

Review Article

TECHNOLOGY FOR THE DEVELOPMENT OF LOGICAL THINKING IN STUDENTS IN PRIMARY SCHOOL

¹Ruziyeva Zulaykho Samadovna, ¹Kurbonova Shoirra Narzullayevna, ¹Saidova Gavxar Ergashevna

**¹Lecturer, Department of Preschool and Primary Education, Bukhara State University, Bukhara, Uzbekistan.
E-mail : gulbahor75@rambler.ru**

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Abstract

The following article deals with the technology of organizing the process of developing logical thinking skills of elementary school pupils. Among the challenges facing the school are: the development of logical thinking of students, the level of formation of which largely determines consciousness, the efficiency of mastering the foundations of sciences, the ability to navigate independently in an ever-growing volume of information, apply existing knowledge to the maximum benefit, create the most favorable conditions for acquiring new knowledge and to communicate it to others. The development efficiency will increase if we implement the psychological and pedagogical conditions for the development of logical thinking of younger students with the help of innovative technologies. The essence of the concepts of "logic", "thinking", "logical thinking", "and logical thinking of junior pupils", "innovative technologies" is considered. The logical thinking of younger schoolchildren is the ability to use simple logical actions by students to form a full-fledged learning activity, which includes the ability to: highlight and hold a learning task; independently find and learn common ways to solve problems; adequately evaluate and control yourself and your activity; own reflection and self-regulation of activity; use the laws of logical thinking; own and use different forms of generalization, including theoretical ones.

Key words: development, logical thinking, students, elementary class, technology, creativity, interest, personality.

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INTRODUCTION

Education is recognized as a key factor in promoting sustainable development in the concept of international education by 2030 and defined by international organizations and countries around the world: "having a deep foundation of knowledge, developing logical, creative and critical thinking of pupils, teachers and students, developing cooperative skills and interests". This is why it is important to use advanced learning technologies in the education system, including primary education, and to develop students' logical thinking skills.

Today, the world focuses on research in the development of logical, independent, creative, critical thinking in students, with a focus on research aimed at collaborative activities, taking into account the age and psychological features of students.

This approach aims at introducing effective forms and methods of teaching, including the formation of life skills in primary school pupils, based on the needs of an individualized learning strategy, the development of logical thinking through teacher-student interaction, and the development of logical thinking in elementary school pupils. Mechanism of designing of educational process, introducing of innovative technologies in this process needs to be improved.

As a result of wide-ranging reforms in the education system of Uzbekistan was adapted Strategies of Movements, that helps to introduce advanced pedagogical and informational technologies into the educational process, gives the opportunities to expand quality education in primary education, also enables the development of one's conscious in a rapidly changing globalization. In this regard, it is important to study the content and mechanisms of formation of pedagogical cooperation and the didactic features of primary education as part of the task of further improving the system of continuous education, as well as creating conditions for the support and realization of the creative and intellectual potential of the young generation.

In the resolution of the Cabinet of Ministers of the Republic of Uzbekistan dated on April 6, 2017 № 187 "On approving of state educational standards of general secondary and secondary special and vocational education"; in resolution of the President of the Republic of Uzbekistan "Improving the activities of National Education Ministry of the Republic of Uzbekistan" dated on September 30, 2017 No PP-3304 was noted about developing logical, creative, independent, critical thinking abilities of students; improving the quality and effectiveness of education in decisions, preparing pupils for social relations as well.

In this article, we have focused on the most important aspects of training in this area, also on the development and implementation of technology for developing students' logical thinking.

MATERIALS AND METHODS

The most detailed theory of thinking is contained in the works of S.L. Rubinstein. In his opinion, "Thinking - is an increasingly complete and multifaceted mental restoration of an object and reality, based on sensory data arising from the influence of the object."

In modern psychology, thinking is understood as "a process of cognitive activity of a person, characterized by a generalized and indirect reflection of reality; the highest form of creative activity".

The concept of "Thinking" includes the concept of "logical thinking", and they relate to each other as a kind to a species.

In a brief dictionary of the system of psychological concepts, logical thinking is defined as "a type of thinking, the essence of which is to operate with concepts, judgments, and conclusions using the laws of logic" [14, p. 123]. This refers to the classical two-valued formal logic, although people's thinking does not have to be based solely on it.

