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Natural Science Teaching at Elementary School

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***Abstract*—The article is devoted to developing group work skills in elementary school children by means of creating specific pedagogical conditions. It presents techniques and criteria employed for diagnosing the level of these skills. The objectives of the study are to give grounds for group work in class, to identify difficulties in organizing this work, and to give recommendations to overcome them. It explores the effective methods of group work organization while studying Natural science at elementary school. Group work requires an adequate system of actions on the part of a teacher, both at the stage of developing the group tasks, and in the course of organizing them in class. The article discusses the methodological support for step-by-step development of communicative skills, which are necessary for group activity. The process of organizing group work with younger children is divided into five stages, where the final stage is a reflexive discussion. The article presents comparative results of the experiment on the effectiveness of pedagogical conditions created for organizing group work with younger children. The findings show positive changes in the level of efficiency in group work.**

Keywords—elementary school, communication skills, Natural science lessons, group methods, educational cooperation

I. INTRODUCTION

The changes taking place in the modern society require improving the educational environment, setting educational targets that meet national, social and personal needs and interests [1]. This is especially important when younger schoolchildren study the subject “The World around us” [2] [3].

Since group work is closely connected with universal communicative activity, we have created certain conditions for the development of communication skills in younger children. A child learns to communicate and speak at an early age. Efficient communicative activity requires developing specific skills, because communication is not only information exchange, but also a behavioral aspect of human interaction. Psychological and Pedagogical sciences devote considerable attention to the development of speaking and writing abilities of junior schoolchildren, including communication and speech readiness of children before they start school: L.S. Vygotsky ([4], [5]), V.V. Davydov ([6], [7]), H.Y. Leymets ([8]), D.E. Elkonin ([9], [10]), L.A. Wenger ([11]), G.A. Zuckerman ([12]). Their research proves both the possibility of employing the effective forms of schoolchildren’s cooperation aimed at learning the school subjects, and a positive impact of cooperation experience on the development of communication skills [13].

Group work as an organizational form of learning in a dual system provides significant opportunities for motivation achievements, which helps enhance self-esteem, as well as develop such communication skills as interacting, mutual influence, and understanding [14].

To form and develop children’s skills to work in a group (team) even at the initial stage of schooling, it is necessary to organize the educational process so that there should be pedagogical conditions for organizing and doing group work.

The formative stage of the experiment had the following objectives:

- to test the set of tasks developed for group work in the course of teaching Natural science;
- to provide pedagogical support for elementary school children in order to develop their subjective positions and to help them interact efficiently;

- to stimulate younger children to succeed in group activity by applying practice-oriented, activity-based approaches.

II. Materials and Methods

In order to study the proficiency level of group work skills that are expected by the Federal state educational standard [15] we conducted experiment at the municipal budgetary educational institution "Secondary Education School No. 30" in the city of Naberezhnye Chelny, the Russian Federation. Two even-aged groups of children took part in the experiment: 1) the experimental group — 28 pupils of the 2nd grade "A"; 2) the checking group – 26 pupils of the 2nd grade "B".

The experiment included the following stages:

1. The ascertaining stage that made a diagnosis of the proficiency level of skills to work in a group using the following tests and techniques: the "Mittens" test developed by G.A. Zuckerman [12], the "The Left and Right Sides" technique developed by J. Piaget [16, 17], the "Road Home" test (a modified option by A.G. Leaders) [18], the communicative game "Journey to a Desert Island" (Younger school children are divided into teams that go to a desert island. Each team member can take only one necessary thing. The teams must decide what items they will take to the island, and what they will do on the island). To diagnose the proficiency level of group work skills the method of pedagogical observation was also actively applied.

The following criteria were applied to evaluate the results of the tests and techniques employed:

- understanding the different points of view, the ability to take into account a partner's position that is not similar to one's own;
- being able to present different opinions and points of view, understanding the possibility of different opinions and points of view (overcoming egocentrism);
- being aware of different bases for evaluating the same subject, understanding relativity of judgments and approaches for one's choice;
- being able to agree with various judgments and the ability to argue;
- being able to take into account needs and interests of other partners;
- being able to prove, to justify, to agree, come to the common conclusion;
- being able to exercise a mutual control when doing the work;
- being able to give mutual assistance when doing the work;
- having the emotional attitude to group work: positive (working with pleasure and interest), neutral (interacting only if it is necessary) or negative (ignoring each other, quarrelling).

