visually impaired students' performance in level 2 pre-test of addition questions from 11 to 20. The mean difference (-40.375) shows that the visually impaired students performed significantly better in post-test (M= 40.38) than the pre-test (M= 00.00).

Table 3
Results of paired sample t-test to compare the students' performance of pre-test and post-test of level 2 subtract questions from 11 to 20.

Sr.No	Variable	Mean Marks pre-test	Mean Marks Post-test	Mean Difference	t-test	Significance
1	Subtraction questions 11- 20	00.00	43.13	-43.125	-21.747	.000

Table 3 shows the results of paired sample t-test to compare the students' performance of pre-test and post-test of level 2 subtract questions from 11 to 20. The value of t-test (-21.747) is significant at the level of 0.5. It shows significant differences in the visually impaired students' performance in level 2 pre-test of subtraction questions from 11 to 20. The mean difference (-43.125) shows that the visually impaired students performed significantly better in post-test (M= 43.13) than the pre-test (M= 00.00).

Table 4
Results of paired sample t-test to compare the students' performance of pre-test and post-test of level 2 multiply questions from 11 to 20.

Sr.No	Variable	Mean Marks pre - test	Mean Marks post- test	Mean Difference	t-test	Significance
1	Multiply questions 11- 20	00.00	41.00	-41.000	-17.754	.000

Table 4 shows the results of paired sample t-test to compare the students' performance of pre-test and post-test of level 2 multiply questions from 11 to 20. The value of t-test (-17.754) is significant at the level of 0.5. It shows significant differences in the visually impaired students' performance in level 2 pre-test of multiply questions from 11 to 20. The mean difference (-41.000) shows that the visually impaired students performed significantly better in post-test (M= 41.000) than the pre-test (M= 00.00).

Table 5
Results of paired sample t-test to compare the students' performance of pre-test and post-test of level 2 division questions from 11 to 20.

Sr.No	Variable	Mean Marks pre- test	Mean Marks post- test	Mean Difference	t-test	Significance
1	Division questions 11- 20	00.00	41.75	-41.750	-15.182	.000

Table 5 shows the results of paired sample t-test to compare the students' performance of pre-test and post-test of level 2 division questions from 11 to 20. The value of t-test (-15.182) is significant at the level of 0.5. It shows significant differences in the visually impaired students' performance in level 2 pre-test of division questions from 11 to 20. The mean difference (-41.750) shows that the visually impaired students performed significantly better in post-test (M= 41.75) than the pre-test (M= 00.00).

Table 6
Results of paired sample t-test to compare the students' performance of pre-test and post-test of level 2 collectively questions from 11 to 20.

Sr.No	Variable	Mean Marks pre- test	Mean Marks post -test	Mean Difference	t-test	Significance
1	Collective questions 11- 20	00.00	41.63	-41.625	-18.068	.000

Table 6 shows the results of paired sample t-test to compare the students' performance of pre-test and post-test of level 2 collective questions from 11 to 20. The value of t-test (-18.068) is significant at the level of 0.5. It shows significant differences in the visually impaired students' performance in level 2 pre-test of collectively questions from 11 to 20. The mean difference (-41.625) shows that the visually impaired students performed significantly better in post-test (M= 41.63) than the pre-test (M= 00.00).

Finding of the study

- The value of t-test (-19.007) is significant at the level of 0.5. It shows significant differences in the visually impaired students' performance in level 2 pre-test of counting from 11 to 20.
- Findings shown that visually impaired students show better marks in post- test in the level of 1 addition questions from 1 to 10.
- The value of t-test (-13.735) is significant at the level of 0.5. It shows significant differences in the visually impaired students' performance in level 2 pre-test of addition questions from 11 to 20.
- Findings shown that significant different on results of pre-test and post-test at the level of 1 subtraction questions.
- Results show that the value of t-test (-20.319) is significant different from the level of 0.5. Visually impaired students performed well in post-test at the level of 1 multiply question from 1 to 10.
- The data showed that in level 1 division questions from 1 to 10 visually impaired students' performance is significantly better as compared to the results of pre-test.
- The value of t-test (27.288) is significant at the level of 0.5. data showed that there is significant difference in pre-test and post-test in the level of 1 collectively question from 1 to 10.
- Results found that there is significant difference in means score of pre-tests (.00) as compare to post-test (42.50) at the level 2 counting from 11 to 20.
- The finding showed that visually impaired students' performance significantly better in the score of post-tests (40.38) at the level 2 addition questions from 11 to 20.
- Results shown the comparatively difference in the mean results of pre-test (.00) to post-test (-
  - 43.125). in subtraction questions level 2 from 11 to 20.
- The value of t-test (-17.754) is significantly better from the level of 0.5 in the multiply questions level 2 from 11 to 20.
- Data shown that the results of t-test (-15.637) is significant difference from the level of 0.5. Visually impaired students performed better in the post test (42.69) in the level of 1 counting from 11 to 20.
- The value of t-test (-18.068) showed a significant difference at the level of 0.5. The different mean score showed that visually impaired students performed better in post t-test (41.63).

