

**OPEN ACCESS**

SUBMITTED 19 July 2025

ACCEPTED 15 August 2025

PUBLISHED 17 September 2025

VOLUME Vol.05 Issue09 2025

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Development Of Mathematical Imagination In Students With Visual Impairments As A Pedagogical Problem

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Abstract: This article analyzes the pedagogical problems of developing mathematical imagination in students with visual impairments. The study shows that traditional methods of teaching mathematics are mainly based on visual perception, which creates significant difficulties for students with visual impairments. The article considers ways to effectively master mathematical knowledge using modern typhloididacttic approaches, adaptive technologies and multisensory learning methods.

Keywords: Typhloididacttics, mathematical imagination, visual impairment, inclusive education, adaptive technologies, multisensory approach.

Introduction: In the modern education system of the 21st century, the principles of inclusive education are increasingly being used. In this regard, the problem of organizing mathematical education for students with visual impairments, a group that requires special attention, is especially relevant. According to the World Health Organization, 285 million people in the world have varying degrees of visual impairment, of which 39 million are completely blind.

The abstract nature of mathematical knowledge and the dependence of many mathematical concepts on visual components create additional pedagogical difficulties for students with visual impairments. This issue is related not only to individual educational needs, but also to the adaptive capabilities of the existing education system.

Imagination and thinking play a central role in human mental development. In particular, the formation of mathematical thinking and imagination is of great importance in the formation of students' logical thinking and skills in solving problem situations. In this regard, the development of mathematical imagination for children with visual impairments (blind or partially sighted) becomes a pedagogical problem that requires special attention. This situation is associated, on the one hand, with the reliance of school mathematics curricula on visual aids, and on the other hand, with the individual development characteristics of students with special needs.

This article analyzes the issue of developing mathematical imagination in students with visual impairments, its role in the educational process, existing problems and ways to overcome them.

Mathematical imagination is the ability to mentally represent, model and manipulate mathematical concepts and processes. According to the theories of A.N. Leontiev and P.Ya. Galperin, mathematical imagination is formed in stages:

Materialized action stage - performing actions with concrete objects

Verbal expression stage - expressing actions in words

Internal mental action stage - performing mathematical operations in the mind

The first stage is especially important for students with visual impairments, since the initial formation of mathematical concepts occurs through tactile and auditory analyzers.

Mathematical imagination is the ability to mentally reflect the quantitative, spatial, relational properties of real or abstract objects and manipulate them. This concept includes components such as spatial imagination, understanding logical connections, and mathematical modeling. In normal students, these skills develop mainly through visual experience, graphs, drawings, and diagrams.

In students with visual impairments, the limited visual resources create difficulties in imagining mathematical images. Therefore, for them, mathematical knowledge is formed more through auditory, sensory, and kinesthetic experiences. This, in turn, requires the teacher to use a special approach, tools and techniques.

Students with visual impairments perceive the environment mainly through hearing, smell, taste and touch. Their spatial imagination is formed not through vision, but through moving the body, touching objects with their hands. Also, abstract thinking develops more slowly in such students, which creates additional

difficulties in mastering mathematical topics.

Taking into account these characteristics, the teacher should form mathematical imagination based on an individual approach appropriate to the level of development of each student. Here, the use of tactile tools, mathematical materials written in Braille, audio presentations, and volumetric models play a particularly important role.

The following methodological tools are highly effective in working with students with visual impairments:

Typhlopedagogical models - learning mathematical concepts through perception through volumetric shapes, geometric figures, dotted writing.

Tactile didactic games - games based on mathematical operations and objects that develop sensory sensitivity.

Audio lessons and sound devices - explaining and reinforcing mathematical processes in a voice manner.

Textbooks and workbooks written in Braille are resources that allow for independent work.

Combined methods - consolidating knowledge by simultaneously activating many sensory organs.

These tools and techniques increase students' motivation for knowledge and create a basis for mastering the subject based on personal interest.

Typhlodidactics is the theory and practice of teaching visually impaired people, based on the following principles:

Compensatory principle: compensating for visual impairment through the activation of other sensory organs

Correctional principle: taking into account the characteristics of individual development

Activity principle: ensuring the active participation of the student in the educational process

Systematic principle: the transfer of knowledge in a consistent and logical sequence

The formation of mathematical representations in visually impaired students has several features:

Tactile-kinesiological dominance: The main part of mathematical concepts is formed through tactile sensations and motor experience. For example, the perception of geometric shapes is carried out by touching with the hands.

High development of auditory memory: The ability to process and remember audio information is usually at a high level, which gives an advantage in memorizing mathematical formulas and algorithms.

Specific development of abstract thinking: The lack of visual images can create some advantages in mastering abstract mathematical concepts, since such students

perceive mathematical relationships without being tied to specific visual images.

The deep mastery of mathematics by students with visual impairments plays an important role in determining their future professional direction. Currently, the widespread introduction of inclusive education guarantees quality education for every child. However, in practice, there is a lack of special methodologies, teacher qualifications and technical means in mathematics, and this issue is rising to the level of a pedagogical problem.

Therefore, it is necessary to systematically develop mathematical imagination for students with special needs, create scientific and methodological foundations, retrain teachers and qualify them in typhlopedagogy.

Mathematical imagination is not just a subject area, but one of the important factors shaping the intellectual potential of a person. Especially for students with visual impairments, the issue of forming this imagination stands out as a pedagogical problem.

