

INTERNATIONAL EXPERIENCE IN DEVELOPING CHILDREN'S THINKING THROUGH MENTAL ARITHMETIC

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Abstract

This article examines international experience in developing children's thinking through mental arithmetic. It analyzes the practices of Japan, China, South Korea, Malaysia, and Singapore in teaching mental arithmetic through the abacus, soroban, suanpan, and modern supplementary education programs. The article highlights how mental arithmetic contributes to the development of children's logical thinking, memory, concentration, quick calculation skills, visual imagination, and independent decision-making. Special attention is given to the methods, age stages, teaching forms, and practical approaches used in foreign countries. Based on international experience, the article also proposes recommendations for adapting effective mental arithmetic practices to the education system of Uzbekistan. The study concludes that mental arithmetic can serve as an effective pedagogical tool for improving children's intellectual development from preschool and primary school age.

Keywords

mental arithmetic, abacus, soroban, suanpan, children's thinking, intellectual development, preschool education, primary education, logical thinking, memory, concentration, international experience, Japan, China, South Korea, Malaysia, Singapore.

Introduction. Today, the development of children's intellectual potential from an early age, as well as the formation of their logical thinking, memory, attention, imagination, and creative thinking, is becoming an increasingly important issue in the global education system. In particular, foreign countries widely use modern and effective methods that contribute to children's intellectual development. One of such methods is mental arithmetic.

Mental arithmetic is an educational method that not only teaches children to perform calculations quickly and accurately, but also activates brain activity and develops thinking processes. Through this method, children learn to work with

numbers and develop such skills as concentration, memorization, quick thinking, and independent decision-making. During mental arithmetic lessons, not only children's mathematical knowledge but also their general intellectual abilities are gradually formed.

In foreign countries, particularly in Japan, China, South Korea, Malaysia, and Singapore, mental arithmetic is widely used as an important supplementary method in children's education. The experience of these countries shows that mental arithmetic serves as an effective tool for developing children's quick thinking, strong memory, logical analysis, concentration, and creative approach.

In the current era of globalization and rapid development of information technologies, the younger generation is required not only to acquire ready-made knowledge, but also to think independently, find solutions to problems, make quick decisions, and apply innovative approaches. Therefore, the relevance of teaching mental arithmetic to children is increasing. This article examines the experience of foreign countries in developing children's thinking through mental arithmetic, its importance in the educational process, and its influence on children's intellectual development.

Main Part. The Experience of Japan. Japan is one of the countries with the richest historical experience in mental arithmetic education. In this country, mental arithmetic is mainly taught through the soroban, the Japanese abacus. Soroban is considered a tool that helps children visually imagine numbers, distinguish them according to place value, and perform calculations mentally.

In Japanese educational practice, soroban is valued not only as a calculation tool, but also as a method that develops children's attention, quick thinking, memory, and logical reasoning. The Japanese Ministry of Education notes in the elementary mathematics curriculum that the appropriate use of tools such as the soroban, calculator, and computer can help improve learning outcomes.

Historically, soroban was widely taught in Japanese elementary schools. During the Meiji period, pupils studied soroban from the 2nd to the 6th grade. After the Second World War, abacus practice in compulsory education was mainly associated with higher elementary grades, particularly the 4th grade and above. Today, soroban is not taught as a compulsory independent subject in all schools, but it continues to be offered as an additional activity in many elementary schools, clubs, and specialized soroban centers.

The teaching process initially begins with the use of a real soroban. Children first understand place values such as units, tens, and hundreds by moving the beads of the abacus. At the next stage, they learn addition and subtraction, followed by multiplication and division. Lessons include speed-based exercises,

auditory calculation based on numbers dictated by the teacher, written tasks, and timed activities. Once children reach a certain level, they move on to calculating without a physical soroban by imagining a “mental abacus” in their mind. This method is called *anzan* in Japanese.

An important feature of the Japanese experience is that mental arithmetic is regarded not only as a way to achieve mathematical results, but also as a means of developing patience, discipline, accuracy, and concentration in children. In recent years, interest in soroban has been increasing again in Japan. For example, in 2024, it was reported that approximately 8 percent of elementary school pupils were engaged in soroban learning. This shows that even in the era of digital technologies, traditional calculation tools remain important for developing children’s thinking.

The Experience of China. In China, mental arithmetic was formed on the basis of the *suanpan*, the Chinese abacus. *Suanpan* occupies an important place in Chinese culture and in the history of practical calculation. It has been used not only as a tool for trade or everyday calculations, but also as a visual means of teaching children number concepts, the place-value system, and arithmetic operations. The Chinese abacus can be used to perform addition, subtraction, multiplication, and division.

