PREPARATION OF TEACHING MATERIALS ON SELECTED MATHEMATICAL TOPICS FOR DISTANCE COURSES

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ABSTRACT

The purpose of the presentation is generalization of teacher's work with students at Kharkiv G. S. Skovoroda Pedagogical University, faculty of physics and mathematics, specialty «mathematics and informatics (information science)». The aims of studies are formalization and representation of educational material on the topics "Symmetry" and "Polyhedra". Further use of this material in the system of distance education in Ukraine is supposed.

Keywords: distance courses, teaching materials, mathematical topic «Symmetry».

Introduction

One of the main directions of distance education development in Ukraine is teacher training. Many universities and specialists in this field should contribute to the creation of whole-Ukrainian teacher training system in distance education. Some experience in this field has Kharkiv G. S. Skovoroda Pedagogical University. The work in the area of distance education is carried out together with National Technical University (Kharkiv Polytechnical Institute) [1].

The program of training teachers in distance education includes such issues as computer literacy, basic knowledge of Internet and distance education, psychological and pedagogical issues of distance education, hypermedia in distance education, technology of distance course design and distance course management, managing the quality of distance education, tutor training for distance education [2].

Since 2000 the research laboratories of distance education of both universities started inviting teachers for professional training. As a result a trainee must work out a small distance course.

The presentation is devoted to one of such works - the representation of an educational material on the selected mathematical topics. The students – future teachers of mathematics - train during the course of informatics. The database, created by the students, consists of small units of teaching material.

Topic «Symmetry». The Example of Its Formalization and Representation

One of the most important directions in the teaching course of informatics in our university is the study of the ways of constructing training programs for high and higher schools. Undergraduate students train during this course and writing the diploma works.

In the process they consider the following topics:

- Psychological and pedagogical principles of constructing programs;
- Functional peculiarities and structure of hypertext;
- Use of the program package PowerPoint, HTML language, visual programming languages, other program environments for building of teaching programs on the hypertext base;
- Computer graphics as a tool of preparing illustrations to the teaching programs.

As a result of work in this direction was the creation of educational course with the appropriate educational materials: a program of the course, a hypertext manual, a course of lectures and practical training, materials for discussion.

A program of the course includes subjects:

- symmetry as the special kind of geometrical law;
- symmetry and geometry of natural forms;
- movements of the first and second kind;
- composition of movements.

A large attention in the course was given to study of the topic "Ornaments". The students participated in developing the hypertext manual "Ornaments". The hypertext manual gives the concept of an ornamental motive. The electronic textbook offers exercises and individual tasks. It contains samples of simple tasks for solving in small student groups.

The manual consists of two parts: the first part titled «Drawing ornaments» describes various types of ornaments; in the second part titled «The graphical editor Paint» instructions are given for drawing illustrations.

The manual tells that the concept of symmetry is one of fundamental concepts of mathematics. The symmetry was studied by artists, mathematicians, naturalists and philosophers [3]. The manual describes the peculiarity and specifics of an ornament, various types of symmetric patterns, kinds of motives for

constructing ornaments (geometric, non-geometric, plant-like, animal-like, human-like and resembling various objects); also mentions borders, net ornaments.

An example of a sample page from the manual is shown in Fig. 1.

