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COOPERATION IN TEACHING AND LEARNING ANALYTIC GEOMETRY

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Abstract. Cooperative or small group learning is widely recognized as pedagogical practise that promotes learning and socialisation across a range of curriculum areas from primary school to high school and college. Our research was realized in two classes. There were 42 pupils (18 pupils in the first class and the 24 pupils in the second class). The main aim of this research was to verify our hypothesis: Can pupils accomplish better results when they cooperate with someone similar?.

Keywords: cooperation, teaching, learning, analytic geometry, teaching method

Mathematics Subject Classification: Primary 97G70; Secondary 97D40

1 Introduction

Cooperation is the basis of human lives. We assume that everybody have cooperated in his/her life – in childhood, at school, at work, etc. Cooperation is related to everybody with no difference. From this reason we decided to study cooperation in teaching and learning analytic geometry.

Cooperative learning has been well documented in the educational research as a successful pedagogy to improve academic achievements of students. It is a fundamental principle of cooperative learning that group members are linked together in such a way that they can succeed, they will actively assist each other to make sure that the assignment is done and the purpose of the group achieved. [1]

Numerous studies have been published over the past four decades that demonstrate the benefits of cooperative learning. These benefits include academic gains across different curriculum domains [2], improved participation in school-based learning [3] and enhanced socialisation among peers [4], including more cross-ethnic and cross-sex relationships [5].

Collaborative learning in the form of groups has been used in teaching for a long time. Many research indicated that a teaching effect can be greatly improved through collaborative learning. [6]

In our research we have chosen the problematics of cooperation as a teaching method. According to the results we have reached we would like to confirm the reliability of cooperation as a well - chosen teaching tool for pupils at grammar school also because of their age and period of life when they create new relationships, meet new people and it is a natural way of being for them.

2 Theoretical background

Cooperative learning is one of the two ways of organizing the learning environment of a classroom, the other being competitive. In cooperative learning environment, the goals of a separate individual become so linked that there is a positive correlation between them; on the contrary, in a competitive conventional environment, the goals of the students are so linked that there is a negative correlation between their goal attainments. [8]

Cooperative learning is a pedagogical practise strongly supported by many state because of the well-documented benefits that accrue to children who experience cooperative learning. [9]

One of the most influential perspectives was developed by [10] who proposed that children´s knowledge, ideas, attitudes, and values develop trough interactions with others. In fact, when children interact with adults or more able peers, children´s learning is mediated or reinforced so they can often complete tasks that they would not be able to do by themselves.

[10] recognized that children´s learning is mediated by adults and more capable peers who teach the knowledge and skills of their culture. This process of mediation of scaffolding, enables children to complete tasks they would not be able to do themselves. When children work cooperatively together, the group creates a zone of proximal development enabling members to be successful at tasks they would be unable to do alone. Instruction within the group is both explicit and implicit, enabling children to engage in more opportunities for developing understanding and meaning.

[11] found that cooperative learning can be enhanced when group size does not exceed four members, instructions are adapted to the needs of the group, and teachers are trained to implement small group work in their classroom.

According to [12] cooperative learning is the “instructional use of small groups so that students work together to maximize their own and each other’s learning.” In order to work well, cooperative learning needs to be planned, with consideration given to the appropriate size if the group, to each student´s role within the group, and to how the results will be evaluated and used in the class session.

The analytic geometry is a very problematic part of education. Pupils are focused on analytic geometry in the third year at grammar school. They learn about coordinate system, vectors and lines. [13]

3 Methodology

The research sample consisted of 42 pupils who study at grammar school. These pupils filled in worksheets which were oriented on solving some problems of analytic geometry especially analytic geometry of circle. Analytic geometry is a content of education in the third year at grammar school.