2. The formative stage that included Natural science lessons where active teaching methods and techniques were used ("Brainstorm", "Bus Stop", "Conflict", "Basket of Ideas", and others).

3. The checking stage that re-diagnosed the proficiency level of the schoolchildren's skills to work in a group. At that stage the same methods as at the ascertaining stage were used.

III. Results and Discussions

The results of the ascertaining stage of the experiment showed that the majority of schoolchildren have rather low levels of group work skills (Table1).

TABLE I. The results of diagnosing the proficiency level of schoolchildren's skills (in %)

Levels of proficiency	Experimental group	Checking group
Low	50	46.1
Average	32.1	38.5
High	17.9	15.4

Dialogue between the parties of the learning and teaching process is the most favorable means for manifesting and developing schoolchildren's personalities. Based on V. V. Davydov's theory [7], as well as on the generalization of the best pedagogical experience and our experimental work, our study finds out the challenges that teachers meet when they try to organize group work aimed at developing the communication skills in schoolchildren. They are as follows:

- making up a group does not always occur in a calm atmosphere, because some children may be reluctant to gather in groups (there are pupils who are eager to work independently);

- often children are noisy;

- some pupils work in a group, while the others avoid group work; some children feel insecure and refuse to work, the other children try to lead and demonstrate intolerance.

Teachers who try to organize group work in class for the first face many challenges. They fail mainly due to children's unwillingness or inability to work together. Learning the skills of group work is a holistic process through gradual involving the children in the situational communicative activity. It is done by creating a motivating environment of communication, which helps to provide self-realization of a developing personality. We overcame children's internal resistance, unwillingness, and inability to work in a group by creating an atmosphere of trust, mutual support, and security. To create that atmosphere we took into account the principles of personality-oriented approach, cooperation, democratic style of relations, and recognition of a child as a subject of learning.

Group work requires a non-traditional organization of workplaces. The desks should be placed so that every child could see his/her partners, nobody should sit with their back to visual materials, and everyone should be able to get the educational supplies, and reach the shared sheet of paper, where the results of the work are recorded.

The ways of grouping the children can be different, depending on the desire of those who make them up. They can be made up randomly, by the teacher or by the "leader" among the children. The numerous studies of pedagogical psychology and experience of practicing teachers show that it is not advisable to randomly arrange groups of schoolchildren sitting at one or neighboring desks. Our recommendation is to consider peculiarities of the subject when making up groups taking into account the level of schoolchildren's performance. With such subjects as Mathematics, the Russian language it is advisable to make up homogeneous groups. The performance level at the elementary stage of Natural science education is not of great importance. When working in class, a mixed performance group that consists of schoolchildren with low and high performance may cause some problems for teachers. With such a group, a high performer becomes a leader, who predominantly fulfils the task. Thus, low performers can use the results of high performers' work. In this case, a teacher plays a key role, as he/she should organize cooperation between all the group members through dialogue interaction. For example, a low performer may be appointed as a leader, who speaks on behalf of a group.

U.N. Kulyutkin thinks that a group shows higher efficiency of joint activity if we take into account the character of interpersonal relations [19].

Group activity involves developing an adequate system of teachers' actions, both at the initial stage of preparing the group tasks, and at the final one of fulfilling them in class. The tasks are developed so that only the whole group can cope with searching for a solution as the period of time is limited. The structure of a task should include "subtasks" that are given to all the members of a group. It is important for teachers to think over all the details of the work in advance, to model their own activity and the activity of each pupil when doing group work.

The teacher monitors the work of the groups. The organization of group activity changes the position of a teacher in the educational process, as he/she becomes a moderator of communicative activity. At the elementary school age, communication development involves children's readiness to be engaged in class activities. Schoolchildren should learn to express their thoughts clearly, based on their personal social experience. After that children master their skills in communicative interaction, such as speaking, cooperating, working in pairs and in groups, participating in project presentations.

It is especially important to organize group work in class so that it ensures schoolchildren's initiatives, their ability to prove their points of view, to find solutions in certain situations through group working. However, the importance of group work at elementary school is underestimated in practice, and it is not employed when schoolchildren acquire competences, including communication ones. The course on Natural science should involve two related ways of developing the communication skills: speaking practice and effective interacting resulted in a set of acquired skills, which are based on the experience of this interaction.

