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# Mental Arithmetic as a Non-Traditional Method of Teaching Oral Calculation to Preschoolers

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## Abstract

*This study examines mental arithmetic as a non-traditional method of teaching oral calculation. The research presents statistical data on the effectiveness of mental arithmetic training, provides an overview of the methodology and its levels of study, and outlines its advantages and disadvantages compared to traditional approaches. Large-scale studies on the effects of mental arithmetic training are reviewed, leading to the conclusion that such training enhances the development of both hemispheres of the brain, which in turn fosters qualities such as flexibility and adaptability. The aim of the study is to explore mental arithmetic as a teaching method and to identify its benefits for intellectual development in early childhood. The research concludes that preschool and early school-age children acquire mental arithmetic skills more easily. The relevance of the study is based on the modern need for adaptability and cognitive flexibility. This article will be useful for educators teaching mental arithmetic and for parents interested in fostering their children's intellectual abilities.*

**Keywords:** *Mental Arithmetic, Effectiveness, Adaptability Development, Imagination, Visualization, Intellectual Development.*

## INTRODUCTION

The study of mathematics is crucial as it fosters cognitive development in young children and is considered one of the primary educational priorities for parents and teachers. It is believed that the current education system does not place sufficient emphasis on developing children's imagination and creative thinking [8]. Most educational activities focus on logical reasoning. However, modern challenges demand a greater number of solutions, which can be achieved through the simultaneous synthesis of analytical and creative thinking.

A neuron (nerve cell) is the fundamental structural unit of the brain. The point of contact between two neurons is called a synapse. The number of synapses between neurons determines a person's intellectual potential, cognitive flexibility, creativity, and adaptability. Thus, brain development is a process of forming and strengthening such neural-synaptic connections. Every new piece of information and subsequent specialized exercises generate new synapses. From the perspective of brain structure, this primarily implies a synaptic network that is equally developed in both hemispheres and, on the other hand, the brain's ability to use both hemispheres simultaneously during thinking processes. The central idea of mental arithmetic methodology is to employ exercises that simultaneously engage both hemispheres.

The relevance of this study is justified by parents' growing interest in enhancing their children's intellectual abilities. Today, flexibility and adaptability are key factors for success, and mental arithmetic aids in developing these qualities. The aim of this research is to examine mental arithmetic as a subject. The research objectives include identifying the shortcomings of mental arithmetic, highlighting its advantages, and drawing conclusions based on their analysis.

## METHODS AND MATERIALS

This study is based on an analysis of information collected from various sources regarding the effectiveness of learning mental arithmetic. The study examines the work of Siti Zulaiha Ahmad [1], which presents the advantages of mastering mental arithmetic while also identifying certain challenges in this field. Additionally, the research considers studies by Min-Sheng Chen, Tzu-Chang Wang, and Chi-Nan Wang [2], as well as Paul Irving [3], which explore the impact of mental arithmetic training on children's thinking and memory. Conducted studies [1-9] indicate that mental arithmetic training enhances brain flexibility, develops both

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hemispheres, and improves adaptability. For example, Frank and Barner's research, conducted with Indian children who had mastered mental calculation techniques, led to such a conclusion. During their listening to the story *Ali Baba and the Forty Thieves*, their ability to process new information was assessed [4]. A similar conclusion was reached by Ochilova Lailo Temirovna and Rajabova Lobar Khorievna [7]. Additionally, the study utilized structuring methods and comparative analysis.

## RESULTS AND DISCUSSION

Mental arithmetic is a method of performing mental calculations, allowing operations such as addition, multiplication, subtraction, and division without writing down numbers or using a calculator. It is a unique approach to developing children's intellectual abilities between the ages of 4 and 16, based on a system of verbal arithmetic.

Several studies [7,9] suggest that learning mental arithmetic stimulates both hemispheres of the brain, thereby increasing the cognitive quotient (CQ), which is a crucial factor in adaptability. Additionally, research conducted by Frank and Barner [4] indicates that using both hands on an abacus (Figure 1) actively engages both hemispheres of the brain, enabling the right hemisphere, which was previously responsible only for creative thinking, to filter and analyze information alongside the left hemisphere.