Pupils learned analytic geometry during the four weeks and then they filled in pre-test. This pre-test consisted of 4 tasks which were oriented on mentioned analytic geometry of circle.
The first task was oriented on a drawing circle in coordinate system when the equation of circle was given. They were able to find out coordinates of centre of circle and radius of circle from mentioned equation of circle. Than drawing circle in coordinate system was not complicated. Other tasks were aimed on acquisition information from a graph of a circle which was drawn in previously task. Pupils had to find points where the graph crosses the y-axis, then points where the graph crosses the x-axis and some more points on the graph.
In the next step pupils were divided into small groups. The positioning of pupils in group was deliberate. The starting point of dividing them into small groups was the result of pre-test from our previous step. Members of each group had one common thing – they had the same or very similar outcome of their pre-test because we wanted to verify our hypothesis: Can pupils accomplish better results when they cooperate with someone similar (someone who had the same or very similar results from his/her pre-test)?.

In each group pupils worked together during the two weeks. Then they filled in the post-test which was oriented on analytic geometry of circle, as well. This post-test consisted on four circle puzzles. The first circle puzzle was oriented on working out coordinates of the points A, B, C and D (Fig 1.) where the centre of the circle and the radius of the circle were known.

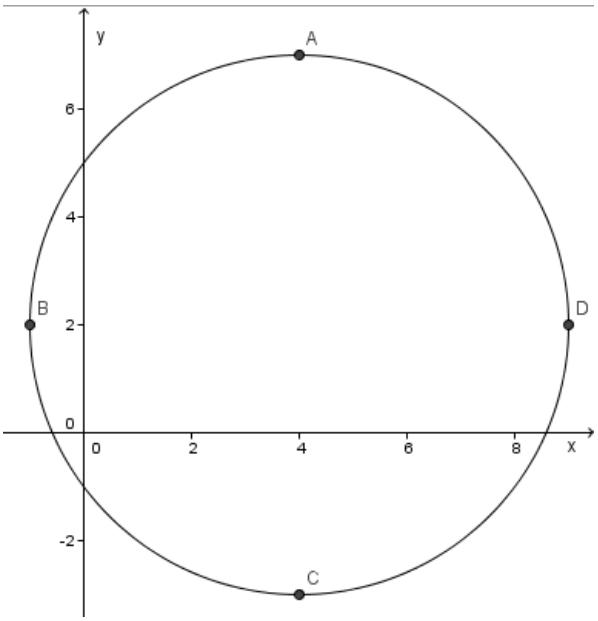

Fig. 1. The circle in the coordinate system.

In the next task there were the equations of two tangents to a circle. Pupils should find out the radius and the coordinates of the centre of the circle. The picture in the third task shows them the location of three circles in the area. They knew the centre of the circle and the radius of

the circle. Pupils had to follow the instructions and answer the questions: Draw the y-axis and the x-axis; What is the radius of the smaller circles? Write down the coordinates of the centres of the two smaller circles. The situation was illustrated in the picture (Fig 2.).

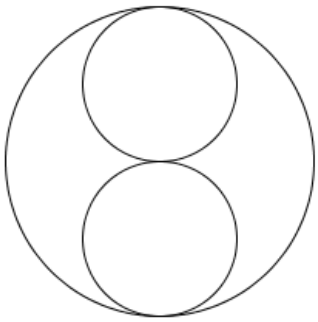

Fig. 2. Two circles inside the third circle.

The last task gave them information about the circle position according to which pupils had to draw it. They knew the radius of the circle and the circle has one intersection point with y-axis and one intersection point with x-axis.

4 Findings

The main aim of this research is to verify our hypothesis: Can pupils accomplish better results when they cooperate with someone similar?

In the methodology we describe how we collected data to prove it. When we had collected data, we could analyse them. We used descriptive statistics. When we sorted pupils in to groups we used result of pre-test. Every pre-test was analysed individually. Of course, we found pre-tests which had very good results and those which not. These results helped us to divide pupils into groups. In table 1 there are results of the pre-test which was sat by pupils from the first class.

the first class									
pupil	1	2	3	4	5	6	7	8	9
result	93%	69%	13%	78%	15%	91%	19%	72%	98%

pupil	10	11	12	13	14	15	16	17	18
result	89%	81%	22%	64%	32%	24%	95%	44%	55%

Tab. 1. Pre-tests´ results in the first class.

