

THE BEGINNING OF A PARTNERSHIP IN THE PROCESS OF STUDYING MATHEMATICS

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***Abstract.** In this paper we present the beginning of a partnership between the students in the upper classes and those in the beginner classes in 21st Secondary School “Hristo Botev”, Sofia. We examine deeply two of the used types of cooperative activity. The work shows the main steps in the organization of the project. We have included the motives for work both of the teachers and the students. The present work shows the concrete advantages for the different age groups and the reflection on the parents, as well.*

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Among the main aims of the Bulgarian school education is to achieve high quality. It involves continuous upgrading of knowledge and skills in order to develop the potential of each child to the maximum and give an opportunity for social realization. Important for intellectual and personal development is the formation of cognitive interest in mathematics and deepen their knowledge in this area. According to our famous scientist and leader of the National Team of Mathematics Sava Grozdev the mathematical interest and talent comes out in the early school age [1]. That is why the teachers should systematically look for different forms, means and methods for the provocation of these mathematical talents in children. Along with this, they must develop a cognitive interest in mathematics. The originality of interest is expressed in deep study, in a constant and self-searching and receiving of mathematical knowledge, in overcoming the difficulties of carrying out this activity. Interest highly increases the effectiveness of the lesson because, as students engage with passion and learning material is easily digested.

To provoke the development of interest in mathematics and to raise the level of mathematical knowledge and skills, we decided to experiment with a different shape from the usual routine of training – collaboration between students from the second and eleventh grade in 21 Secondary School Hristo Botev.

This cooperation is caused by love of children to the knowledge and desire to improve. It is cooperation prompted and encouraged by the teachers of those children who had other educational purposes as: a deepening interest in the fields of mathematics, that don't learnt in school, linking scientific knowledge to practice, etc.

Simultaneously with the educational goals we set ourselves and instructive ones:

- Development of a learning atmosphere. The amiable conditions in school, the spirit of friendship and understanding enables students to concentrate on the application of academic work and are a prerequisite for acquiring knowledge. One of the problems of the contemporary school is the aggression of young people, targeting both peers and to the larger (respectively smaller) students. The formation of cooperation and friendly relations can eliminate (or minimize) aggressive behavior.
- Formation of motivation among young people to pursue the teaching profession. In recent years the teaching profession wasn't attractive. There is a shortage of qualified teachers [2]. Creating a lasting interest in it can lead to motivating young people for vocational guidance to it. The rationalization of the social aspect of this profession and to touch the strong emotional experiences of teachers are able to change the negative attitude of society towards the part of teachers.

When the form of mutual cooperation is used, the small students impatiently follow the steps of the older ones and search for a role model. The older ones can now see the passion for mathematics in their younger classmates. A premise for this cooperation is also the spiral approach in the study of mathematics, included in the school program.

The idea came out following the methodical work in school during the presentation of the project activity of the older students that join the club Sigma [3].

During the preplanning we laid out two joint activities: math club Sigma lesson and teaching in second grade. We chose the topic of the session of Fractals club.

Our choice was motivated by:

1. To awaken interest and curiosity of the two groups of students. Fractal geometry is a relatively new branch of mathematics and as such stirs curiosity.
2. The topic expands their horizons.
3. Actuality – the development of this branch of mathematics was initiated by the practice and has broad applications in science, in engineering and modeling of complex organic and geological systems.
4. Accessibility and visibility – it can be served in conjunction with many illustrations, animations, background music, etc. Indeed, without the use of modern computer graphics fractals can not be displayed. Presented visually, the subject becomes available for different age groups.
5. It creates an opportunity for appropriate emotional saturation, which is extremely important for children of elementary school. According Rubinsteyn “emotional attitude towards the subject extends to all its parts and by the parts of the whole subject. Initially, the subjective emotional experiences of the child to some extent directly included in its perception

and then the knowledge of the world and emotional attitude towards it are differentiating.” [4]. The positive emotions and experiences influence to the children in elementary school in high degree. They can cause a positive attitude towards the matter and to create interest in a particular area.

In the preparation stage, we identify and realizing the following steps:

The primary school teacher talked to the younger students and explained the unusual meeting with mathematics, that was going to happen. The objectives set were: to arouse, to create preliminary interest, excitement and to spark the curiosity of children. As it is right to visit younger students prepared gifts – elaborated drawings for the hosts.

Older students have other tasks:

1. To adapt the presentation Fractal for many smaller ones. Of all knowledge on the topic, that “big students” have, they had to filter out the part that could be adapted for children. As Gortcheva [5] notes, “the effective teaching of mathematics is hardly possible without taking into account the characteristics of the students and the level of preparedness to perceive the mathematical concepts studied.” We decided to not give a precise definition for fractals with self-similarity and proportionality and considered the selection of the material with this. However, in conducting the lesson, the definition was discussed with the children so that they intuitively find basic geometric and algebraic properties. The 11 - grade students prepared more animations to re-enforce the emotional perceptions. Special place in preparation of the presentation was devoted to the historical facts of the development of the concept of the fractal and mathematicians, worked on it.
2. Selection of available vocabulary, which will be presented to the knowledge in front of “small ones”.
3. They needed some psychological preparation. They had to know the psychological characteristics associated with the development of children of primary school.

For the “older ones” the upcoming meeting had important social motives [6]. It is both an opportunity for appearance and popularity, as well as taking a special place among the students of the same age (narrow social reasons). At the same time eleventh grade students are responsible and undertake the commitment with a sense of duty (broad social reasons). Their motives are related to the need for communication and striving to obtain satisfaction from it.

