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EXAMPLES OF USING NEW INTERACTIVE TECHNOLOGIES FOR FILLING THE GAPS IN STUDENTS KNOWLEDGE

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Abstract. Many changes in the curriculum of mathematics have been made during a few last years. Frequent changes carry certain consequences. Pupils which finish high school may possess different knowledge in different years. This is because they may have various ranges of educational material (different from those of their older or younger colleagues). Additionally, some parts of school mathematical material are more difficult to learn than others. Unfortunately, sometimes teachers tend to treat them cursorily. The planimetry is such a specific field of mathematics which requires specific thinking and analysis. It is necessary to reduce such differences in knowledge and skills, to supplement lacks of knowledge of students of the first year mathematics study. It is necessary to use the suitable tools to do this quickly and effective. Utilization of interactive GeoGebra based simulations and visualizations may be helpful in such a situation. Perfect co-operation with the interactive whiteboard and possibility of delivering didactic materials by Internet are their additional advantage.

We will show examples of such materials relating to similarities in our presentation. They are a part of developing project – the course of geometrical transformations on the plane. It is addressed to students of the first year of mathematics study. However, these materials can be used at high school level during additional activities according to pupils interests.

1. Introduction

During several recent years we observe many changes made in Polish curriculum of mathematics. Frequent changes bring certain consequences. Pupils finishing the secondary school next years can possess different knowledge. Pupils finishing high school in successive years can possess different knowledge, because they are obliged by somewhat different range of the material (different from the range of their older or younger colleagues) [1]. Teachers at high schools at various stage realize particular portions of the material depending on the various quantity of hours. On the other hand, the beginning of studies at university is a serious challenge for a young man. Appearing in a completely new environment, coming across a new system of work and education, operating in new realities with different requirements – this is the problem for high school student at the beginning of the studies.

Universities try to undertake various actions which ought to make easier student's entry in the new reality and to help match new requirements. They have also noticed the program differences and very often organized equalizing lessons for new students. Such help is organized using various ways, forms and knowledge depending on needs and possibility. Focusing attention on technological development of society, accessibility to various sources of knowledge exchanged by Internet etc., we should use available resources for such lessons. in this situation, using of suitable ICT tools can support the process of learning, improve it, can make problems, terms and questions more accessible for students. Such a didactic material can be partly realized in traditional way, during study at the university, and partly by Internet, e.g. by e-learning platform. It certainty allows to save time and finance, and also it makes possible individualization of the process of learning. The project, which started up in 2002 under direction of dr. T. Ratusiński in Institute of Mathematics at Pedagogical University of Cracow, is an example of such a material [2]. It is an answer to the abovementioned lacks, a trial of solution of the appeared problem.

2. Course of geometry

A course of elementary geometry is one of subjects realized in first year of studies since years. It is perceived as very useful for young students starting not easy mathematical studies. The subject area and the way of realization of its curriculum can help students to understand what higher mathematics is, and also to become acquainted with its special language. In the curriculum there is a large part of material concentrated on transformations (e.g., the properties of isometry, similarity of figures or geometrical constructions).

Young students beginning studies at a high school should fill lacks for the short time. In view of the range of changes in the curriculum, this is a very serious problem. That is why the e-learning course of elementary geometry was created as a supplement to studies realized in traditional way (Figure 1).[1]

Figure 1. The main page of the course.

Contents of teaching were organized in thematic blocks. The respective parts of the course are concentrated on concrete transformations, for example, such as main isometries, central symmetry, axial symmetry, translation symmetry, translation, rotation, similitude, similitarity, conchoid transformation, the power of a point, inversion, some kind of "glued" transformation and many others.

All units consistituting the whole course are closely related with each other. Materials relating to respective transformations contain links to essential contents at the actual stage. All pages of the whole project have standardized graphic and cardinal components and navigation. Students often have problems with understanding the idea of a new acquainting term. Working with abstract terms, it is often hard to assimilate them or imagine a suitable model. That is why the principal part of presented materials include theoretical knowledge which students ought to assimilate during study.

