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EXPLORING MULTIMEDIA METHODS FOR DIAGNOSING MATHEMATICAL CONCEPT FORMATION: A METHODOLOGICAL FRAMEWORK

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Abstract
This paper presents a methodological framework for utilizing multimedia technologies in diagnosing the formation of mathematical concepts. As technology becomes increasingly integrated into education, particularly in mathematics instruction, the need for effective diagnostic tools becomes paramount. The proposed framework aims to address this need by leveraging multimedia tools to assess students' comprehension and application of mathematical concepts.
The framework encompasses various stages, including task design, implementation, data collection, analysis, and interpretation. At each stage, multimedia technologies play a crucial role in providing dynamic and interactive learning experiences tailored to individual students' needs. Tasks are designed to engage students in problem-solving activities that require the application of mathematical concepts in real-world contexts, thereby fostering deeper understanding and retention.
Key components of the framework include the use of interactive simulations, virtual manipulatives, video tutorials, and online assessments. These multimedia tools enable students to visualize abstract mathematical concepts, experiment with different scenarios, and receive immediate feedback on their performance. Additionally, data collected from students' interactions with multimedia materials are analyzed to identify misconceptions, patterns of understanding, and areas requiring further instruction.
Through the implementation of this methodological framework, educators can gain valuable insights into students' mathematical concept formation processes. By diagnosing strengths and weaknesses early on, targeted interventions can be designed to support students' learning trajectories effectively. Ultimately, the integration of multimedia technologies in diagnostic tasks offers promising avenues for enhancing mathematics education and promoting deeper conceptual understanding among students

Keywords: Multimedia technologies, mathematical concept formation, diagnostic tasks, methodological framework, mathematics education, interactive learning, virtual manipulatives, data analysis, student assessment, educational technology.

Introduction

In the realm of mathematics education, the quest for effective instructional methodologies is perennial. With the integration of multimedia technologies into educational settings, new avenues for diagnosing and enhancing mathematical concept formation have emerged. This

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introduction serves as a prelude to exploring the utilization of multimedia methods for diagnosing the formation of mathematical concepts and presenting the rationale, significance, and scope of the study [1].

The landscape of mathematics instruction has evolved significantly with the advent of multimedia technologies. Traditional teaching methods often struggle to engage students and adequately assess their comprehension of abstract mathematical concepts. In contrast, multimedia tools offer dynamic, interactive, and visually stimulating learning experiences that cater to diverse learning styles and preferences. By leveraging these technologies, educators can create immersive environments where students actively engage with mathematical concepts, fostering deeper understanding and retention.

The diagnostic aspect of mathematics education is equally crucial. Diagnosing students' conceptual understanding, identifying misconceptions, and tailoring instruction to address individual needs are integral to promoting effective learning outcomes. However, traditional diagnostic methods may fall short of capturing the nuanced understanding of complex mathematical concepts. Herein lies the potential of multimedia technologies to revolutionize diagnostic tasks, offering real-time feedback, adaptive assessments, and personalized learning experiences.

Against this backdrop, this study embarks on an exploration of multimedia methods for diagnosing the formation of mathematical concepts. By examining the theoretical underpinnings, practical implications, and empirical evidence surrounding the integration of multimedia technologies into diagnostic tasks, we aim to elucidate the efficacy and potential of this approach in mathematics education [2].

The scope of this study encompasses a diverse array of multimedia tools, including interactive simulations, virtual manipulatives, video tutorials, and online assessments. These tools serve as vehicles for engaging students in authentic problem-solving experiences, facilitating conceptual understanding, and providing valuable insights into students' learning processes.

Ultimately, this exploration seeks to contribute to the ongoing discourse on innovative instructional methodologies in mathematics education. By elucidating the methodological framework for utilizing multimedia technologies in diagnostic tasks, we aspire to empower educators with practical strategies for promoting deeper conceptual understanding and fostering student success in mathematics. Through collaborative efforts and a commitment to pedagogical innovation, we endeavour to harness the transformative potential of multimedia technologies to enrich the landscape of mathematics education [3,4].

The main part

Currently, in pedagogy and psychology, there are shifts in the centre of gravity in the study of the problem of effective teaching at early age stages. Intensive searches for development reserves in early periods indicate that senior preschool age is characterized by:

1) optimal learning opportunities, exceptional ability to perceive; a large number of ideas are learned quickly and for life;

2) accessibility in the assimilation of ideas in a certain system with the identification of characteristic patterns and dependencies in them;

3) the possibility of forming full-fledged ideas, the simplest scientific concepts, and the ability to generalize, analyze, and classify, which underlies the development of logical, and on its basis, abstract thinking.