Most mathematical concepts (shape, size, proportion, geometry, graphs, drawings) are perceived through vision. For students with visual impairments, this means being deprived of the main source of perception. Therefore, imagination is not independent knowledge for them, but a skill that is formed through a special approach.

In recent years, an inclusive education policy has been actively implemented. It aims to guarantee quality and equal education for all children, including those with visual impairments. However, in ordinary teaching methodologies, special needs are often not taken into account. Therefore, the development of teaching methods suitable for this category of students is becoming an urgent issue.

Today's digital world and labor market require more analytical thinking, mathematical logic, and problem-solving skills. In order for children with visual impairments to compete on an equal footing with their peers, they must also have a fully developed mathematical imagination.

Most teachers working with students with visual impairments do not have sufficient knowledge of special methodologies and tools for developing mathematical imagination. Therefore, there is a growing need for scientific and methodological manuals, trainings, and experimental methods in this area.

The following are specific recommendations for a broader academic approach to the topic of "Developing Mathematical Imagination in Students

with Visual Impairments" along with an analysis:

1. Theoretical Basis of the Pedagogical Approach

• Augmented Vision Perception Model

Visually impaired students acquire spatial mathematical concepts through perception. Multisensory (sight, hearing, touch) methods help develop Van Hiele's geometry concepts in stages (Visualization → Analysis → Abstraction) Wikipedia.

• Universal Design

Developing didactic tools that are accessible to all students is an important part of strengthening inclusivity Perkins School for the BlindSpringerLink.

2. Practical Tools and Technologies

Typhlopedagogical Traditional Tools (Low-tech)

- Didactic tools in conflict: abacus, dotted lines, volumetric geometric shapes, distributed graphics (tactile graphics) Texas School for the Blind and Visually Impaired StudentsTTA OnlineStudents for Students with Visual Impairments.

- Formulas, geometric concepts using Braille mathematical codes (Nemeth Code) (Braille-Printers, Perkins braille) for Texas School for the Blind and Visually Impaired Students.

- Facilitating the visual images of the day: optimal contrast with visuals — for example, using black lines on a yellow background Perkins School for the Blind.

- Games at home: mathematically meaningful text (DK Braille), interactive board games; tactile/graphic adapted displays such as Password, Farkle, Mastermind, Shut the Box Perkins School for the BlindTTA Online.

Modern (High-tech) and multimedia tools

- Tactile graphics creation tools: PIAF, Swell Form Machine, embossers (ViewPlus), TactileDoodle Texas School for the Blind and Visually Impaired StudentsPaths to Literacy.

- Audiovisual platforms: Talking pens, voice calculators, interactive sliders, voice-based computing (Splash City Maths, GeoMaths) macularsociety.orgalchem.ie.

- Mobile applications and smartphone-based solutions: i Math (automatic text reading), iCETA (haptic + audio feedback), AudioMath, TouchMath, Math Robot™, Slapstack Math, Math Melodies, MathSpeak, etc. SpringerLinkalchem.ie.

- Interactive systems with haptic touch and audio feedback: electrostatic haptic touchscreen, Haptic Deictic System (learning complex mathematical expressions based on sensations) SpringerLink.

3. Systematic pedagogical recommendations

1. Step-by-step approach:

o Explain concepts in small parts, give practical exercises at each stage Paths to LiteracyTTA Online.

2. Multisensory method:

o Combine didactic tools used in each lesson (touch, hearing, visual) - a multisensory approach increases learning success Perkins School for the BlindTTA Online.

3. Individual approach and planning:

o Plan advice for each student (IT tools, materials), encourage personal creative initiative Paths to LiteracyTexas School Inside and Outside.

4. Technological competence and pedagogical

readiness:

o Teachers need to master IT tools, be assistants to students, keep backups of toxic materials ready for Texas School See and Do TTA Online.

5. Creating a multimodal framework:

o Braille, audio, tactile graphics — all are more effective when used together in teaching SpringerLinkalchem.ie.

6. Practical, life-like mathematical relevance:

o Connect the lesson to real life — work with money, food labels, sports statistics, weather data Students for students who cannot see.

List of recommended structural recommendations

Number	Recommendation	The main thing
1	Creating a multisensory teaching methodology	Thefidis + practical experience
2	Preparation of typhlopedagogical tools	Braille, tactile graphics
3	Introduction to and support of IT tools	Voice calculators, applications
4	Teaching teachers how to work with apps	i Math, Math Robot™, Slapstack Math
5	Integrating examples into real-life situations	Money, size, weather
6	Adapting to the individual needs of each student	Planning tables
7	Strengthening collaboration with parents and the community	Games and tutorials at home
8	Backup plans — if IT fails, revert to the traditional method	Typhlopedagogical materials

Developing mathematical imagination in students with visual impairments is a complex and multifaceted pedagogical problem. Developing mathematical imagination in students with visual impairments is an

urgent issue not only for the teacher, but also for the entire education system. To achieve success in this area, educational institutions should be provided with the necessary didactic tools, adapted programs, and typhlotechnical equipment, and teachers should have

the necessary knowledge and skills in this area. Also, a positive attitude of families and society makes a significant contribution to the social integration of children. Mathematical imagination is not only a science, but also a key component of thinking. Therefore, every child, including a child with visual impairments, should have the opportunity to develop this ability.

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