[1]The legends in Figures being screen images are in Polish.

Students can become familiar with terms, their definitions and properties in easy way thanks to utilization of interactive constructions made with DGS (Dynamic Geometry Systems) like GeoGebra (Figure 2). The huge advantage of such a solution is the possibility of their multi-regeneration. Utilization of interactive constructions helps to analyze deeper mathematics problems step by step. Students can also modify geometrical objects used in the construction and observe positions or others properties of constructed figures. It is possible, for example, to discover terms, to observe properties of figures, to notice how a figure changes in transformation depending on its shape or initial bearing. Such an approach makes it possible to look at the whole contents and also facilitates investigation of special cases.

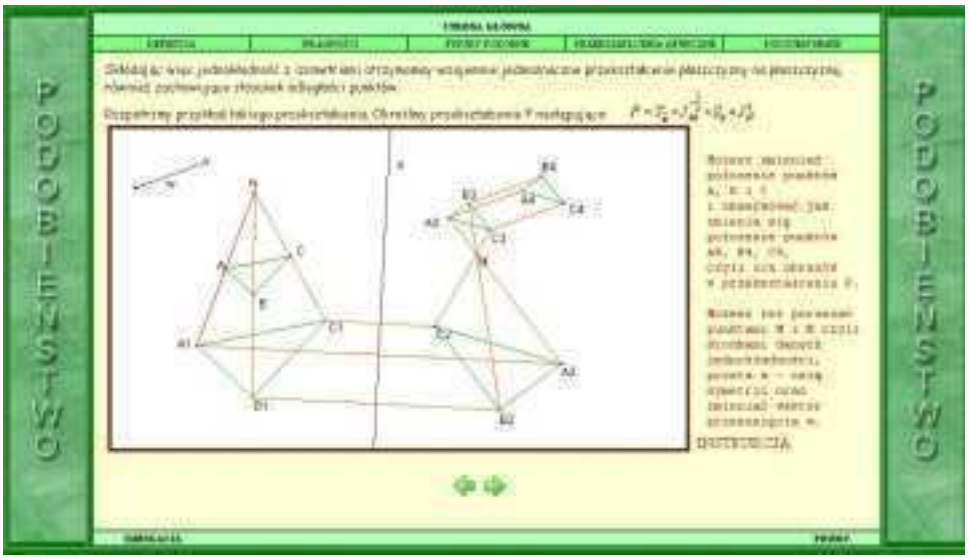

Figure 2. Interactive definition of similarity.

Proofs are essential complements to the theoretical part of the course. Applying the formal notation, saving logical sequence of reasoning, the proofs are next activities which are not easy for students. In the course, proofs are often introduced in interactive way.

Students can analyze the presented notation and observe illustrating figures in the part of materials. Sometimes a proof is important to learn itself, and in such a situation interactive didactic material can manage students to became an active author of them (Figure 3). For example, the text of the proof is

displayed on a screen step by step and contains certain gaps which should be filled in with correct statements. The only way to pass each step of proof is to choose the correct answer. Interesting solutions used in the course are tips which appear after incorrect answers. They ought to help students to correct their mistakes. In such a way a computer becomes a helper in the process of getting knowledge, and a student is not only a reproducer of skilled theory, but becomes its creator.