Logical thinking, which is also called in the broad sense of the word discursive, presupposes a logical transition from one particular concept to another. It differs significantly from the intuitive, cognizing the world by contemplation and establishing the truth by direct discretion without proof.

Logical thinking is a type of thinking, the essence of which is in operating with concepts, judgments, inferences based on the laws of logic, comparing and correlating them with actions or the totality of mental logically valid actions or thinking operations associated with cause-and-effect patterns that allow matching existing knowledge with a view to descriptions and transformations of objective reality.

The ability to think logically, according to N. A. Podgoretskaya [28, p.15], includes a number of components: the ability to navigate the essential features of objects and phenomena, the ability to obey the laws of logic, to build their actions in accordance with them, the ability to produce logical operations, consciously arguing them, the ability to build hypotheses and derive consequences from these premises, etc. Therefore, according to her opinion logical thinking includes a number of components: the ability to determine the composition, structure and organization of the elements and parts of the whole and focus on the essential features of objects and phenomena; the ability to determine the relationship of the subject and objects, to see their change in time; the ability to obey the laws of logic, to discover patterns and trends on this basis, build hypotheses and derive consequences from these premises; the ability to perform logical operations, consciously arguing for them.

The component of the state standard, which was developed taking into account the main directions of modernization of education is focused not only on the knowledge, but primarily on the activity component of education which allows to increase the motivation of learning, to realize to the greatest extent the child's abilities, capabilities, needs and interests. Therefore, it is no coincidence that one of the main goals at the stage of general education is the development of cognitive activity of students, their mental processes.

Thinking is a creative cognitive process that generalizes and indirectly reflects the relation of objects and phenomena, the laws of the objective world.

But the development of logical thinking is impossible in principle without knowledge of the characteristics of psychology of primary school age. All this is necessary in order for the child to successfully finish elementary grades, to study successfully in middle school, i.e. it is necessary to help him in the development of his mental processes, the formation of mental functions.

In any psychological and pedagogical literature not given consensus on when children have the ability to form and develop logical operations. In modern psychology, there are two main directions in the study of the emergence and development of logical structures of thinking in children. The first of them is related to the works of J. Piage [27, p. 349], A. Vallona, B. Inelder, and others. In these works, age boundaries (stages) of the formation of logical structures that reflect the spontaneous process based on spontaneous mechanisms of development of children's intelligence. These mechanisms are the main factor determining the successful mastery of logic. Piage and Inelder limit the role of learning, believing that it obeys the laws of development. Piage believed that learning takes on different meanings, depending on what period of development it falls on. In order to be successful and not to be formal, education and teaching must adapt to the current level of development.

The second direction is connected with the research of P.P. Blonsky, L.S. Vigotsky [9, p. 381], S.L. Rubinshtein, A. N. Leontyev, P.Ya. Galperin, D.B. Elkonin, V.V. Davidov and others. These authors believe that the appearance of logical operations in an individual's experience is determined by the transfer of

knowledge and logical experience in communication and training. In this case, intellectual activity should act as a subject of special assimilation in the learning process.

In the works of L.S. Vigotsky [9, p.246], L.V. Zankov, N.A. Menchinskaya, S.L. Rubinshtein, A.N. Leontyev, M. Montessori, the leading role of education as the main stimulus for development is substantiated and indicates the illegality of the contrast between the development of psychological structures and training.

Psychological and pedagogical studies of scientists have proved that basic logical skills at an elementary level are formed in children, starting from 5-6 years of age. However, almost all presented works are aimed to develop individual components of logical thinking in communication and structure.

In this regard, a contradiction arises between the need for the structural development of logical thinking and the lack of effective things to put them into practice.

Questions of the development of logical thinking of primary school students in the learning process were considered by V.M. Deryabin, T. Kamalova, E.P. Malanyuk and others. V.C. Ablova devoted her work to the formation of elements of the logical-algorithmic culture of students in the process of teaching mathematics in primary school. Features of the formation of logical thinking methods in six-year-old children are considered by M.V. Krapina. All the above-mentioned authors in their works pointed to the need for a special formation of logical thinking techniques, emphasizing the exclusive role of logical knowledge and skills in teaching the young generation.

