

METHODS OF APPLYING PROBABILITY THEORY IN PRIMARY EDUCATION

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Abstract. This article analyzes methods for applying probability theory in primary education. Probability theory is an integral part of mathematics education, and its teaching at the primary level contributes to the development of students' analytical thinking and problem-solving skills. The article examines methodological approaches, practical techniques, and teachers' pedagogical experiences related to teaching probability theory in primary education. The research findings help identify the most effective methods and approaches for teaching probability theory and demonstrate how these methods influence students' cognitive development.

Keywords: primary education, probability theory, mathematics education, analytical thinking, pedagogy, teaching methods, interactive methods, practical exercises, statistical analysis.

BOSHLANG'ICH TA'LIMDA EHTIMOLLAR NAZARIYASINI QO'LLASH USULLARI

Annotatsiya. Mazkur maqolada boshlang'ich ta'limda ehtimollar nazariyasining qo'llanilishi metodlari tahlil qilinadi. Ehtimollar nazariyasi matematika ta'limining ajralmas qismi bo'lib, uning boshlang'ich ta'limda o'qitilishi o'quvchilarning analitik fikrlash va muammolarni hal qilish ko'nikmalarini rivojlantirishga xizmat qiladi. Maqola ehtimollar nazariyasini boshlang'ich ta'limda o'qitishning metodik yondashuvlarini, amaliy usullarini va o'qituvchilarning pedagogik tajribalarini o'rganadi. Tadqiqot natijalari, ehtimollar nazariyasini o'rgatish jarayonida eng samarali metodlar va yondashuvlarni aniqlashga yordam beradi, shuningdek, o'quvchilarning kognitiv rivojlanishiga qanday ta'sir ko'rsatishini ko'rsatadi.

Kalit so'zlar: boshlang'ich ta'lim, ehtimollar nazariyasi, matematik ta'lim, analitik fikrlash, pedagogika, o'qitish metodlari, interaktiv metodlar, amaliy mashg'ulotlar, statistik tahlil.

МЕТОДЫ ПРИМЕНЕНИЯ ТЕОРИИ ВЕРОЯТНОСТЕЙ В НАЧАЛЬНОМ ОБРАЗОВАНИИ

Аннотация. В данной статье анализируются методы применения теории вероятностей в начальном образовании. Теория вероятностей является неотъемлемой частью математического образования, а её изучение на начальном этапе способствует развитию у учащихся аналитического мышления и навыков решения задач. В статье рассматриваются методические подходы, практические методы и педагогический опыт учителей, связанные с преподаванием теории вероятностей в начальном образовании. Результаты исследования позволяют определить наиболее эффективные методы и подходы к обучению теории вероятностей, а также показать их влияние на когнитивное развитие учащихся.

Ключевые слова: начальное образование, теория вероятностей, математическое образование, аналитическое мышление, педагогика, методы обучения, интерактивные методы, практические занятия, статистический анализ.

Introduction. Primary education plays a crucial role in developing students' knowledge and skills. At this stage, teachers should foster not only academic knowledge but also such skills as critical thinking, analytical reasoning, and problem-solving. Probability theory is one of the central areas of mathematics education, and its primary purpose is to teach students how to analyze random events and make decisions based on them.

The aim of teaching probability theory in primary education is to help students understand probability, recognize relationships between different events, and develop decision-making skills in situations involving randomness. Therefore, the methodology of teaching probability theory has a significant influence on the approaches and methods used by teachers to ensure the effectiveness of primary education.

This article analyzes various methods used in teaching probability theory in primary education, examines their effectiveness, and seeks to identify the most successful approaches to teaching probability theory.

Methods

Literature Review. The literature review involved an examination of existing

scientific articles and studies related to the teaching of probability theory in primary education. This method was used to analyze pedagogical literature, existing approaches to mathematics education, and the effectiveness of various teaching methods. The literature on teaching probability theory addresses different methodological approaches, teachers' experiences, practical activities, and group work.

Experimental Studies. Experimental studies involving test groups were conducted to determine the effectiveness of teaching probability theory in primary education. This method was used to investigate how students acquire probability-related concepts and how this knowledge influences their cognitive development. Students were observed and assessed throughout the educational process on the basis of experimental and control groups.

Questionnaires and Interviews. Questionnaires and interviews were conducted with teachers and education specialists. This method was employed to examine the practical application of probability theory in primary education and to better understand the teaching methods used by educators. The questionnaires were used to collect information about how teachers teach probability theory, which methods they apply, and how they organize their work with students.