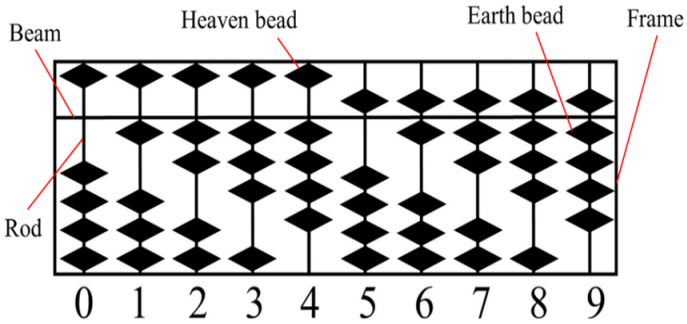


**Figure 1.** The Abacus [5]

A university in the United Kingdom conducted a study comparing the IQ of children who regularly practiced mental arithmetic with those who did not. The results showed that the IQ of children in the first group was, on average, 7 points higher than that of children in the second group [3].

Thus, the primary goal of mental arithmetic education is not merely acquiring mental calculation skills but fostering intellectual development by engaging both hemispheres and increasing cognitive quotient. It is also noteworthy that, according to research, children aged 4 to 12 learn mental calculation techniques significantly faster than those over 13 years old [8]. This supports the idea that preschool and early school-age children have a higher capacity for information absorption compared to adolescents. The advantages of learning mental arithmetic are presented in Table 1.

**Table 1.** Advantages of Learning Mental Arithmetic (compiled by the author based on [2,6,7,8])

| Advantages | Explanation |
|---|---|
| Early development | Mental arithmetic helps develop a child's intellectual abilities before they enter school, potentially making future learning processes significantly easier. |
| Development of both brain hemispheres | Mental arithmetic is one of the few tools that actively engages and develops both hemispheres of the brain. This means that it does not focus on a specific function, such as memory or imagination, but rather enhances cognitive processing as a whole. |
| Development of personal qualities | Mental arithmetic influences not only learning abilities but also leadership skills and independent thinking. While school subjects primarily focus on knowledge acquisition and logical reasoning, mental arithmetic also works on personality development. |
| Concentration | Mental arithmetic exercises require performing calculations in the mind, which is impossible without proper concentration. |
| Visual memory | Mental calculations become possible through working with an abacus. Once a certain level is achieved, the abacus is removed, and calculations are performed through visualization. |
| Creative thinking | Mental arithmetic engages both hemispheres simultaneously—the left hemisphere, responsible for logic, and the right hemisphere, responsible for creativity. |
| Listening and observation skills | Mental calculations train the ability to maintain focus on a given task without being distracted by external stimuli. |
| Imagination | Mental arithmetic develops the ability to visualize objects in detail and manipulate them mentally. |
| Logic | Children develop skills such as articulating thoughts clearly and comprehensively, noticing details, building logical connections, identifying patterns, and predicting consequences of events and actions. |
| Analytical thinking | Strengthening interhemispheric connections enhances the ability to process information quickly and switch efficiently between tasks. |

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|---|---|
| Leadership skills | Mental arithmetic is not just about numbers—it fosters confidence, quick thinking, and broader reasoning. When children realize they can solve tasks faster and more easily than others, they begin to believe in themselves and their abilities. |
| Memory | Mental arithmetic develops all types of memory, both short-term and long-term. |
| Academic performance improvement | The development of memory, thinking, concentration, and stress resistance inevitably leads to improved academic performance. |
| Independence | A well-trained brain facilitates the acquisition of new knowledge, while children learn how to manage their time effectively and study efficiently. |
| Stress resistance | A child who sees progress in areas where they previously struggled and adapts quickly to new conditions will experience less stress in a fast-changing world. |
| Fine motor skills | Working with an abacus provides excellent fine motor skill training. |
| Emotional intelligence | Children learn to set goals, strive for them, and achieve success. As a result, they develop resilience and a strong character. |
| Self-discipline | Learning mental arithmetic requires systematic practice and perseverance, fostering self-discipline and the ability to overcome challenges. |
| Critical thinking | The ability to reason logically is the foundation of critical thinking. Mental arithmetic helps develop mental flexibility, logical reasoning, and problem-solving skills. |

It can be concluded that learning mental arithmetic emphasizes rapid calculation, the development of critical thinking, problem-solving, and the application of acquired skills in real-world conditions. This method equips students with the skills and confidence necessary to succeed in both academic settings and practical activities. As educators continue to explore innovative teaching strategies, mental arithmetic emerges as a powerful tool for enhancing mathematical skills and preparing students for success in the 21st century. However, mental arithmetic is not a universal solution; it addresses only a specific range of tasks but provides students with a tool to develop a wide array of skills [6].

Mental arithmetic incorporates the following methods:

Memorization. Memorization is a crucial factor in learning mathematics, developing a lifelong skill. In mathematics, memorization is essential for mastering concepts, as students must learn numerous mathematical formulas required for solving complex problems. Several strategies can improve memorization skills, such as using mnemonics or melodies. Mental arithmetic lessons engage visual memory (remembering and visualizing the abacus), auditory memory (dictation exercises), and kinesthetic memory (finger movements).