The role of training the development of logical thinking and the main methodological provisions for the education of the logical culture of students are given in the works of S. Alikhanov, R. Vafaev, Yu.M. Kalyagina, M.I. Moro, A.M. Pishkalo and others.

By the way, the issues of logical literacy of students are still under the hot discussion nowadays.

Long-term observations show that, in the thinking of senior students one can find drawbacks similar to those observed in untrained children: focusing on random signs that are currently the most "vivid", undifferentiated parameters of the studied objects, inability to respond to a given the question is to give a definition to some concept, the great coherence of the specifics of the proposed material, insensitivity to contradictions, the pressure of everyday explanations over the logic and etc.

Thus, it is obvious that in the practice of the modern school (the traditional teaching system) there is a serious problem: the system of logical preparation of students does not meet the requirements of the time.

We see the main reason for this state of affairs in the created contradiction between the existing potential opportunities for the logical development of students, the need for society for creative specialists with deductive thinking skills, and the low implementation of these opportunities in the established practice of schools, traditionally oriented mainly to the content and volume of knowledge gained, and not on the formation of means and methods of mental activity.

The analysis of psychological and pedagogical literature and special studies on the problem of the development of intellectual abilities in general and logical thinking has showed that the most active in psychological research are questions of the nature and mechanisms of the formation of mental processes and weaker issues of pedagogical influence on their formation, the problem of methods, meanings, content and didactic conditions.

These data shows that in primary school age that it is necessary to carry out focused work on teaching children the basic techniques of mental activity. A variety of psychological and pedagogical exercises can help in this.

The development of thinking in primary school age has a special role and developing the thinking skills of a child in primary school age is a critical issue. During this period, a transition is made from visual-figurative to verbal-logical, conceptual thinking, which gives the child's mental activity a dual character: concrete thinking, connected with reality and direct observation, that is already subject to logical principles, but abstract, formally logical reasoning is still not available. Without the logic of thinking, that is like without the ability to correct concepts (define, classify, etc.), judgments, conclusions and evidence.

The purpose of pedagogical activity is to ensure positive dynamics of the development of logical thinking in the learning process of pupils in forms 1-4.

To achieve this goal it is supposed to solve the following **tasks**:

- Creating a system of exercises that contribute to the development of logical thinking;
- Classification and description of practical tools that a teacher can use to develop logical thinking;
- To implement the tasks, a set of methods were used:
- Theoretical analysis of scientific literature;
- Monitoring the activities of students in the classroom and after school hours;
- Application of a system of exercises that contribute to the development of logical thinking;
- Conducting psychological and pedagogical diagnostics;
- Pupils questioning and testing.

The development of logical thinking is inseparable from the formation of performing skills. The more versatile and perfect the skills of schoolchildren, the richer their imagination, the more real their design, the more complex mathematical problems they solve.

In order to develop logical thinking of young schoolchildren, it is necessary that he gains experience and curiosity, in miniature repeat the path of mankind in cognition, satisfy the emerging needs in overcoming difficulties, solving problems.

Education needs to be built taking into account the interests of students associated with their life experience, this will give much better results than training based on remembering and accumulating a simple amount of knowledge. A student begins to think and reason logically when he encounters difficulties, the overcoming of which is of importance to him.

Tasks for the development of the ability of comparing

Comparison is a mental operation consisting in comparing objects and phenomena, their properties and relations with each other and thus revealing a community or difference between them. Comparison is characterized as a more elementary process with which, as a rule, cognition begins. At the initial stages of familiarization with the surrounding world, various objects are recognized primarily by comparison. Any comparison of two or more objects begins with a comparison or correlation of them with each other, i.e. begins with synthesis. In the course of this synthetic act, an analysis is made of the compared phenomena, objects, events - the allocation in them of the general and the different. The composition of this technique includes the following basic operations:

1. The selection of the features of the subject.
2. The division of the selected features into essential and non-essential.
3. The selection of signs that are the basis of comparison.
4. Finding similar and different features of objects, the implementation of incomplete comparisons.
5. The conclusion of the comparison.

Showing the object (cube, ball, pencil, apple, ruler, etc.), we proposed to name the signs (properties) of the object. Children called 2-3 signs, and then experienced difficulty. Then we proposed to compare this item (cube) with a group of other

items (apple, cotton wool, glass, weights). When comparing with an apple, the guys noticed that the apple is round in shape, and our cube has corners; when comparing with cotton, we noticed that the cube is hard, and the cotton is soft, etc. We found more and more new properties (signs) of the cube. By analogy, we compared other objects and found all their signs.

