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Methodology for Completing Test Tasks of Different Degrees of Complexity in the Computer Graphics Display

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Abstract: Increasing the effectiveness of education in the process of teaching computer graphics lies in organizing the educational process using new information and communication technologies, as well as monitoring the quality of mastering units of the educational module. Taking this into account, the article theoretically analyzes the methodology for creating test questions in computer graphics and a number of related graphic disciplines. It has been determined that factor theory is related to graphic sciences. As a result, the structure of a system of three-level test tasks based on specific formulas and their coefficients was studied. In addition, a four-category student assessment system was tested using a general automated software tool for questionnaire control. Based on the results, a mathematical and statistical analysis was carried out and the range of variation of the four categories was shown.

Keywords: factors, number of factors, degree of difficulty of the test, degree of difficulty of the test in the discipline "Computer Graphics"

Introduction

Nowadays, the development of a graphic education system involves the use of convenient tools and methods for comprehensive monitoring of the level of knowledge and skills acquired by young specialists. These means today consist of widespread oral, written and test types of control, and all of them are the main guarantor of strengthening the knowledge acquired by students.

For example, when monitoring students' knowledge in the disciplines "Descriptive Geometry and Engineering Graphics" and "Computer Graphics," testing is used along with oral and written types of knowledge control. As we know, these days this type of control is more often used on the basis of computer technology and this gives more effective results, but in order to further improve the quality of education, develop students' desire to acquire knowledge, identify the most capable students in the field of graphic education and stage-by-stage the development of their knowledge and skills is an urgent problem - the creation of a methodology for compiling test tasks of varying degrees of complexity and their development [1].

These factors are interrelated and they are used as a unit of measurement when assessing the degree of knowledge of students in the discipline "Computer Graphics". The more the student's knowledge corresponds to these factors, the more likely it is that he will be able to perform tasks of a certain degree of complexity.

Danish scientist G. Rasch [14] introduced a new unit of measurement "logit", which allows reflecting on the same scale the level of knowledge of the student and the degree of difficulty of the test [15].

The degree of knowledge of a particular student is determined by the number of points he scored based on the results of the test. $Q_i = \ln(p_i / q_i), i = 1,2,...n$ (1)

Here: n is the number of subjects, pi is the proportion of possible correct answers to the number of tests; qi – possible incorrect answers to the number of tests.

The complexity of test tasks is determined using the same principle.

$$\beta_j = \ln(p_j / q_j), j = 1,2,...n \quad (2)$$

Here: n is the number of test tasks, pj is the proportion of possible correct answers of all students; qj – possible incorrect answers of all students.

In determining the complexity of tests in the Computer Graphics discipline, factors formed by the test takers play an important role, and taking into account the number of these factors, the degree of complexity of a given test can be assessed.

To complete a test of the 1st degree of difficulty, a student must demonstrate at least ≥2 factors.

To complete a test of the 2nd degree of difficulty, a student must demonstrate at least ≥4 factors.

To complete a test of the 3rd degree of difficulty, a student must demonstrate at least ≥6 factors, etc. This principle is used to determine the degree of difficulty in tests of even greater complexity.

For now, we will assume that there are 3 degrees of complexity; to solve tests of each degree of complexity, students must have the above factors, and we will denote this in general terms as

$F_s = F_i, F_j, F_k \ldots\ldots F_m$ (3)

This means, based on the results of G. Rush's research, the degree of knowledge of each student is determined by formula (1). Taking into account the features of computer graphics tests, we can note that the pi given in formula (1) - the proportion of possible correct answers to the number of tests and qi - possible incorrect answers to the number of tests, regardless of the degree of complexity of the tests being solved, shows the relationship between the level of knowledge of the student and factors required from the student. (4)

$$\begin{cases} p_i \rangle q_i agar F_s > 0 \\ p_i \langle q_i agar F_s < 0 \end{cases} (4)$$