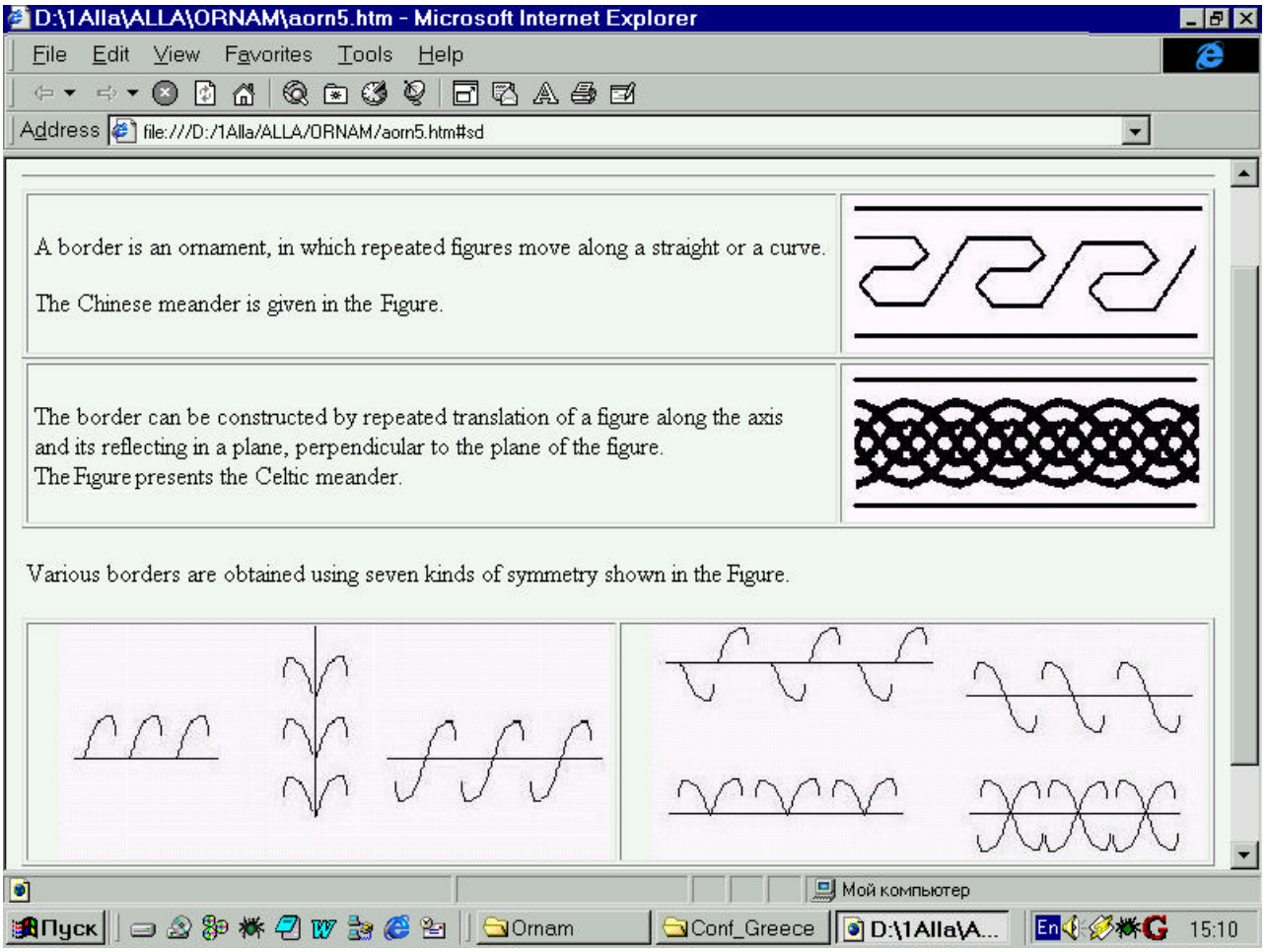

Fig. 1. A page from the manual

Before beginning the performance of the individual tasks it is recommended to tell the students about the remarkable feature of mathematics: in solving different problems quite unexpectedly appear similar concepts and methods. This miraculously similarity may be demonstrated on the example of the elementary transformation group. The transformation group appears everywhere, where symmetry is present. So, samples of architectural and art ornaments are connected with geometry: ornamental figures are symmetric.

Students used geometric and symmetric transformations: symmetry with respect to a point, symmetry with respect to a straight line or plane, rotation, parallel translation, homothety and similarity in their individual work.

Let's consider a simple example borrowed from the ancient Greek art. We regard the rotation of a plane, which maps the plane onto itself. In Fig. 2 the meander element is shown.

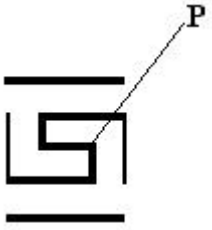

Fig. 2 A meander

The border in Fig. 3 is obtained from the meander by means of the rotation. The rotation axis passes through a point P perpendicular to the planes of the image. The rotation is done by the angle of 180° (we have the second order rotation axis). The border unlimited from the left and from the right has rotation axes of two types. The rotation axis of one type passes through any point equivalent to the point P. The rotation axis of another type passes through a point of other kind. Around of each of axes it is possible to carry out turn on 180°. Thus, in presenting this topic the question may be raised on the second rotation point of the border.

Fig. 3. A border

The patterns connected with this topic are presented in Fig. 4.