To consolidate this skill, I used the game "Guess the subject". Instruction is that, the called student goes to the board and turns his back to the class. The teacher shows the children the subject. Students do not name the subject, but highlights its basic properties. The called student must recognize the subject. Or the teacher lists the properties of the subject, and the students name the subject.

When the guys learned to distinguish the properties of objects when comparing them with other objects, I started to form a concept of common and distinctive features of objects. They suggested comparing 2, and then 3 subjects (book and notebook, pencil, triangle and ruler, etc.). In the process of comparison, we learned to find common and distinctive features. For the further development of this technique, a series of tasks was carried out: "Identical, different in two", "Identical, different in three", "Identical, different in four".

Task: Talk about the shape, taste, color of the apple, watermelon.

Task: Name the time of year according to the specified criteria.

A cold wind blows, there are clouds in the sky, and it often rains. Vegetables are harvested in the village. Birds fly away to warmer climes. The day is getting shorter.

Task: highlight the two words that are most significant for the word in front of the brackets:

a city (a car, a building, a crowd, a bike, a street)

a river (a shore, a fish, mud, water, a fisherman)

a game (players, a chess, tennis, rules of punishment)

a hospital (a garden, a doctor, a radio, a hospital, premises)

Task. To name the common signs of objects:

cats - dogs

an apple - a watermelon,

a fire tree, a pine tree,

a birch-an aspen.

Task. Name common features; name the distinguishing features:

a fork-a spoon,

a table-a chair,

a window - cloth - cloud.

Task. To name an object that has the following features: have 4 sides and 4 angles.

Task. What are the similarities and differences in the tasks?

It was - 25 p. It was -? P.9 pages left. 9 pages left. I read -? p. Read - 16 p.

Tasks for the development of the ability to generalize

Generalization is a mental operation consisting in combining many objects or phenomena on some common basis.

During the generalization in the compared objects - as a result of their analysis - something common is highlighted. These properties common to various objects are of two types: 1) common as similar features and 2) common as essential features.

Task. Name a group of words as a common word:

January - February - March - June

a table - a sofa - a chair

Task. Call a group of numbers a common word:

a) 2; 5; 6; 9 _____.

b) 12; 31; 57; 72 _____.

Task Find the equations among the following entries write them out and solve them:

$30 + x > 40$ $45 - 5 = 40$ $62 + x = 94$

$80 - x$ $39 - 9 < 50$ $x - 39 = 115$

Task. What common word can be called the following words?

1. Vera, Nadejda, Lyubov, Sarvara

2. a, b, c, v, n

3. a table, a sofa, an arm-chair, a chair

4. Monday, Sunday, Wednesday, Thursday

5. January, March, July, September.

Tasks for the development of the ability to establish patterns

Task: There are given a series of numbers. Mark the features of the series and write the following number:

16; 14; 12; 10; ...

Task: Find the pattern and insert the missing number:

57	16	41
36	21	15
48	?	36

Tasks for the development of the ability to classify

Task: the words are given: lemon, orange, pear, raspberries, apple, strawberries, plums, currants.

Name: 1) berries; 2) fruits.

Task: words are given: table, cup, chair, plate, cupboard, teapot, sofa, spoon, stool, chair, pan.

Underline the names of the furniture with one line, the name of the dishes with two lines.

Task: words are given: mandarin, apple, potato, plum, oranges. Give me another word.

Tasks for the development of the ability to determine the relationship between objects of the genus-species type

Task: From the list of words, select utensils: a cup, a table, a plate, a jacket, a bedside table, a hat, a scarf, a saucepan, a coat, a frying pan, a dress and a chair.

Task: From the list of words, select shoe items: doll, shoes, and pencil case, felt boots, ball, briefcase, pen, slippers, bear, shoes, notebook, spinning top, gym shoes, pencil, and designer.

ANALYSIS AND RESULTS

Experiments aimed at developing logical thinking in elementary school students using innovative methods were conducted with the 3rd and 4th form pupils. In total, 606 pupils participated. During the experiment the lessons were conducted in the following areas:

- Developing skills in working with specialized dictionaries to build logical thinking through innovative strategies;
- Creating a collaborative environment;
- Teaching them to express themselves freely;
- Building communication skills;
- To give students the skills to work independently.