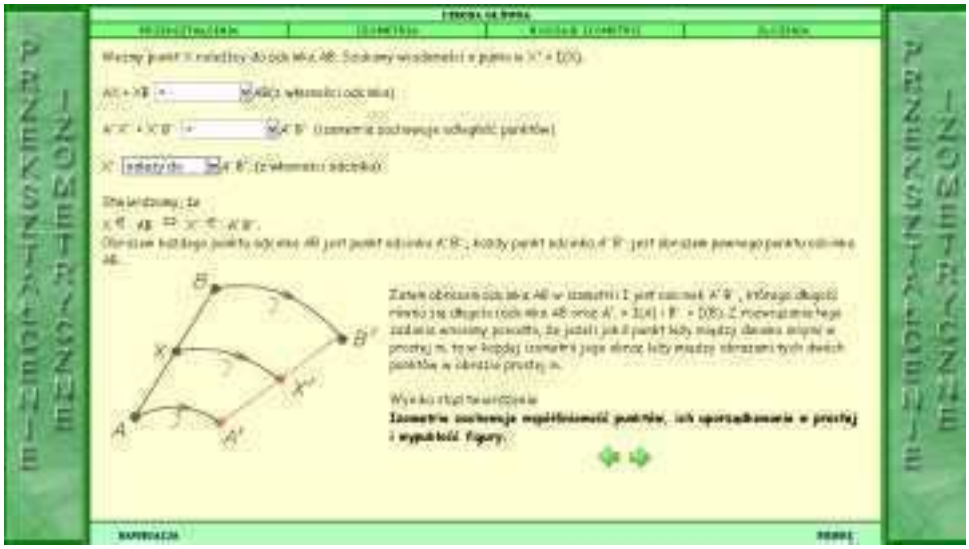

Figure 3. Example of short active proof.

The course also contains various types of tasks and problems. Using the course, solving the problems, students can evaluate not only their knowledge and acquired skills, but also the stage of understanding the properties of transformations. A part of problems should be conceived so that their solution allows us to make certain observations, notice properties and make correct notations. There are many types of tests, for example, a single and multiple choice, a task to make opinion about truth of a statement (Figure 4), a problem of the type TRUTH/FALSE, a complementing text with gaps and others.

Every time when students display each page of the course, all the problems are "new", they regenerate. This allows to avoid mechanical approach to solved problems. Order of problems or answers changes each time automatically (numerical data also change). Each time a computer shows only a part (chosen problems) from the large base of questions and tasks. Additionally, the course

has lists of thematic tasks in text files which students can use for independent repeating the composed material.

The huge advantage of material prepared in such a way is individualization of learning process. A student himself decides how he can work with the course. The accessibility of material, the way and form of work with it allows students to decide how much they are engaged and how many time they spend on it. Students can pass the chosen part of materials many times for repetition or for supplement knowledge.

Figure 4. Example of self evaluation task.

Some fragments of the course also contain additional tips and information which students can display if they recognize that they need them. There are also some curiosity facts in the course such as, for example, physical look at mathematical transformations, materials relating to utilization of geometry in physics, and also some popular mathematical theorems and figures of their discoverers.

3. Conclusions

The described course can be used by e-learning platform or by Internet website (what is more and more popular solutions). Such an approach to process of teaching / learning based on traditional method supported by online

materials (blended learning) allows us to approach mathematics in the functional way. The bases of this conception were founded by A.Z. Krygowska, and she said that it is unusually essential conception because "*the efficient character of mathematics comes out in the pupil mathematical language in every situation*" [3].

The described conception concentrate on solving problems through executing consciously actions. Pupils can name and rank them. The search of the solution can be active: the use of the method of tests and mistakes, or through utilization of already known schemes. The use of such e-learning course allows us to pass every stage of the solution step by step. A teacher is able to organize sensible problematic situations and lead pupils from concrete actions through conceivable ones to mathematical abstractions.

The course based on blended learning method has one more advantage – the phenomenon of social facilitation [4]. It consists in such a fact that new material is assimilated more easily without observers. The stress does not generate, a pupil does not act under the pressure. He works in the own pace, in conditions convenient for him. A teacher ought to turn the attention at this fact when planning work for students. The first contact with some new problems can be held by e-learning platform.

The described didactic material was prepared, used and verified in classes with students of the first years of mathematics studies during several last years. The presented course turned out be also helpful for pupils of high schools interested in mathematics. Utilization of units of the course is possible as the whole course and as respective fragments. The course is also perfectly suitable as a material for use at extended lessons at high school (during additional activities) as well as a material for filling lacks of students knowledge at the beginning of mathematics studies.

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