To develop efficient group work skills in younger schoolchildren within the course on Natural science, we worked out the following pedagogical conditions:

- implementing the practices and methods that motivate schoolchildren and encourage active discussions in class;
- involving the learners in reflexive judgment of their social and communicative experience.

To fulfill these pedagogical conditions we developed and tested a system of tasks for group work within the educational framework "The Horizon" designed for the 2nd grade schoolchildren. To prepare young schoolchildren for group work we organized their work in pairs. At that stage it was important to develop children's abilities to negotiate and communicate. Organizing the work in pairs while studying the new material, revising the material covered, and testing the knowledge, i.e. at any stage of a lesson, we involved the children in discussion. To discuss means to talk about something in order to exchange ideas, to ask each other questions, to express opinions, etc.

In order to pass over from the work in pairs to group work the "Snow Ball" technique was employed. It involves working in a group, which begins with solving an individual problem. That work was followed by the work in pairs. At the final stage, the groups did not discuss the solutions but reported on the work done.

At the lesson where we studied how different animals prepared for the winter we organized group work using the "Searching for Treasure" technique. The schoolchildren were asked different questions: "What animals hibernate?", "What animals change their hair?", "What animals stock with supplies for winter?", "How do reptiles survive in winter?", and "What birds fly away to warm countries?" The children were supposed to use their textbooks and additional literature, as well as the Internet. Preparing for the answers involved discussions within the group. There were leaders who assigned responsibilities in the group – searching for the necessary information in a textbook, using the Internet, making notes, and reading some additional material. Many children used their personal experience connected with the topic under discussion. Some children wanted an encyclopedia or a book of fairy tales. At the end of the discussion, each group read out its answer, then expressed their opinions on their own activity and the activities of other groups.

At the lesson devoted to health problems the children were asked what they should do to be in good health. Group work was organized to discuss the problem. Each group had to make its own list of actions to promote good health.

When discussing the topic "Our Earth" we employed the "Basket of Ideas" technique. After discussions each group tried to complete the sentence "Our Earth is ...". The "Round-table Discussion" was used at the lesson devoted to calendars. The schoolchildren took turns describing what a calendar was meant for. The children's abilities to listen to their classmates, to formulate their ideas, to share responsibilities, to negotiate with each other were diagnosed with the help of such

techniques as “Bus stop”, “Zigzag”, “Conflict”, “Puzzle”, and others.

The children had to correct semantic mistakes when they did the “Catch a Mistake” test. After completing the test, the groups checked each other’s works and assessed them according to the criteria established by the teacher. When employing the “Puzzle” technique we divided the material under discussion into some parts. Each group had its own part of the material. All the groups were also given a list of the necessary sources or materials to study their parts of the information under discussion. When the children studied the material and coped with the task, their groups were rearranged so that every group had one representative from other groups. Each new member explained their part of the material to his/her group mates and answered their questions. At the end of the discussion the groups had to draw their conclusions.

The tasks from the “Zigzag” test involved working in groups of 4-5 schoolchildren that studied the material divided into some fragments. Then the children from different groups, who had studied the same problem, met and exchanged the information. That stage was called “Experts Meeting”. After the “meeting” they came back to their group mates and told them everything they had learnt from the other “experts”.

The “Recognize me” technique was employed when studying the topic “Spring and the World of Insects”. It was aimed at developing such skills as formulating ideas in writing and orally, listening to the partners, and understanding their speech. Each group chose an insect and made up some prompts to help the other groups guess the insect from those prompts.

The “Bus Stop” technique involves arranging the groups between “bus stops”. Each “bus stop” was a certain section of the material under study. There was a large sheet of paper with the key questions covered the material at each “bus stop”. The groups had to write down the appropriate answers on the sheets. Then, according to our signal, the groups moved clockwise to the next “bus stop” and read the answers given by their group mates, and if necessary, added them within 3 minutes. When the group returned to its starting “stop”, they studied all the answers and chose a group member who gave presentation of the material. At the end of the game the teacher had to summarize what had been said by all the groups and, if necessary, to make corrections and evaluate the results of the work.