Experimental work was carried out during the lessons of the subjects of Native language, "Odobnoma", Natural Science and Reading. During the experiment, it was mainly aimed at exploring a system designed to generate logical thinking in students through innovative strategies such as Business Games, Brain ring, Pin board, Two-Day Diary, Euler Drawings, and Sink way.

During the experiments the experimental groups were trained according to the recommended methodology. The reading in the control classes continued with the traditional methodology. All research data was recorded in special registers and processed by statistical data.

During the pilot lessons, special attention was paid to the development of logical thinking skills for junior high school students. It presented a set of tasks from interactive methods to form logical thinking through the Pin board method.

The students were able to think logically in three areas when completing the presented tasks. In this case, the familiar situations in which students are familiar with the situation have created a tendency to think logically. Such texts aroused great interest among the readers and raised many questions.

As a result of the training, the students gained reflexive actions. Students have developed the skills of independent thinking, problem understanding and understanding. Students used dictionaries to comprehend the meaning of words that were difficult to understand. For this reason, we also used the method of dealing with complex texts during the experimental work. For this purpose, texts were selected taking into account the learners' interests.

In later stages of the experiment, tasks were consistently complicated. The aim was to observe the extent to which students' logical thinking skills were included. In the process, an attempt was made to ensure the subject-to-subject relationship. The fourth-graders were divided into small groups, each of which sought to master the learning material independently. Strong collaboration has been established between the teacher and the students, and the team spirit has grown. Such trainings have contributed to the activation of the cognitive process and the expansion of students' opportunities for communication and each student has the opportunity to think logically.

Thus, the lessons learned using innovative methods have enabled students to develop logical thinking skills, to express their thoughts freely, to gain information, to work in a team, to strengthen their position in the group, to defend their ideas.

In the course of the research, the development of logical thinking in elementary school students was related to the development of their common knowledge. This is achieved through innovative teaching methods, strategies that encourage students to think logically, and the implementation of specially selected tasks into the learning process.

If at the beginning of the pilot study the level of logical thinking in elementary school students was slightly lower, by the end of the study, these indicators were slightly increased (Table 1).

Table 1 Indicators of the ability of elementary school students to demonstrate logical thinking skills in practice

Criteria and indicators of students' ability to demonstrate logical thinking skills in practice	3-4-form pupils					
	Experimental-testing					
	low	medium	high	low	medium	high
The level of knowledge of pupils	34	32	39	28	37	33
Basic knowledge and understanding of the content of the study subjects	41	29	34	39	38	33
Levels of students' spiritual and moral development	39	38	36	31	25	29

Since the observed value of the statistical criterion is greater than the critical value of a = 0.05 reliability (7), the significance of the hi-square criterion is based on the validity of the research hypothesis.

Attention was drawn to the extent to which the properties of the sampling objects differ from each other in the criteria used to determine the effectiveness of logical thinking in elementary school students.

The smaller is the importance of logical reasoning during the experiment, the greater is the degree of accuracy. However, this opportunity was limited to what could be achieved in practice. For example, when a reliability level of 0.05 was chosen, the accuracy was $0 = 1 - \alpha = 1 - 0.05 = 0.95$.

As a result of the samples and selections, to improve the efficiency of the research, the original objective properties of the objects were achieved as much as possible.

The results of the pilot work were observed on the high, medium and low evaluation criteria. In the control group, the highest rate was 58% at the end of the experiment and 94.5% in the experimental group. That is, the rate of formation of logical thinking in the students of experimental groups is almost more for 2.3 times.

In the analysis of the results of the pedagogical experiment, mathematical and statistical methods were used, based on the results of the questionnaires with the students on the level of logical thinking in elementary school pupils.

We tried to show the results at the beginning and at the end of the experiment in the following tables.