Visualization. Visualization is the ability to create mental representations of complex information. In mathematics, visualization is applied when working with real-world objects. For example, when solving a problem related to the surface area of a pyramid, a student who already understands what a pyramid is can mentally visualize a pyramid's net and label the sides with given measurements. The best way to develop visualization skills is through studying diagrams, graphical representations, three-dimensional models, and timelines. This helps students develop spatial awareness and confidence in applying visualization, significantly improving their depth of understanding in mathematics.

Pattern recognition. Pattern recognition involves identifying mathematical regularities. This skill is crucial for performing mental calculations as it significantly simplifies them. For example, summing all numbers from 1 to 100 becomes easier by recognizing a pattern: the sum of the first and last numbers equals 101, as does the sum of the second and second-to-last, and so on. Since there are 50 such pairs, the total sum is $101 \times 50 = 5050$ [2,8].

Mental arithmetic schools exist in many countries, leading to slight variations in methodology. Each mental arithmetic school has its own system of levels and stages, but all follow a step-by-step learning process. On average, there are between six and ten levels (Table 2) [1-9].

**Table 2.** Levels of Learning Mental Arithmetic (compiled by the author based on 1-9)

| Level | Description |
|---|---|
| First level | At the beginner level, children become familiar with the abacus and learn mental calculations within the range of 10, including two-digit mirrored numbers (22, 33, 55, 66, etc.), where the abacus beads are sufficient, and formula application is unnecessary. |
| Second level | Students learn to add and subtract multi-digit positive numbers, apply special formulas, and mentally calculate non-mirrored two-digit numbers. |
| Third level | Students learn to work with negative numbers in mental calculations. |
| Fourth level | Students learn to add and subtract decimal fractions and multiply two-digit numbers. |

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| Fifth level | Students learn to multiply two-digit numbers by two-digit and three-digit numbers. By the beginning of the fifth level, they can already multiply two-digit numbers by single-digit numbers, add and subtract negative, positive, and fractional numbers mentally with ease. |
| Sixth level | Students learn to divide three-digit numbers by single-digit numbers with remainders. They perform addition and subtraction operations on the abacus with numbers up to one million. |
| Seventhandsubsequent levels | The complexity of previous levels increases, and new concepts such as squaring, square root extraction, and percentage calculations are introduced. |

Thus, mental arithmetic is a structured discipline that follows a gradual progression from simpler to more complex concepts. As previously mentioned, this program represents a scientific method of cognitive development based on performing arithmetic operations. Each exercise requires maximum concentration, simultaneous engagement of multiple cognitive skills, and synchronized use of both hemispheres of the brain, leading to their balanced and simultaneous development.

## CONCLUSION

The conducted study demonstrates that practicing mental arithmetic provides far more benefits than just the ability to perform calculations mentally. The brain is a tool that individuals use throughout their lives, and like any tool, it requires consistent training. Intellectual development is established at an early age, and modern parents have the opportunity to enhance their child's cognitive potential. Mental arithmetic can be applied to both simple and complex calculations, depending on the student's level of proficiency. As children grow, they are expected to solve increasingly complex problems, making it essential for them to acquire effective methods and skills early on. Many of these methods are not included in standard curricula, requiring students to take initiative and learn independently. The window for cognitive development in children is relatively small, making mental arithmetic an excellent tool for fostering adaptability and cognitive flexibility—skills that will be valuable throughout their lives.

It should also be noted that mental arithmetic, as a method, cannot replace traditional mathematics lessons. Studying mental arithmetic does not guarantee success in mathematics and, in some cases, may even be detrimental if a student experiences a conflict between traditional and non-traditional methods. Traditional mathematics extends beyond simple calculations; it requires an understanding of problem conditions and strategic approaches to solutions. However, the visualization, concentration, and memory skills developed through mental arithmetic practice can contribute positively to success in mathematics classes.

This study demonstrates that practicing mental arithmetic serves as a cognitive training tool for children. This effect follows a straightforward logical sequence—mental arithmetic requires concentration and visualization, which in turn enhance focus and imagination. Visualization places demands on memory, just as any mental calculation does, indicating that mental arithmetic actively strengthens a child's memory. Combined with other factors, this contributes to improved academic performance, as children find it easier to concentrate on subjects and retain new information. As a result, they develop greater confidence, which enhances leadership skills and self-assurance.

Mental arithmetic is one of the few disciplines whose benefits extend beyond a single subject, equipping children with a lifelong cognitive tool that aids in acquiring new information and facilitates faster adaptation in adulthood.

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