Subsequently we made this groups - group 1 (pupil 1, pupil 9 and pupil 16), group 2 (pupil 10, pupil 11 and pupil 6), group 3 (pupil 4, pupil 8 and pupil 2), pupil 4 (pupil 13, pupil 17 and pupil 18), group 5 (pupil 12, pupil 15 and pupil 14), group 6 (pupil 3, pupil 5 and pupil 7).

In table 2 there is the same situation than in the table 1 but there are results of the pre-test which was done by pupils from the second class.

the second class								
pupil	1	2	3	4	5	6	7	8
result	10%	5%	46%	13%	100%	60%	24%	57%
pupil	9	10	11	12	13	14	15	16
result	8%	63%	74%	79%	99%	50%	29%	49%
pupil	17	18	19	20	21	22	23	24
result	15%	81%	99%	76%	31%	89%	6%	84%

Tab. 2. Pre-tests´ results in the second class.

In the second class we made this groups - group 1 (pupil 5, pupil 13 and pupil 19), group 2 (pupil 2, pupil 9 and pupil 23), group 3 (pupil 4, pupil 7 and pupil 1), pupil 4 (pupil 15, pupil 7 and pupil 21), group 5 (pupil 3, pupil 16 and pupil 14), group 6 (pupil 8, pupil 6 and pupil 10), group 7 (pupil 20, pupil 11 and pupil 12), group 6 (pupil 24, pupil 22 and pupil 18).

This division into groups was deliberate because we were afraid of a situation in which pupils work with classmates with different school results. Then we would not have relevant information because in the group there could be pupils with excellent results and pupils with not so good results. Subsequently it could happen that their way of doing the tests would not be cooperation but only work one pupil or some pupils. Results from post-tests are in table 3 (the first class) and table 4 (the second class).

the first class									
pupil	1	2	3	4	5	6	7	8	9
result	93%	73%	26%	80%	19%	96%	25%	75%	99%
pupil	10	11	12	13	14	15	16	17	18
result	96%	84%	28%	69%	43%	35%	100%	54%	60%

Tab. 3. Post-tests´ results in the first class.

the second class								
pupil	1	2	3	4	5	6	7	8
result	13%	19%	53%	23%	93%	65%	29%	63%
pupil	9	10	11	12	13	14	15	16
result	14%	76%	98%	89%	89%	54%	31%	56%
pupil	17	18	19	20	21	22	23	24
result	15%	81%	99%	83%	50%	96%	26%	94%

Tab. 4. Post-tests´ results in the second class.

When we compare results of pre-test and the post-test (Tab 1., Tab 2., Tab 3., Tab 4.) we can notice some obvious facts:

- some pupils have better results of post-test,
- some pupils attain not any improvement (result of their pre-test and result of their post-test are similar),
- some pupils have worse results of post-tests.

The first finding can be considered as a validation of our supposition. In the second finding we see some pupils are not better or worse. They stay on the same level than before they fill in post-test. The third finding shows us some pupils (small group) have worse results of post-test. It can be caused by a lot of factors that we have not researched so far.
In general our hypothesis about cooperation in teaching and learning in analytic geometry is true in this case. We confirmed our hypothesis that pupils have better results of post-test than results of pre-test. We can say that cooperation in teaching and learning in analytic geometry is a good way for pupils at grammar school.

5 Conclusion

Cooperative learning establishes a community in which pupils can get help and support from other group members immediately in a non-competitive learning environment, just raising their hands and waiting for the right answers to be given.
We showed cooperation has its own place in teaching and learning in general but also especially in analytic geometry.
This study is not only a confirmation and a proof of our hypothesis, we also showed pupils how they can be better and reach greater results when they learn something – in our case not only new knowledge but also new social interactions – making friends, giving and getting support, helping one another, talking to someone with a purpose, etc. which are very important in everyday life in any period of life.
This study shows teacher they can be successful in teaching when they use cooperation in teaching pupils. Pupils are oriented on common work and they work as team then they feel their own need. These facts can help them to be better in learning problematic. We think the method of cooperation can be used in teaching and learning each problematic.

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