During the implementation of joint occupation of the mathematical club, a very emotional moment in the contact process was the special welcoming of the small guests in Sigma Club. Each one of them was placed to sit near a student from 11th grade. Exited, holding their breath, with wide open eyes the young students followed the presentation of the older ones. The explanations, together with the extremely beautiful pictures and music background provoked the curiosity of the

second-year students. We were happy to find out that our expectancy was confirmed: the small students have a lot of questions, and this means already generated interest.

With enthusiasm and two groups of young people commented properties of fractals, such that their length is greater than the distance to the moon and collect on a computer screen.

The visit ended with a satisfaction for both sides. Older students felt satisfied with the fact that they managed to intrigue the small ones and that they found appropriate ways and words to provoke their attention. The younger students were excited by the received information, by the reception, by the created situation and given their attention.

The meeting ended, but it caused following actions, showing the formation of a lasting interest. We observed the following phenomena:

1. The second grade students painted fractal images. Some of them made an attempt to draw the Koch snowflake. The drawings showed intuition and insight into the unusual mathematical situation, that except knowledge bring aesthetic experiences.
2. The impact was brought to families, including parents who helped the children in printing color images of fractals on the internet.
3. It followed an exhibition in the classroom of second grade.
4. The pupils made an exchange of fractal images.

The described actions are indicative for the strong impact of the meeting on young pupils, the long lasting interest created in the topic, in the knowledge, in mathematics, and science as a whole.

With a pleasure we established that had achieved other purpose: we created new friendships and relationships between students with great age difference. They received more popular and enjoyed more attention from younger students. But all members of the club Sigma deepened the motivation to cooperate, with responsibility accepted the interest of the small pupils. Juniors were very impressed by the excitement and interest of the small ones. They managed to get the thrill, to feel like a teacher.

The next step was conducting the lesson by students from 11th grade in second grade. We chose the topic of "Short writing of a text problem". This topic is somehow difficult for the students. The second-year students are still not used to work with the text of the problem and the separation of what is given and what is needed. It is still difficult for them to find out the exact question in the problem and how it should be used in order to find the solution. This was the reason to settle the aim of the lesson to be "how to make a short writing in the solution of text problems". During the lesson we had the following tasks to be done:

1. Usage of addition, subtraction, multiplication, and division for the solution of text problems
2. Differentiation of "more", "times more", "less", "times less"

3. Differentiation of the key messages in the text problems questions
4. Short writing of the text in “Given” and “Needed”
5. Ordering the solution

The preparation and conduction of a mathematical lesson by pedagogically unprepared people is quite a challenge. In the stage of preparation we needed to focus on the following:

1. Definition of the key messages: “less” and “times less”; “more” and “times more”. Special attention paid to the questions of “how much more” and “how many times more”, as well as the unifying concepts “total”, “together”, “all together” or the lack of such concepts.
2. Optimal choice of the number of problems: Their quantity had to be defined in such way that they are enough for the class hour and not more. The text problems were ordered in growing difficulty.
3. Variety in questions: When giving the clause of the problem, they were presented as text, short writing, and a diagram. When asking about the needed, the question was explained with synonyms.
4. Integrated purpose: It was achieved by unification with a topic of “Environment” – “Spring Flowers”.
5. Definition of the technical means, needed for the conduction of the lesson. The older students decided to use Power Point Presentation. They prepared a presentation that included beautiful images, consecutive pop-ups of the elements of the problems’ clause, their short writing, and their solution.
6. To end the lesson we prepared a logical task (a problem for second class), enabling the “teacher” to select a suitable clear explanations, guiding the younger students to more complex reflections, thus leading them to the solution. For the actor in the task was chosen fairy Patilan. Its participation involves strong emotional experiences. „Modern elementary school curriculum is designed to build pupils’ basic skills in reading, writing, mathematics, etc., keeping at the same time little students’ joy of childhood. Play, fantasy, and imagination are an inseparable part of children’s world and educators use them creatively to construct an effective learning process – indicates Gorcheva [7].

The lesson was held in the class room of second grade. We decided that it would be better if this meeting was attended by just a small group of the older students – only these that had to take part in the lesson – three girls that were to present the lesson. They carried out the lesson on their own, in the presence of teachers that encouraged the girls. During the lesson the presenting girls paid special attention to the differentiation of given and needed, the key messages, the formulation and writing of the solution. As real teachers, they checked and helped for the short writing. Correctness of decisions are discussed and considered different ones. It was used and reproduced, because as shown Krutetskiy “in order

to remember something well, it must be repeated several times” [8]. They discussed the different solutions with the whole class. The “teachers” managed to stimulate all small students. The latter were encouraged to share their personal point about the problems and also the proposed solutions. The older students presented their solutions as well.

At the end of the lesson, the three leading girls gave special stimulating congratulations to all that took part actively (i.e. the whole class) with spring flowers and the “teachers” were greeted by the younger students with hand-made images of “Fractals”. The emotional end of the lesson was a song, expressing the friendship between people, with which the second-year students greeted their “young teachers”.

The lesson accomplished the settled in advance targets and reached to a high-level interest in mathematics in the young students. It showed them that mathematics could be pleasant and multiform, and the complicated problems might have easy solution. It actually showed them the practical application of the studied mathematical actions. The older students, on the other hand, felt the great moral satisfaction of being “A Teacher”. This first appearance in the teaching profession had a very strong positive reflection on young people and inspired one of the girls to follow the steps of her teachers. A year later she made her choice in the teacher’s profession and is currently a student at the Sofia University, with the specialty of Education.

We believe that this trial partnership is the beginning of a good practice at school. It may be enriched and developed. It is especially useful for schools that train students with great age difference. The activity can be enhanced by the formation of cooperate teams, developing projects on a given topic, organization of mathematical contests among the young students by the older ones, celebration of a special mathematical day for the small ones.

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