Discussion

The primary goal of the research was to determine how visually impaired pupils' basic numeracy skills were affected by the use of integrating technology in the classroom. In this study, we found that visually impaired pupils' basic numeracy skills were significantly impacted by the effects of integrated technology. According to the findings, talking mobile phone calculators and assistive mobile phone technologies have a favorable influence.

Hasselhorn, Linke-(2013) Advised that teaching pupils basic arithmetic abilities at a young age is extremely challenging. As they prepare to enter the academic world, it is best to begin training them. Give the concept of numbers your whole attention when you're in kindergarten. With practice, students can master the fundamentals of mathematics. Get a head start on learning the fundamentals of mathematics as soon as

possible. The findings of this study demonstrate that visually impaired students can effectively acquire basic numerical abilities through the utilization of technology beginning at an early age in their educational journey.

Students who are visually handicapped may benefit greatly from the use of electrical devices and computer-based technology, according to Salminen et al. (2015). In addition, they found that students with visual impairments can make good use of talking cell phone calculators, computer-based technologies, and other similar tools to acquire functional numeracy.

In an inclusive setting, technology plays a crucial role, according to Hassel, B. (2000). The unique requirements of people who are visually impaired should inform the development of adaptive technology. The results show that training teachers on how to use assistive technology effectively in the classroom is crucial. Stakeholders should ensure that visually impaired pupils have access to assistive technologies. In order to master basic numerical abilities, this study found that visually impaired students achieved significant achievements by adapting various technologies to their individual needs.

In an effort to better understand how to support students with disabilities in the classroom, Supalo and Mallouk (2016) conducted research on the topic. According to their findings, visually challenged children make use of a variety of assistive technology devices. To master the fundamentals of mathematics, for instance, they use JAWS. Students who are visually handicapped will find this software invaluable, as it translates written materials into spoken language. The logger pro program helps children who are visually impaired with their arithmetic homework as well. The visually challenged pupils' lives are positively affected by these technology, according to their reports. New studies also demonstrate that visually impaired youngsters can benefit greatly from assistive technologies, such as talking software on mobile and computers, when it comes to learning basic arithmetic abilities.

According to research presented by Cox and Marshall (2007), there are numerous challenges associated with the use of assistive technologies for students who are visually impaired. To effectively employ technology, educators should be confronted with all obstacles. The group came to the opinion that classrooms should be equipped with technology to help visually impaired children learn. This study highlights the favorable impact of incorporating assistive technologies into the learning environment for visually impaired students.

According to Fichten et al. (2003), students who are visually impaired can benefit from computer-based assistive technologies in many ways, including the ability to collaborate on assignments and notes, improve their grammar and vocabulary, and acquire basic mathematical skills. The talking learning materials can also be incorporated into their classroom learning environment. They came to the conclusion that visually impaired pupils should study mathematics skills using a variety of devices. The results of this study demonstrate that visually impaired pupils' performance improves when they employ integration technology to improve their basic mathematical skills. In 2014, Ertmer P.A. investigated the strong connection between the instructional practices of educators and various assistive technology. The current research shows that when lecturing to visually challenged pupils, teachers use a variety of approaches. Students who are visually challenged and use assistive mobile phone technologies or talking materials have more success in the classroom.

The study by Hughes (2005) looked at the idea that teachers should employ technology that is specific to their subjects in the classroom. They noted that the use of technology into the classroom increased teacher knowledge involvement. Educators are better able to share their expertise with their students when they make use of a variety of technological tools. According to the findings of this study, students' lives are greatly impacted by assistive technologies. Teachers are able to improve their own capacity for learning through the use of technology in the classroom.

Conclusion

The purpose of the research was to find out how visually impaired pupils' basic numeracy skills changed once teachers started using integration technologies. The results of this study showed that various forms of technology have a substantial impact on the way visually impaired students learn basic arithmetic. According to the research, visually impaired students' lives are greatly improved by the use of assistive mobile phone technology. This study's findings demonstrated that visually impaired students' performance improved when they used talking mobile phone calculator technology to master basic numerical abilities.

Findings from this study indicate that visually impaired students' ability to learn basic mathematical abilities is significantly improved when they use integrated technologies such as talking mobile phone calculators and assistive mobile phone technology.

Finding out how visually impaired pupils' basic numeracy skills changed when teachers started using integration technology was the main goal of this study. All the test questions from levels 1 and 2 (numbers 1–20) showed a statistically significant difference between the pre- and post-tests.

Recommendations

The study's findings informed the following recommendations.

- Visually impaired students, particularly those taking math classes, should have access to appropriate assistive technology.
- Students who are visually impaired should have access to talking mobile calculators and assistive mobile phone technology in the classroom.
- Institutions should carry out teacher training programs and instruct educators on the best ways to use various technology into the classroom for students with visual impairments.
- Prepare future educators to work with pupils who are visually impaired by instructing them in the use of appropriate assistive technology.
- It is the responsibility of the government to ensure that all schools have the necessary assistive technology for pupils who are visually impaired.
- In order to understand the fundamentals of basic numeracy, teachers should make use of assistive technology in the classroom.
- For pupils who are visually handicapped, I should lead lectures on how to use and integrate various technology.

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