The organization of group work employing these tests and techniques is similar to the game activity. Therefore it facilitates the learning process and contributes to developing the following communication skills of elementary school children: interacting and cooperating; taking into account the situation; proving their points of view, etc. As a result, even the most timid and anxious children overcome their fears connected with mastering the material. It is important to encourage children to work independently and to exchange ideas. It helps to motivate elementary school children to achieve in their group work. At first, everyone thinks and acts independently. Then there is an exchange of views and a general reflection on the problems under discussion. A teacher should not make children work together, keep silence, as well as should not punish children or deny them the right to participate in group work.

Thus developing communication skills at Natural science lessons involves a number of stages that are given in our study. The group work starts with making assumptions and expressing points of view. It is quite difficult for children of the 2nd grade to have a discussion and to select ideas at the same time. Therefore, at this stage it is important to teach children to be patient, respectful for partners’ points of view, and able to write down all the ideas on a piece of paper.

Then the children discuss their ideas. Listening to partners, following the discussion, and giving arguments are of great importance to discuss effectively.

The third stage of group work deals with group decision-making. At this stage children are supposed to come to conclusion or to find a solution of the problem. The stage involves critical discussing the proposed problem, selecting the most optimal solution, and proving the group point of view. Our pedagogical observation has shown that it is quite difficult for young children to find a solution due to the fact that there are some children who do not agree with the majority of the group. Since schoolchildren solve task-oriented problems, it was important for us to bring them to the universal way of problem-solving (rule, pattern, algorithm, etc.).

It is vital to give children the opportunity express all their ideas and opinions.

The fourth phase includes discussing the results of group work. When a representative of each group speaks, we record all the ideas and then discuss them. We ask different questions to find the correct solution, for example, “Which of the suggested ideas do you like best? Is it different from the others?” Sometimes to show the range of the solutions, we can ask such questions as, “Why are the solutions different? What is the most important (best) solution? And what other solutions can you suggest?”

The fifth stage of group work is a reflexive discussion. Here we ask questions of the following type, “What difficulties did you face when solving the problems? Why was it difficult (easy) to cope with the task?” Step-by-step work helps to succeed as schoolchildren learn the rules of the discussion and see the possibility of self-improvement.

Purpose-oriented pedagogical work at the formative stage of the experiment was done taking into account the level of children’s cognitive interests, as well as their personal social experience. Following the stages of group work, we provide pedagogical support for elementary school children in order to develop their subjective positions, to help them interact efficiently, to show their initiative, openness, and creativity.

So, we can say that group work is an efficient way to develop communication skills when studying the course on Natural science. In a group each child is expected to think and express their own opinion. Each group is involved in learning, as the achievements of the group depend on the personal contribution of each member, as well as on the solution found together [20].

To evaluate the results of the formative stage the checking experiment was conducted. The same methods (with some changes in questions or tasks) as at the ascertaining stage were employed. In order to verify the obtained results the following objectives were set:

- to re-diagnose the proficiency level of group work skills and compare the results of the stages;
- to identify the dynamic of the proficiency levels of group work skills.

Comparative results of the ascertaining and checking stages of the experiment are presented in table 2.

TABLE II. COMPARATIVE ANALYSIS OF THE RESULTS OF DIAGNOSING SCHOOLCHILDREN'S SKILLS (%)

Levels	**The results of the experimental group (%)**		**The results of the checking group (%)**	
	Ascertaining stage	***Checking stage***	***Ascertaining stage***	***Checking stage***
Low	50	21.4	46.1	42.3
Average	32.1	32.2	38.5	30.7
High	17.9	46.4	154	27

IV. CONCLUSION

The effective development of group work skills in schoolchildren is ensured by creating the adequate pedagogical conditions. They are:

- development of cognitive situational tasks designed for group work with applying modern teaching methods and techniques;
- regular motivation of younger children to improve group work taking into account the general development of children, the subject performance, as well as the starting level of cooperation skills;
- methodological support for developing the group work skills, which provides step-by-step organization of group activity.

The findings of our study prove that systematic organization of group work with younger schoolchildren creates favorable conditions for active and productive communication in the course of teaching Natural science. Adequate group work encourages cognitive activity, creativity, and effective communication. Establishing favorable interpersonal relations, efficient interacting, taking into account the positions of others, and mutual understanding can be developed within group activities based on cooperation.

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