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MOTIVATION TO GEOMETRY AT HIGH SCHOOL OF VISUAL ARTS

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ABSTRACT. *In the article we deal with the problem of lack of pupils' motivation to geometry in high school of visual arts. Our theoretical framework is van Hiele model of Geometry Thought. We prepared one lesson from mathematics based on activities fitting on the first and second level of the van Hiele model. One of the aim was to show pupils a cross curricular relation between mathematics and visual arts.*

KEY WORDS: *teaching geometry, motivation, visual arts*

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Introduction

In our opinion, the most beautiful part of teaching mathematics is geometry. Geometry includes many interesting problems and theories and is still open to new approaches. The history of geometry comes from the time of creating the mankind where it was a part of a real life and culture. In the past, the geometry was the component of architecture in many various forms. Mathematics as a teaching subject belongs to less popular subjects for many different reasons. One reason could be that not so many students are successful in mathematics. According to [1] students' perception of success in mathematics has a great effect on students' motivation attitudes. And we think that maybe the teaching of geometry in a more interesting way could be an element of motivation for learning of students, because geometry has an influence on our aesthetical and visual perception of the world. In the present, the real life is often used in the connection of mathematics, however, students do not find the connection between mathematics and their experiences.

Why is important to teach geometry?

The world around us is a visual. Since we live in 3D space, it means, that it is necessary to know interpret visual information. See the visual arts, architecture and many other cultural artifacts from an aesthetical point of view, includes geometrical principals: symmetry, perspective, an orientation in space and so on. The teaching subject geometry offers a rich way of developing the visual abilities of students. "*No mathematical subject is more relevant than geometry. It lies at the heart of physics, chemistry, biology, geology, and geography, art and architecture. It is also lies at the heart of mathematics, though through much of the 20th century the centrality of geometry was obscured by fashionable abstraction"*. [2]

In the article, we will talk about 15 and 16 years old pupils of the high school of visual arts. In our opinion geometry, especially spatial imagination is a necessary ability for them and for their future work.

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How to teach geometry?

According to [3] and [4], if the activities in geometry are frustrating and not interesting, then pupils might not be motivated to learn what the teacher is trying to teach them. On the other hand, if the activities are too easy, they might not attract pupils' attention to the topic. So they might fail to generate a sense of success. The tasks in instruction should contain respectable challenges that pupils could achieve. With appropriate students' ability to achieve geometry tasks dealt many educators and researchers. One of them was Dina van Hiele-Geldof and Pierre van Hiele. We placed our work into the theoretical framework based on their Van Hiele model of Geometric Thought. It is a theory in mathematics education, which describes the way how students reason about shapes and other geometric ideas. Five discrete hierarchical levels of thinking were described in this model [5]:

Level 0 (Visualization): Students recognize the figures by appearance alone, often by comparing them to a known prototype. The properties of a figure are not perceived. At this level, students make decisions based on perception, not reasoning.

Level 1 (Analysis): Students see figures as sets of properties. They can recognize and name properties of geometric figures, but they do not see relationships among these properties. When describing an object, a student operating at this level might list all the properties he/she knows, but may not discern which properties are necessary and which are sufficient to describe the object.

Level 2 (Abstraction): Students perceive relationships between properties and between figures. At this level, students can create meaningful definitions and give informal arguments to justify their reasoning. Logical implications and class inclusions, such as squares being a type of rectangle, are understood. The role and significance of formal deduction are, however, not understood.

Level 3 (Deduction): Students can construct proofs, understand the role of axioms and definitions, and know the meaning of necessary and sufficient conditions. At this level, students should be able to construct proofs such as those typically found in a high school geometry class.

Level 4 (Rigor): Students at this level understand the formal aspects of deduction, such as establishing and comparing mathematical systems. Students at this level can understand the use of indirect proof and proof by contrapositive, and can understand non-Euclidean systems.

Every of these levels has its own linguistic symbols and its own systems of relations connecting this symbol. It is important for the teacher to know on which level their students are to give them suitable instructions, which there are able to understand. Although the activities on lesson should fit their level.