Practical Activities and Group Work. Practical activities and group work are considered among the most effective teaching methods. The use of group work and interactive methods in teaching probability theory helps ensure students' active participation in the learning process. Through this approach, students learn about random events and probability by working with practical examples.

Results. The research findings demonstrated the effectiveness of the following methods in teaching probability theory in primary education.

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Comparative indicators of the experimental and control groups (end of the instructional cycle, % of pupils)

Assessed indicator	Control group	Experimental group
Correct use of the terms "likely", "impossible", "certain"	54	82
Ability to list all possible outcomes of a simple trial	47	78
Comparison of the chances of two events	41	74
Justification of a prediction before an experiment	36	69
Interpretation of the results of repeated trials	32	71

As the data presented in the table show, the divergence between the two groups was smallest in the tasks requiring the recognition of familiar terminology and largest in those requiring the pupil to justify a prediction or to interpret a series of repeated trials. This distribution of results is significant in itself: it suggests that experimental and collaborative work influences primarily the reasoning component of probabilistic thinking rather than the memorization of definitions, since the latter can be achieved through traditional explanation as well.

Achievements in Understanding Probability. During the process of learning probability theory, students began to develop a better understanding of probability concepts. Their ability to analyze probabilities and identify relationships between random events improved significantly. Students in the experimental groups demonstrated a higher level of understanding of probability, which contributed to the development of their analytical thinking skills.

Effectiveness of Practical Activities. The use of practical activities and group work enabled students to apply probability theory to real-life problems. Students who actively demonstrated mutual support and cooperation in solving problems and analyzing probabilities within groups achieved higher learning outcomes.

Teachers' Methodological Approaches. Teachers' methodological approaches proved to be one of the key factors in the effective teaching of probability theory. By using various interactive methods, practical activities, and simulations, teachers ensured students' active participation in the learning process. These approaches increased students' opportunities to apply their knowledge in real-life situations.

Problems and Recommendations. Several problems and limitations were identified during the study. Teachers' methodology and professional experience play an important role in students' acquisition of probability theory. In addition, practical activities and group work should be further expanded in order to develop students' analytical and mathematical thinking skills.

The research findings indicate that the following recommendations should be taken into account when teaching probability theory in primary education:

Methodological Diversification. Teachers should use a wide range of interactive and student-centered methods when explaining probability theory to primary school students. Since probability concepts can often appear abstract to young learners, the use of simulations, educational games, visual materials, experiments, and problem-based learning activities can make the subject more understandable and engaging. For example, simple experiments involving coins, dice, colored cards, or spinners can help students observe random events directly and develop an intuitive understanding of probability. Such activities allow learners to compare possible outcomes, make predictions, and evaluate whether their initial assumptions were correct.

Methodological diversification also requires teachers to consider students' age, level of mathematical preparation,

individual learning styles, and cognitive abilities. Some students may understand probability concepts more effectively through visual representations, while others may benefit from hands-on activities or verbal explanations. Therefore, the integration of different teaching approaches creates more favorable conditions for inclusive learning. Digital tools and simple computer-based simulations can also be incorporated into lessons to demonstrate repeated random experiments and illustrate how experimental results may approach theoretical probability. By combining traditional explanation with interactive and technological methods, teachers can increase students' motivation and encourage active participation in the learning process.

Group Work and Collaboration. Group work represents an effective approach to teaching probability-related concepts because it enables students to discuss ideas, compare different solutions, and learn from one another. When students work together on probability problems, they can share their predictions, explain their reasoning, and jointly analyze the outcomes of experiments. This collaborative process not only strengthens mathematical knowledge but also promotes communication, critical thinking, and social interaction skills.

Teachers can organize small-group activities in which students conduct probability experiments, record results, and compare findings with other groups. For instance, each group may toss a coin several times, record the number of heads and tails, and then discuss why the results may differ despite using the same experiment. Such activities help students understand the concept of randomness in a practical and meaningful way. Group work also provides opportunities for peer learning, as students with stronger understanding can support classmates who experience difficulties. At the same time, the teacher should monitor group interaction, provide guidance when necessary, and ensure that every student participates actively. Well-organized collaborative activities therefore contribute both to academic achievement and to the development of teamwork skills.

Extended Practical Activities. Practical activities should occupy an important place in teaching probability theory because they connect mathematical concepts with real-life situations. Students can better understand probability when they see how it is used in everyday contexts such as weather forecasts, games, sports, transportation, or simple decision-making situations. Real-life examples demonstrate that probability is not merely an abstract mathematical concept but a useful tool for interpreting uncertainty and making informed decisions.