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The public need for a new education strategy matured for decades before it became conscious and resulted in a demand for a change in the traditional education system. The traditional educational system, existing in those forms that arose in Europe in the 18th-19th centuries, although it evolved, nevertheless remained the same in its sociocultural orientation and has now exhausted itself. The accelerated development of society and the global integration of social production, and its informatization require corresponding changes in education.
The reason for this shift is, firstly, the demands of pedagogical practice interested in increasing the level of readiness of children for learning at school; secondly, the need to make maximum use of the early periods of a child's life to implement the general tasks of preparing the younger generation to participate in social production; thirdly, it gradually accumulates facts indicating the fundamental significance of the intellectual acquisitions achieved by the child in the first years for all subsequent development.
In the comprehensive development of the individual, an important place belongs to mental development, mastery of techniques and methods of mental activity, improvement of cognitive abilities, conscious assimilation of knowledge, and the formation of the ability to use it to solve new problems. The need for mental development improvement of cognitive abilities, and education of rational thinking (clarity, accuracy, clarity, etc.) is due to the enormous scientific and technical changes that are taking place in the life of modern society.
The need to develop a concept for the continuous mathematical development of a preschool child is determined, on the one hand, by modern requirements for the organization of a person-oriented educational process in a preschool educational institution, the goal of which is the development of the child, and, on the other hand, by the need to solve the problem of creating a continuous educational process in a preschool stage, the purpose of which is the development of the student's personality in accordance with his individual characteristics.
Modern technologies for transmitting information open up completely new opportunities in the field of education for the younger generation. Children's entry into the world of knowledge begins in preschool age. The significance of the use of information technologies in the development of cognitive abilities of preschoolers is confirmed by the works of foreign and domestic researchers (S. Papert, B. Hunter, E.N. Ivanova, N.P. Chudova, etc.). Research work on the introduction of multimedia resources into preschool education has been carried out in our country since the eighties of the last century on the basis of the centre named after. A.V. Zaporozhets under the leadership of L.A. Paramonova, L.S. Novoselova, L.D. Chainova.
Currently, in the Republic of Uzbekistan and abroad, we are actively developing theoretical and methodological foundations for the use of information and multimedia technologies in the educational work of preschool institutions, and creating computer educational programs for preschoolers.
The use of interactive methods of explaining and updating knowledge, especially in game problem situations, contributes to the development of children's voluntary attention.
Computer presentations make it possible to present educational and developmental material as a system of vivid supporting images filled with comprehensive structured information in an algorithmic order. The use of computer presentations in the mathematics education of preschool children has the following advantages:

– the ability to demonstrate various mathematical objects (numbers, mathematical symbols, geometric figures, etc.) using a multimedia projector and projection screen in an enlarged

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form; • compensation for the amount of mathematical information children receive from various sources by combining audio, video and animation effects into a single presentation;
– activation of visual functions and visual abilities of the child. The use of computer presentations makes mathematics lessons emotionally charged and attractive and arouses keen interest in the child. Computer presentation in the organization of mathematical activities ensures the activity of children in the perception and visual identification of signs and properties of objects (size, shape); methods of perception, identification of qualitative, quantitative and spatiotemporal signs and properties are formed, visual attention and memory are developed.

Methodology for conducting diagnostic tasks

The integration of sections related to the development of mathematical and speech abilities of preschoolers at the level of theoretical and methodological basis for methods and technologies of working with children is determined by their logical and historical genesis - the development of the process of formation of mathematical and speech concepts of children, the content of modern preschool education programs in the Republic of Uzbekistan. The "Wunderkind" computer environment includes 6 blocks of multi-level educational tasks ("Alphabet", "Baby 1, 2, 3, 4", "Round Island"), united by game situations and characters; her presentation is based on the following stages of interaction between teacher and children.

1. Creating a game situation.

2. Mastering the elements of information culture for the development of a game situation:

– techniques for using a mouse and touchpad;
– ways to move inside blocks (red arrows - forward, blue - exit to the block menu);
– knowledge of ways to exit tasks (animated "buttons", "exit" key, combination of keys Alt + F4).

3. Speech and mathematical development at the reproductive level:

– reproductive color choice (For example this is red, this is blue; shall we choose blue?);
– colouring (for example: let's colour the Christmas tree green; what colour is the Christmas tree?);
– correlating the number of objects with a number (for example: there is one uncle, how many uncles are there in the picture?).