Table 2 Formation of logical thinking in primary school pupils (at the beginning of experiment)

Experimental group (3-4-forms)				Control group (3-4-forms)			
1-selection				2-selection			
X	High	Medium	Law	Y	High	Medium	Law
H=152	45	65	42	H=153	43	64	46

Table 3 Level of logical thinking in elementary school students (in the end of practice)

Experimental group (3-4-forms)				Control group (3-4-forms)			
1-selection				2-selection			
X	High	Medium	Law	Y	High	Medium	Law
H=148	79	44	25	H=153	57	56	40

Summarizing on the above tables, it is important to remember that the baseline state of thinking of primary school pupils was slightly lower than that in the control groups. At the end of the study, pupils tried to properly describe the knowledge and concepts that would help them to develop logical thinking skills.

Logical thinking was formed using the Pin board and Insert methods to accelerate pupils' performance of the tasks. According to our observations, pupils' logical thinking through innovative strategies was increased by 16.1 percent.

Table 4 Indicators of the development of logical thinking skills in primary school pupils

Indicators of the formation of critical thinking	3-4-forms					
	Experimental-testing					
	Law	Medium	High	Law	Medium	High
Analyzing expressed opinion	14	44	53	49	44	16
Summarizing	17	39	51	53	41	19
Comparing, compare, compare	12	38	47	50	38	15
Classifying	9	45	43	45	45	21
Summarizing, proving	13	49	46	49	42	14

During the research, we were able to form logical thinking in primary school pupils using a well-chosen methodology. (Form 3-4; Table 3.2.5)

A comparative analysis was conducted with a total of 606 pupils participating in the pilot study. In the groups which were involved in the pilot process, pupils were able to develop logical thinking skills, broaden their outlook, increase learning activity and develop positive traits.

Thus, the development of logical thinking skills of primary school pupils was determined by increasing the level of independent thinking of pupils in experimental groups.

CONCLUSIONS

As the goals which should be set at school: the development of logical thinking of students; the level of formation of which largely determines consciousness; the efficiency of mastering the foundations of sciences; the ability to navigate independently in an ever-growing volume of information; to apply existing knowledge to the maximum benefit; to create the most favorable conditions for acquiring new knowledge and to communicate it to others. The development of efficiency will increase if we implement the psychological and pedagogical conditions for the development of logical thinking of younger students with the help of innovative technologies.

In accordance with the tasks, the following conclusions were made during the research work:

1. The essence of the concepts "logic", "thinking", "logical thinking", "logical thinking of young schoolchildren", "innovative technologies" has been considered. The logical thinking of young schoolchildren is the ability to use simple logical actions by students to form a full-fledged learning activity, which includes the ability to: highlight and hold a learning task; independently find and learn common ways to solve problems; adequately evaluate and control yourself and your activity; own reflection and self-regulation of activity; use the laws of logical thinking; own and use different forms of generalization, including theoretical ones.
2. Studying the influence of innovative technologies on the development of logical thinking of the lower grades, we can conclude that the application of innovation in the lessons greatly simplifies and makes the process diverse. Using innovative technologies, primary school children more easily absorb educational material and increase the level of logical culture.
3. The formation of logical thinking skills in primary schoolchildren requires a number of didactic features and pedagogical and psychological peculiarities.
4. It is advisable to establish and introduce a system of learning tasks that encourage students to think logically in the context of the primary education process.
5. The development and implementation of didactic projects that promote the development of logical thinking in primary schoolchildren and the development of logical thinking as well. Pupils were given a system to develop logical thinking through different strategies and their specific areas successfully.
6. The use of innovative technologies that encourages early thinking and independent thinking in the learning process helps the primary pupils to develop logical thinking and enables them to achieve the expected effectiveness in this area.
7. The results of the experiment showed the validity of the research hypothesis by justifying the effectiveness of the methodology used in the pedagogical process aimed at forming logical thinking of primary schoolchildren. The initial hypothesis showed that it is possible to achieve logical thinking of primary schoolchildren by expanding their general knowledge and intellectual level.

RECOMMENDATIONS

In order to develop logical thinking in primary schoolchildren, it is necessary to fulfill the followings:

1. The content of elementary education curricula of primary education should be integrated into teaching strategies, instructional tasks and innovative approaches aimed at developing students' logical thinking skills in accordance with state educational standards.
2. The Ministry of Public Education: the curriculum of the subjects like Reading, Native language should be complicated; requirements for creating encyclopedic dictionaries and film-strips that aimed to develop logical thinking of pupils in primary education should be reflected in government educational grant projects.

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