In China, mental arithmetic is often taught from preschool education and the early grades of primary school. Some studies note that the abacus should be introduced in the lower grades of primary education within Chinese national mathematics programs. At the same time, many kindergartens and primary schools in China have a tradition of teaching mathematics to children through the abacus. Research also emphasizes that teaching mathematics through the abacus has become a widespread practice in Chinese kindergartens.

In the Chinese experience, teaching begins with the use of a real *suanpan*. Children understand the structure of numbers through the movement of beads. For example, they learn to recognize numbers through unit and five-value beads, group them, and express them according to place value. Later, children transfer these actions into internal visualization and begin to calculate without an abacus. This process is called *mental abacus* or *zhu xin suan* in Chinese.

Another important aspect of the Chinese experience is the system of competitions and level-based assessment. Children are often trained step by step in special courses, clubs, and mental arithmetic centers. Lessons include exercises such as rapid calculation, auditory calculation, visual calculation, working with multi-digit numbers, and retaining numbers in memory. Scientific studies show

that Chinese children trained in mental abacus demonstrate higher speed and accuracy in complex mental calculations.

The Experience of South Korea. In South Korea, mental arithmetic is mainly taught through supplementary education, that is, after-school clubs, private learning centers, and developmental courses. Since educational competition is strong in Korea, parents pay great attention to the development of children's mathematical thinking, concentration, and quick calculation skills. Therefore, abacus and mental arithmetic lessons are considered one of the common forms of supplementary education among primary school pupils.

In the Korean experience, children are usually introduced to mental arithmetic from preschool age or from grades 1–3. Scientific studies have compared the results of Korean primary school pupils who received abacus training with those who did not. For example, in a 2015 study, 75 primary school pupils participated, 43 of whom had received abacus training. According to the results, children who had practiced abacus demonstrated better arithmetic abilities than the control group.

In South Korea, the teaching process is organized step by step. First, children learn the structure of the abacus, the value of the beads, and the rules for placing numbers. At the next stage, they practice addition and subtraction, followed by multiplication and division. Speed, accuracy, and repeated practice are considered important in lessons. Once children acquire sufficient skills, they gradually move away from the real abacus and begin to calculate mentally. The main focus is placed on visual memory, quick response, concentration, and reducing errors.

The main feature of the Korean experience is that mental arithmetic is more closely linked with practical results, namely improving speed and accuracy in mathematics. At the same time, some studies note that abacus training may also have a positive effect on children's response inhibition, that is, their ability to reduce impulsive errors.

The Experience of Malaysia. Malaysia is one of the countries that pays special attention to mental arithmetic education. This is because the world-famous UCMAS - Universal Concept of Mental Arithmetic System - was established in Malaysia. UCMAS was founded in Malaysia in 1993 by Dr. Dino Wong and was initially created to develop children's intellectual potential through abacus and mental mathematics.

In Malaysia, mental arithmetic is usually taught through programs designed for children aged 4 to 13. This age range covers both preschool education and primary school. In UCMAS and similar centers, children are divided into groups according to their age and level of knowledge. Programs are usually organized as beginner levels for children aged 4–6 and main levels for children aged 7–13.

The main teaching method in the Malaysian experience is the transition from practical calculation using the abacus to mental calculation. At first, children work with a small abacus, while the teacher explains the topic using a large abacus. Then pupils complete timed exercises in workbooks, calculate numbers dictated orally, practice fast writing of numbers, work with flashcards, and strengthen their skills through homework. UCMAS materials show that lessons have a practical nature, teachers use a large abacus, pupils complete timed exercises on small abacuses, and weekly homework is assigned.

In the Malaysian model, mental arithmetic is interpreted not only as mathematical calculation, but also as a program aimed at developing the child's whole brain activity. Lessons include the use of both hands on the abacus, learning through sight, hearing, and movement, rapid exercises, competitions, and level-based examinations. These methods help develop children's attention, memory, quick thinking, self-confidence, and independent working skills.

The Experience of Singapore. In Singapore, mental arithmetic is mainly taught through supplementary education centers, private courses, and extracurricular developmental programs. Although Singapore's education system is well known for its high achievements in mathematics, mental arithmetic is usually not taught as a compulsory core subject in public schools. Instead, it is widely used as an additional activity aimed at developing children's calculation speed, attention, and memory.

