



The role of repetition in learning math

Yessenbolkyzy Akerke, Yessirkepova Ardak

Suleyman Demirel University

*Mathematics is not about numbers, equations, computations, or algorithms: it is about
understanding.*

— *William Paul Thurston, American mathematician*

Abstract

Mathematics is one of the most important aspects of school education. School mathematics is a meaningful, fascinating and accessible field of activity, giving the student rich food for the mind, connecting him with universal human culture, forming the most important personality traits. In learning mathematics, practice makes perfect. In the process of teaching math, the repetition of the studied material is given an important place. Properly organized repetition is one of the factors contributing to the intellectual development of each student, their achievement of deep and lasting knowledge. The need to repeat the previously studied material is caused by the very structure of the curriculum of mathematics. For example, students go through the curriculum topic: "Quadrangles" in 8th grade, but use it in grades 10-11 when studying the topics: "Surface of bodies of revolution", "Surface area", "Volume of bodies", etc. To teach mathematics without repeating the material previously passed on every lesson every day, this means transmitting, retelling to students a certain amount of different laws, theorems, formulas, etc., completely not caring about how firmly and consciously this material was mastered by our pets; it means not giving children deep and lasting knowledge. Researches showed us that repetition is the main instrument of the study. Results of the analysis revealed that students exposed to repetition with variation approach had significantly higher achievement, conceptual understanding and improved retention.

Keywords: math, repetition, learning, education.

The role of repetition in learning math

Mathematics is a significant and important part of human culture. The accumulation of mathematical facts over the millennia of human development led to the emergence of mathematics as a science about two and a half thousand years ago. Turning to the history of philosophy, it should be noted that the scientists who created mathematics regarded it as an integral part of philosophy, which served as a means of understanding the world. It is no accident that quadrivius, studied in ancient Greece, included arithmetic, geometry, astronomy, and music. The importance of mathematics for humanity is also evidenced by the fact that the book of Euclid's "Beginnings" was published the greatest number of times.

Mathematics has the richest possibilities of influencing the development of a scientific worldview and the achievement of the necessary general cultural level. Trying to explain the world around us, asking the question "why?", The ancient philosophers-sophists came to the necessity of separating mathematical knowledge into an independent science. The history of the origin of great mathematical ideas, the fate of outstanding mathematicians (Archimedes, Galois, Pascal, Galileo, Gauss, Euler, Kovalevskaya, Chebyshev, etc.) provide food for the mind and heart, examples of selfless service to science, lead to philosophical reflection and moral search. Logical reasoning is one of the methods of mathematics. Therefore, its study forms logical thinking, allows you to correctly establish causal relationships, which, of course, should be able to every person. The style of presentation of mathematics, its language affect the development of speech. Every cultural person should have an idea of the basic concepts of mathematics, such as number, function, mathematical model, algorithm, probability, optimization, discrete and continuous values, infinitesimal and infinitely large. It is about the basic concepts and ideas, and not about a set of specific formulas and theorems.

Importance of repetition

The main task of teaching mathematics becomes not only the study of the foundations of mathematical science as such, but general intellectual development - the formation in students in the process of studying the discipline of the qualities of thinking necessary for the full functioning of man in modern society, for the dynamic adaptation of man to this society. From the point of view of the priority of the developing function, specific mathematical knowledge is considered not so much as the purpose of training, but as a base, a "training ground" for organizing intellectually complete activities. For the formation of personality, to achieve a high level of its development, this particular activity, as a rule, turns out to be more significant than the specific mathematical knowledge that served as its basis. "Humanitarian" teaching of mathematics is impossible without studying its history. This includes brief information about the emergence of certain mathematical concepts, biographical data on outstanding mathematicians, familiarity with the history of mathematical discoveries. That is why in the future we will pay special attention to the history of the emergence and development of mathematical ideas, the role of great mathematicians in the formation of individual sections of mathematics. The other side of math education is the study of math applications. A system of examples and tasks focused on humanitarian applications is currently being created. Modern mathematics, combined with computer science, is becoming, as it were, an interdisciplinary toolbox that performs two main functions: the first is to educate a professional specialist in the ability to correctly set a goal for a particular process, to determine conditions and limitations in achieving a goal; the second is analytical, i.e. "Playing" on models of possible situations and obtaining optimal solutions.

Methods of repetition¹

In the process of teaching mathematics, the repetition of the studied material is given an important place. Properly organized repetition is one of the factors contributing to the intellectual development of each student, their achievement of deep and lasting knowledge. Without a solid preservation of acquired knowledge, without the ability to reproduce the material passed at the necessary moment of studying new material, it is always fraught with great difficulties and does not give the proper effect. Previously passed material should serve as the foundation upon which the study of new material is based, the latter, in turn, should enrich and broaden horizons, bring knowledge into the system, and organize the student.