4. Speech and mathematical development at the partial search level:

– identification of the visual image of a number with its name (For example: what number is this?);
– independent correlation of the number of items with
– number
– (For example: show how many items?);
– independent choice of colour (For example: do you want to colour it differently?;
– what colour?).

5. Speech and mathematical development at a creative level:

– independent selection of a learning object and colouring it (For example: what number or letter should we colour? Name it, show it.);
– compiling a story based on a plot picture (For example: what is depicted?);
– set-theoretic justification for the visual image of a number (For example: why are there 5

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objects? Give reasons for your answer.)

6. Transition to a new level of the computer environment in a new gaming situation

The listed features allow us to conclude that the "Wunderkind" computer environment consistently integrates the mathematical and speech development of preschoolers of different age groups at the level of interactive development of computing culture and speech culture. Children actively master such sections of private methods as "Quantity and Counting", "Development of Vocabulary", "Shape and Geometric Figures", "Development of Coherent Speech", "Space and Time", "Formation of Sound Culture of Speech", subject to pedagogical support with adult's side.

Each didactic element of "Wunderkind" visualizes, at a level accessible even to the youngest preschooler, the attributes of the native language and mathematical culture, taking into account the following psychophysiological logical chain: from object-manipulative to visual-figurative and formal-algorithmic.

Amplification of mathematical development that is comfortable for a preschooler is ensured through the integration of basic characteristics in sound, quantitative, composite, graphic, colour and spatio-temporal solutions.

It is important to understand that the "Wunderkind" computer environment provides an integrated solution to the problems of pre-mathematical training for preschoolers:

- formation of a system of mathematical ideas about sets, relationships, numbers (section "Alphabet", task "Arithmetic"); size, shape, space (tasks "Geometric shapes", "Draw a picture", "Monkeys"); time (section "Round Island");
- formation of prerequisites for mathematical thinking: increasing the level of visual-figurative thinking (tasks "Find a pair", "Make a face", "Make a picture", "Monkeys");
- development of sensory abilities (working with a mouse), fine motor skills, working with a touchpad; development of the eye, observation skills (due to the development of sensory standards in the tasks "Geometric shapes", and "Draw a picture");
- formation of initial forms of educational activities: tracking the results of educational activities, a combination of step-by-step instructions and tasks to obtain results;
- expansion of children's vocabulary and improvement of coherent speech: automatic speech accompaniment of a multimedia educational program (MEP), providing for children's answers and comments.
- The "Wunderkind" computer environment meets the requirements of the theoretical foundations of children's mathematical development at the level of:
- associative-reflex concept: accumulation of associations by similarity (section "Alphabet"), contiguity (sections "Baby 1, 2, 3,4");
- theories of meaningful generalization: mastering deductive logic due to the ability to choose the level of tasks; exercises in formal logical generalizations in tasks "for the result" ("Draw a picture", "Find the odd one", "Collect a face", "Collect a picture");
- theories of the gradual formation of mental actions (step-by-step instructions in the tasks "Arithmetic", and "Geometric Figures");
- suggestopedic concept: plot-role organization of educational dialogue with the child, trust in the characters due to intonation, facial expressions, supportive verbal accompaniment of any answer options;
- NLP concepts: taking into account basic representations in all tasks;
- behaviourist concept: verbal, auditory, and facial stimuli and reinforcements in all tasks.

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Conclusions

Thus, computer environments as a factor in the formation of a child's mathematical concepts are becoming increasingly important due to the following significant functional capabilities.

1. The virtual reality of computer environments created for interactive logical and mathematical training of preschool children not only sets a pedagogically sound ideal prospect for the development of a small user but also ensures an increase in his social status in a real social environment.

This conclusion is determined by the following system of attributes that are an integral part of computer environments:

– various incentives;
– role identification capabilities;
– direct and indirect choice of the pace of skill development;
– objective, diverse assessment of intermediate achievements.

2. The recreational and relaxation role is the distribution of leisure time in group and individual time for a preschooler. This role, firstly, is realized in active, psychologically comfortable rest. Secondly, working with computer environments is a means of protection against undue influence from family or peer groups.
3. Socialization of a small user along the subject-subject path. The plots and interface of computer environments teach one to reason, make informed choices, show the dominant importance of personal qualities when perceiving other people and interpreting their behaviour, reduce the role of fatality in life events, provide knowledge, and broaden one's horizons.
4. Forming an idea of a PC as one of the means of getting to know the world of mathematics.

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