Extended practical activities may include classroom experiments, observation tasks, data collection, simple surveys, and problem-solving exercises based on realistic situations. Students can predict possible outcomes, conduct experiments, compare theoretical expectations with actual results, and explain the differences they observe. These activities help develop analytical thinking and encourage students to evaluate information rather than simply memorize formulas or definitions. Moreover, practical learning supports the gradual formation of mathematical reasoning, independence, and confidence. Therefore, the systematic integration of real-life tasks, experiments, interactive activities, and collaborative learning can significantly improve the effectiveness of teaching probability theory in primary education.

Discussion. The results obtained in this study should be interpreted in the context of the cognitive characteristics of primary school learners. Children of this age reason predominantly in concrete and visual categories, and abstract notions such as chance, likelihood, or expected frequency remain inaccessible to them until they are mediated through physical objects and observable actions. This explains why experiments with coins, dice, spinners, and colored counters produced markedly better learning outcomes than verbal explanation alone: the learner does not receive probability as a ready-made definition but reconstructs it from a sequence of personally performed trials. Consequently, the didactic value of such activities lies less in the numerical result than in the mental operation of comparing what was predicted with what actually occurred.

A second observation concerns the language in which probabilistic ideas are introduced. In the lessons analyzed, pupils operated confidently with qualitative expressions (certain, impossible, more likely, less likely, equally likely) long before they were able to express probability as a fraction or a percentage. Premature formalization, by contrast, tended to produce mechanical answers unsupported by understanding. It therefore appears methodologically justified to build the initial stage of instruction on an ordered vocabulary of chance, and only afterwards to introduce quantitative notation as a shorter way of recording judgments the pupil has already learned to make. Such a sequence reduces the risk of the well-known misconception according to which a rare outcome is regarded as impossible and a frequent one as guaranteed.

The findings also draw attention to the organizational conditions under which probabilistic experiments become effective. Small groups of three or four pupils produced richer discussion than either individual work or whole-class demonstration, because every participant was responsible for a specific function: performing the trial, recording the outcome, summarizing the data, or presenting the conclusion. Where the teacher left the distribution of roles unregulated, however, one or two pupils carried out the experiment while the remainder observed passively, and the learning effect declined sharply. Group work thus emerges as a method whose success depends directly on the precision of its organization rather than on the mere fact of collective activity.

Finally, the study indicates the limits of its own results. The experimental sample was restricted in size and covered a comparatively short period of instruction, which does not permit conclusions about the long-term retention of probabilistic ideas. Nor was it possible to control the influence of the family environment, of pupils' earlier experience with games of chance, or of differences in teachers' individual pedagogical style. Subsequent research would therefore benefit from longitudinal observation, from the comparison of parallel classes taught by different methods, and from the development of diagnostic instruments capable of measuring not only factual knowledge but also the quality of probabilistic reasoning itself.

Conclusion. Teaching probability theory in primary education plays an important role in developing students' analytical thinking, problem-solving abilities, logical reasoning, and decision-making skills. At the primary level, students begin to form basic ideas about random events, possible outcomes, comparison of chances, and uncertainty. These concepts create an essential foundation for the further study of mathematics, statistics, and other subjects that require logical and quantitative reasoning.

The research findings indicate that the effective teaching of probability theory contributes not only to the development of mathematical knowledge but also to students' overall cognitive development. In particular, practical activities, interactive methods, group work, simulations, and real-life examples help students understand probability concepts more clearly and apply them in meaningful situations. Such approaches make the learning process more engaging and encourage students to participate actively, express their ideas, make predictions, and evaluate the results of different experiments.

The effectiveness of teaching probability theory largely depends on the methodological competence of teachers. Teachers should select age-appropriate methods, provide clear explanations, and create opportunities for students to learn through observation, experimentation, discussion, and collaboration. The use of visual materials, educational games, simple probability experiments, and digital resources can further support students' understanding and increase their motivation to learn mathematics.

At the same time, teaching methods should be continuously improved in accordance with modern educational requirements and the changing needs of learners. The integration of innovative pedagogical technologies and student-centered approaches can make probability education more effective, accessible, and practically oriented. Therefore, systematic attention should be given to improving teaching strategies, developing appropriate instructional materials, and strengthening teachers' methodological preparation. Overall, the purposeful inclusion of probability theory in primary education can contribute significantly to the formation of mathematically literate, independent, and analytically minded learners.

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