In this regard, there are the following types of repetition of previously covered material:

1. Repetition at the beginning of the school year.

When repeating at the beginning of the school year, the repetition of those having a direct connection with the new educational material should come to the forefront. New knowledge acquired in the lesson should be based on a solid foundation already learned. When repeating at the beginning of the year, it is necessary, along with the repetition of those closely related to the new material, to repeat other sections that do not yet adjoin the newly studied material. Here it is necessary to combine both tasks: conduct a general repetition in the order of review of the main questions from the material of past years and more deeply repeat the questions directly related to the next material on the program of the school year. The repetition itself should be carried out both in the classroom and at home. In deciding which material should be repeated in the classroom and which is left to the student for independent repetition at home, one must proceed from the features of the material. The most difficult material was repeated in the classroom, while the less difficult material was given to the house for independent work.

2. The current repetition of everything previously completed:

- Repetition of what has been learned in connection with the study of new material

(related repetitions);

- Repetition of what has been done without regard to new material.

The current repetition in the process of studying new material is a very important point in the repetition system. It helps to establish an organic connection between new material and previously covered material. The current repetition may be carried out in connection with the study of new material. In this case, the material is naturally linked to the new material. Repetition here is an integral and integral part of the newly studied material. Under the guidance of a teacher, students in the lesson reproduce the necessary material previously studied by them. As a result of this, the proof of the new theorem is easily perceived by students, and the teacher's further work is the reproduction of what has been proved and exercises that provide a second understanding of the theorem and its consolidation. In the second case, all relations with the new material, when the repeated material does not find a natural link with the new one and it has to be repeated in special lessons. With the current repetition, questions and exercises can be offered to students from various sections of the program. The current repetition is carried out in the process of analysis of exercises, is included in the homework. It can be carried out both at the beginning or at the end of the lesson, and during the survey of students. The current repetition is complemented by an accompanying repetition that cannot be strictly planned for a long period. The accompanying repetition is not included in the calendar plans, special time is not allocated for it, but it is an organic part of each lesson. The accompanying repetition depends on the material used to study the next question, on the ability to establish connections between the new and the old, on the state of knowledge of students at the moment. The success of the concomitant

repetition is largely determined by the experience and resourcefulness of the teacher. With the accompanying repetition, the teacher eliminates inaccuracies in knowledge in the course of work, recalls briefly the long-passed, indicates their connection with the new.

3. Thematic repetition (generalizing and systematizing the repetition of completed topics and sections of the program). In the process of working on mathematical material, the repetition of each completed topic or an entire section of the course becomes especially important. With a thematic repetition, students' knowledge on the topic is systematized at the final stage of its passage or after a break. For the thematic repetition, special lessons are highlighted on which the material of one topic is concentrated and generalized. In the process of working on the topic, the questions proposed to students in each section should be reviewed again; leave the most significant and discard the smaller ones. The generalizing nature of questions during the thematic repetition is displayed on their number. The teacher has to cover the main material of the topic in a smaller number of questions. Repetition in the lesson is conducted through a conversation with the wide involvement of students in this conversation. After this, students receive a task to repeat a specific topic and are warned that control work will be carried out. Examination on the topic should include all its main issues. After completing the test work, a analysis of characteristic errors is carried out and a repetition is organized to eliminate them. For thematic repetition, it is useful to draw up a questionnaire, and then a logical plan on the topic and complete the work by drawing up the final schemes. A table or diagram economically and visually shows the general for the concepts included in this topic, their relationship in a logical sequence. The process of compiling tables in some cases, the selection and recording of examples after analyzing the finished table in other cases, is also a form of written exercises with a generalizing and systematizing repetition. A sequential study of various special cases during repetition is very

useful to complete their classification, which will help students more clearly distinguish between individual cases and group them according to a specific attribute.

4. Final repetition (organized at the end of the passage of a large section of the program or at the end of the school year). The repetition, carried out at the final stage of studying the main questions of the course of mathematics and carried out in logical connection with the study of the educational material for this section or the course as a whole, will be called the final repetition. The objectives of thematic repetition and final repetition are similar, the material of repetition (selection of material) is very close, and the methods of repetition in some cases coincide.

The final repetition of the training material aims:

1. An overview of the basic concepts, leading ideas of the course of the corresponding academic subject; reminders in possible large lines of the path traveled, the evolution of concepts, their development, their theoretical and practical applications.

2. Deepening and, if possible, expanding the knowledge of students on the main issues of the course in the repetition process.

3. Some restructuring and a different approach to the previously studied material, joining to the repeated material new knowledge allowed by the program with the aim of deepening it. The goals and time of repetition are closely related and interdependent, and in turn determine the methods and techniques of repetition. When planning the repetition, it is necessary to select the material, establish the sequence and time of the repetition, distribute the selected material according to the lessons, establish the forms and methods for the repetition, of course, it is necessary to take into account the property of memory.

Conclusion

It is necessary to carefully analyze the theory and practice of repetition in order to establish the positive and negative aspects of work in repetition. Repetition of educational material requires the teacher to work creatively. It should provide a clear connection between the types of repetition, implement a deeply thought-out system of repetition.

In our days, repetition gives a lot of positive progresses. People use correctly the methods that was detailed above. In our country, it is so useful and helpful in education programs and process.

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