Students in our study group have low levels of geometrical thinking. We could say that the level of thinking of our study group has been just first or second. As we write below they were not interested in math, neither geometry. For this type of students is especially desirable to choose the appropriate approach of teaching geometry. For these levels are proper also manipulating activities and didactical plays. Activities fitting the first and the second levels could be for instance:

- to manipulate with geometric shapes,
- to identify a shape or geometric relations in simply physical objects in the classroom, the home, photographs, and other places,
- to compose and decompose shapes,
- to solve tasks where properties of figures and interrelationships are important

Should be the teaching mathematics at the high school of visual arts effective?

In the Private high school of visual arts in Nitra is mathematics teach once a week in the first and second year of the study in school year 2013/2014, what is 33 hours per school year. Should be so lessons effective? If we want to teach everything from the curriculum, it will not be possible to do so. Moreover, the textbooks are so difficult for this type of school and there does not exist textbook of mathematics for high schools of visual arts. For this reason is sometimes really hard for teachers to prepare for the lesson. The age of pupils in our study group is between 15 and 16 years. It is an age when pupils are not interested in studying generally and they are searching for answers of the sense of life.

We prepared one lesson of geometry, based on activating teaching strategies. One of our main aim was to show pupils the geometry in a real life. The next aim was to make a lesson for each student, also for students who are not interested in mathematics and they are not so successful and give them a chance to be an active. We prepare for them activities fitting the first and the second level of the van Hiele model. Through these activities pupils have the opportunity to learn, explore geometry by their own way and tempo. The thought was also to show students a cross curricular relation between mathematics and visual arts.

Geometric figure in the plane

For the lesson of mathematics pupils needed their own cameras. The teaching lesson began with an introduction talk about geometry and our surroundings. The first task was to take a picture of any geometrical figure in their class. Then the second task was to take a picture of any geometrical figure in their school. The last picture pupils had to take outside of the school building. After coming back to the classroom, pupils had to figure out their own tasks inspired by their pictures, if they did not know to figure out tasks they should compose a poem or a short story.

Students after first pictures were motivated to work and they took more than three pictures. Every pupil in the class made this task and we could see that this activity is likely for them.

Now, for instance, we offer some tasks of pupils':

1. The area of the circle with radius *11 cm* is *x* cm^2. The circle is divided in two not the same parts. Red part of the circle has the area 421 cm^2. How many percent of a circle's area is a rose part of the circle?

Figure 1

2. The sum of the same three circles' areas is the same as the area of the rectangle. Radius of one circle is 3cm. Sides of the rectangle are a = ? and b = 7 cm. What is scale of side a?

Figure 2

3. Peter weights *70* kilograms and one his step measure *80 cm*. In the one lazy Friday Peter was walking from the school, he was joking by the jump of the canals. Each canal he jumped on one his step. During the way he jumped 11 canals.

a) What is the sum of radiuses all jumped canals?
b) What is the sum of canals' hoods weight, if the one weight is 14 times less as Peter's weight?

Figure 3

4. Pupils also created a short poem:

It keeps us on the ground,
it keeps us in the driving,
whether it's to the Skoda
or Mazda.
What is this?
(Wheel)

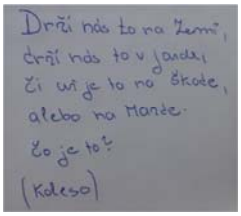

Figure 4

Conclusion

Geometry found its beginning due to a utilitarian need to understand and predict phenomena in the natural world. Although the world and society changed, geometry still gives us a tool to understand our environment. That is one of the reasons, why we found

geometry to be an important part of school mathematics. Especially, we see the needs of geometry in high school of visual arts, where students deal with geometrical principals in architecture or linear perspective. However, in this type of school is low dotation of math classes and also a problem with lack of pupils' interest. Due to these problems we tried to find the way to motivate students to learn geometry. We prepared one lesson of geometry with activities fitting pupils' levels of geometry thinking. During this lesson, students have the opportunity to observe the geometrical shapes in their environment. Every pupil, were not interested in math, participated in these activities and they enjoyed it. So we consider our aim to be satisfied. Our plans to the future is to prepare next lessons with the similar aim to active pupils in the teaching of mathematics, because we think that one lesson of the week must be also effective and must bring some mathematical knowledge to pupils of the high school of visual arts.

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