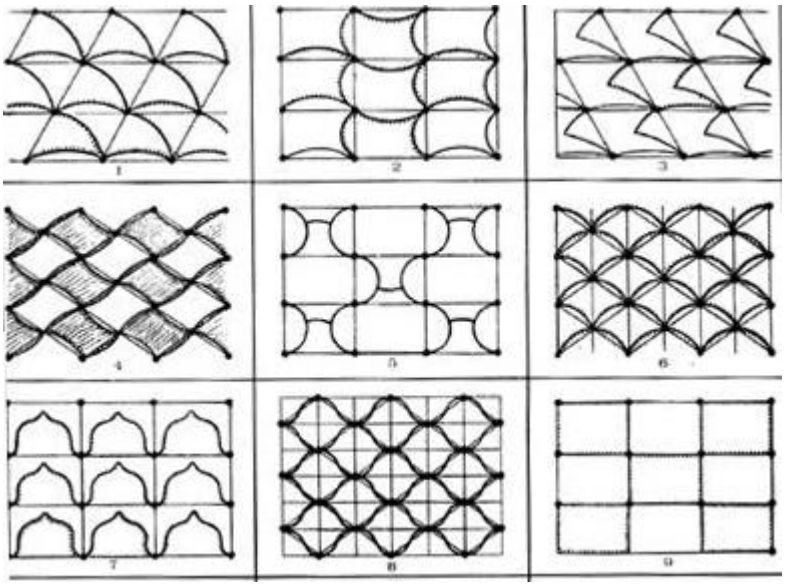

Fig. 4. Some patterns for the tasks

The illustrative material obtained as a result of solving such tasks, enables students to draw conclusions:

1) Any symmetry operation is a movement, and under its action the most part of pattern changes the position.

2) If any object possesses a symmetry element corresponding to the symmetry operation, which it undergoes, then the operation does not change the external sight of the object.

It permits one to classify objects according to those symmetry operations, which leave the objects invariant, and owing to this to reveal their internal essence.

The students' samples are a part of an educational material on the topic "Symmetry". The samples collect in the database. The databases prepared by students contain figures, solved tasks, and text problems. The students' database contains materials for their use at different levels of displaying an educational activity.

In parallels the instructor or teacher forms the corresponding knowledge base. It contains the needed theory, practical skills, tasks and links between them. This set of items and connections among them is called the logical structure of a teaching material. Depending on the teaching purpose elements and connections between them are determined in different way. Two examples of different splitting of

teaching material are the consideration of subtopics of a teaching course on the one hand and the analyses of concepts entering this course on the other hand. In our case we have version 2.

Elements of the considered material also include the fragments of the preceding materials of the course. In Fig. 5 the classification of movements is shown used in constructing the semantic network. It reflects the structure of the teaching material of the topic «Symmetry».