In Singapore, children can begin learning mental arithmetic at a very early age. For example, the CMA Singapore program includes a Kindy Programme for children aged 3–4.5, a Kinder Programme for children aged 4.5–6, and a Primary Programme for children aged 7–13. This means that in the Singaporean experience, mental arithmetic is organized as a staged system that begins in preschool education and continues through the primary school years.

In the teaching process, children first perform real operations with the abacus. Then they gradually move on to visual calculation, that is, imagining numbers in their mind. Mental arithmetic centers in Singapore use multimedia tools, flashcards, game-based exercises, different levels of modules, auditory calculation, and visual calculation activities. The CMA Singapore program emphasizes ability-based teaching, multi-level learning, multimedia, multisensory activities, and special training methods.

Other centers are also active in Singapore. For example, the UCMAS Singapore program aims to develop children's concentration, memory, creativity, and confidence. In addition, centers such as Crestar Learning Centre offer abacus and

mental arithmetic courses for children aged 4–7, focusing on strengthening memory and attention and teaching techniques that make complex calculations easier.

An important feature of the Singaporean model is that mental arithmetic is taught to children through games, movement, visual materials, and step-by-step exercises. For younger children, lessons are organized through songs, physical activity, encouragement, and interesting tasks. For primary school children, the focus is on rapid calculation, independent thinking, accuracy, and logical approach.

General Conclusion. The experience of Japan, China, South Korea, Malaysia, and Singapore shows that mental arithmetic is not limited to teaching children simple calculation. It contributes to the development of concentration, memorization, visualization of numbers, quick thinking, logical reasoning, and self-confidence.

In these countries, mental arithmetic is organized in different forms. In Japan, soroban is connected with historical and school education traditions. In China, suanpan and mental abacus have developed as a cultural and mathematical tradition. In South Korea, mental arithmetic is mainly used as a form of supplementary education. In Malaysia, it has been systematized through international programs such as UCMAS. In Singapore, it is widely used as a developmental course for preschool and primary school children.

Thus, the experience of foreign countries shows that mental arithmetic can be regarded as an effective pedagogical tool for developing children’s thinking. In particular, teaching it from the primary grades or preschool education stage through gradual, game-based, and practical exercises has a positive influence on children’s intellectual development.

Recommendations for Adapting Foreign Experience to the Education System of Uzbekistan:

1. The step-by-step teaching method based on Japan’s soroban experience can be adopted. In Uzbekistan, it would be appropriate to teach mental arithmetic to primary school pupils first with the help of an abacus or soroban, and then gradually move them toward calculation without the abacus, that is, mental calculation. This method develops children’s ability to visualize numbers and think logically.

2. The Chinese experience of beginning from the preschool stage can be adapted. Mental arithmetic can be introduced not only at school, but also in a simplified form in preschool preparatory groups for children aged 5–6. If lessons are organized through games, colorful visual materials, number cards, and simple abacuses, mathematical concepts will be formed in children at an early age.

3. The system of supplementary clubs can be adopted from the South Korean experience. It is advisable to organize mental arithmetic not as a compulsory subject, but as an additional club or optional lesson in schools. Through this approach, interested pupils can study more deeply, while teachers can apply an individual approach according to children's abilities.

4. A special program and level-based teaching system can be adopted from the Malaysian experience. Similar to the UCMAS experience, it would be useful to divide pupils into levels according to their age and knowledge. For example, beginner, intermediate, and advanced levels can be organized, and small assessments or certification can be introduced at the end of each stage.

5. The use of game-based and multimedia tools can be adopted from the Singaporean experience. For young children, mental arithmetic lessons should not be limited to written examples only. They should also include slides, interactive boards, flashcards, games, and rapid question-and-answer activities. This increases children's interest in the lesson and makes learning easier.

6. Exercises aimed at developing attention and discipline can be adopted from the Japanese and Korean experiences. In mental arithmetic lessons, attention should be paid not only to fast calculation, but also to concentration, error checking, orderly work, and patient practice. This helps develop not only mathematical skills but also general learning culture in children.

7. The system of competitions and encouragement can be adapted from the Chinese and Malaysian experiences. It would be useful to organize small competitions, rapid calculation contests, and demonstration lessons in mental arithmetic at school, district, and regional levels. Awarding winners with diplomas, certificates, or motivational prizes will increase children's interest and self-confidence.

8. Cooperation with parents can be adopted from the Singaporean and Malaysian experiences. Parents' participation is also important in teaching mental arithmetic effectively. Therefore, parents should be given recommendations on how to practice with children at home, how much time to spend, and how to motivate their children. This helps strengthen the knowledge acquired during lessons at home.

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