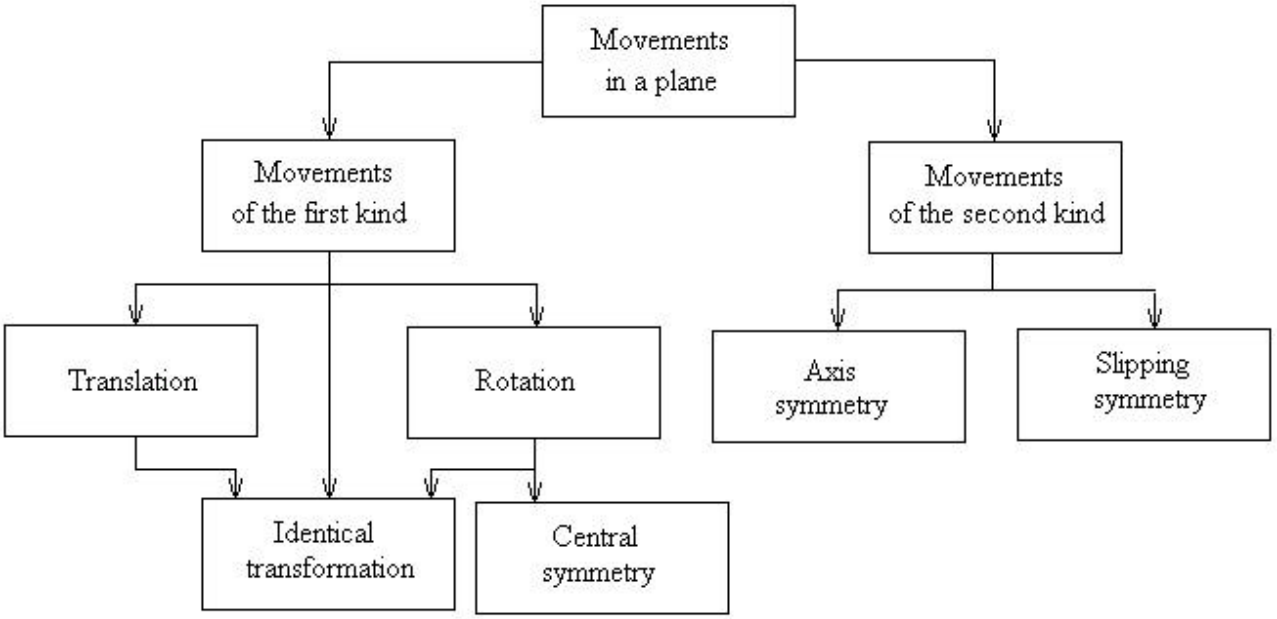

Fig. 5. A classification of movements

The educational tasks look like exercises, control questions, which are usually resulted at the end of the units of the textbook.

The structure of a concrete course is a subset of the object domain model.

The structure of an educational material includes theoretical elements of an educational material and connections between them. They form its theoretical substructure.

The theoretical knowledge is a basis for formation of the appropriate knowledge at trainees of distance courses.

A practical substructure describes the samples of activity and connections between them.

Practical skills are a set of the needed algorithms and activity samples.

A common substructure of educational tasks includes the educational tasks in the terms of elements of these two substructures.

In the practical part we distinguish between two classes of elements: basic skills and formed skills.

The basic skills are the activity samples present in the current teaching material; they are also used in the preceding teaching material.

Formed skills - samples of activity contained in the given educational material and which was not met in previous educational materials.

Therefore large attention in the manual is given to examples.

Let us consider an example of the structure of teaching material in the part «Central symmetry ».

We shall start with theoretical elements. Consider definition. Objects, that have a point O, such that if for any point Õ of each object there exists the point $Õ_1$, such that lies on the straight line ÎÕ at the distance $ÎÕ_1$, equal to ÎÕ, are called center-symmetric relative to the point Î.

Exercises.

1) Prove that if a figure has two symmetry centers O and $Î_1$, then it has an infinite number of such centers and the figure is unbounded. The examples of such figures are a straight line, a strip and a circular cylinder.

2) Prove that if a figure has three centers of symmetry O, $\hat{I}_1$, $\hat{I}_2$ that do not lie on one straight line it has an infinite number of centers on a plane $\hat{I}\hat{I}_1\hat{I}_2$. They form a parallelogram lattice.

3) Prove that if a figure has four centers of symmetry that do not lie on the same plane, it has infinite set of centers. All these centers form a parallelepiped lattice.

Questions.

1) How many centers of symmetry have a straight line, a plane, 3D-space?

2) Give examples of 1D objects which have: à) not more than one center of symmetry, b) infinite number of symmetry, c) do not have symmetry centers at all.

3) Is it possible to fill 3D-space with regular hexahedral prisms?

Practical skills.

1) Construct center-symmetric cube vertices images with respect to the points: a) the intersection of the cube diagonals, b) one of the cube vertex.

2) Which regular polygons can cover the 2D-plane? Construct an example.

The result of work of the students during one semester consists of 50 pages of the electronic tutorial in HTML language and from more than 100 illustrations. Database includes exercises, control questions on topics, samples of the tasks.

It is clear that general (analysis, synthesis, comparison, abstraction, concretization, generalization) and specific (determining the concept and the opposite operation) intellectual operations enter to the structure of the cognitive activity while mastering new mathematical concepts.

The object domain «Polyhedra» is processed in the similar way as «Symmetry». The work is based on Ref. [4].

The illustrations of the regular, semi-regular, star-shaped polyhedrons and some models of polyhedrons, exercises, and questions on topic have come in the database on a topic "Polyhedra". This work was realized in Visual Basic language.

Conclusion

This work describes an object database: its contents and how the students created it.

The peculiarity of the databases is the fact that they include both theoretical elements and samples of practical activity, and a way of combining these two levels.

We further shall expand and modify a database, especially in the direction connected with the construction of educational material of the topic «17 crystallographic groups».

As a whole, the idea of the presentation is forming visual and intellectual vision, visual perception and thinking, external visible and internal figurative form. Thus, the formalization of educational material is shaping intellectual and visual vision of future teachers [5].

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