Since the way the student solved the test shows how much the necessary factors have been formed. If we designate these factors according to the degree of difficulty of the test Fi, Fj, Fk..... Fm then we get the following equation. (5) $\alpha_p \begin{cases} D_t^1 = F_i \\ D_t^2 = F_j \\ D_t^3 = F_k \\ \ldots\ldots\ldots\ldots \\ .D_t^n = F_m \end{cases}$ $i \geq 1,2$; $j \geq 1,2,3,4$; $k \geq 1,2,3,4,5,6$; m= i,j,k,…..r, (5)

$$\alpha_p = D_t^1, D_t^2, ..., D_t^n \ (6)$$

For example: in order to draw a straight line in AutoCAD, you need to select...

A) “Segment with lines” on the “Drawing (Drawing)” panel;

C) “Straight” on the “Drawing (Drawing)” panel;

C) “Halfline” on the “Drawing (Drawing)” panel;

D) “Arc” in the “Drawing (Drawing)” panel.

When performing a test of the 2nd degree of complexity, in addition to the requirements set in the test of the 1st complexity, the student is required to logically comprehend the test task, correctly carry out the solution algorithm and achieve a result. For example, in the first picture, identify the row in which Fig. 1. Is the correct algorithm for carrying out the external one indicated?

The radius of the circle is 50 mm.A) “Circle” is selected - the right mouse button is pressed and the line KKR is selected (as for radius) - the approximate points of the attempt are indicated - the radius of the circle is entered as 50 mm - Enter is pressed once.

C) “Circle” is selected - the left mouse button is pressed and the line KKR is selected (as for radius) - the approximate points of the attempt are indicated - the radius of the circle is entered as 50 mm - Enter is pressed once.

C) “Circle” is selected - the button is pressed and the line KKR is selected (as for radius) - the centers of the circles are indicated - the radius of the circle is entered as 50 mm - Enter is pressed once.

D) “Arc” is selected – the approximate points of the attempt are indicated – the radius of the circle is entered as 50mm – Enter is pressed once.

To complete a test of the 3rd degree of complexity, in addition to the knowledge and skills necessary to solve tests of the 1st and 2nd degree of complexity, a student is required to have a logical and creative understanding of tasks that have a step-by-step solution, the ability to make the right decision, obtain the result, analyze the result result.

For example, define the sequence of actions when arranging a given axonometric image using the “split” task (Viewports).

A) View menu – Viewports – New VIs – Four: evenly

C) Edit menu – Viewports – New VIs – Four: evenly

C) Drawing menu – Viewports – New VIs – Four: evenly

D) View Menu – 3D Views – New VEs – Four: Evenly

In implementing the above factors, it is first necessary to determine the students’ interest in the subject “Computer Graphics” using an automated “Questionnaire”. The “Questionnaire” determines the initial knowledge of students in the subject “Descriptive Geometry and Engineering Graphics”; using assessment questions of interest and attitude towards the subject, students are divided into categories. In order for students to master the subject “Computer Graphics” perfectly, they must have sufficient qualifications to work with graphic programs and carry out the design process based on the rules of the subject “Descriptive Geometry and Engineering Graphics”. Therefore, initial knowledge in the subject “Descriptive Geometry and Engineering Graphics” and interest in this subject are of great importance for the perfect mastery of the subject “Computer Graphics”.

When comparing categories, it is revealed that the R-category students know how to think creatively, they can achieve 86%-100% indicator. S-category students, can think creatively

partially, can achieve 71%-85% indicator. T-category students, have simple concepts in the subject, can achieve a 56%-70% score. The U category does not have simple concepts, it can be assumed that it can achieve a 55% mastery rate of the subject. (1.2) the results of the "Questionnaire" are determined by the following formulas:

$$n = \sum_{i=1}^{N} m_i, \; m_i > 0 \quad (1)$$

Here – contains the correctness or incorrectness of the answer, N is the number of questions, n is the sum of correct answers. View as a percentage of answers to the questions of the "Questionnaire":

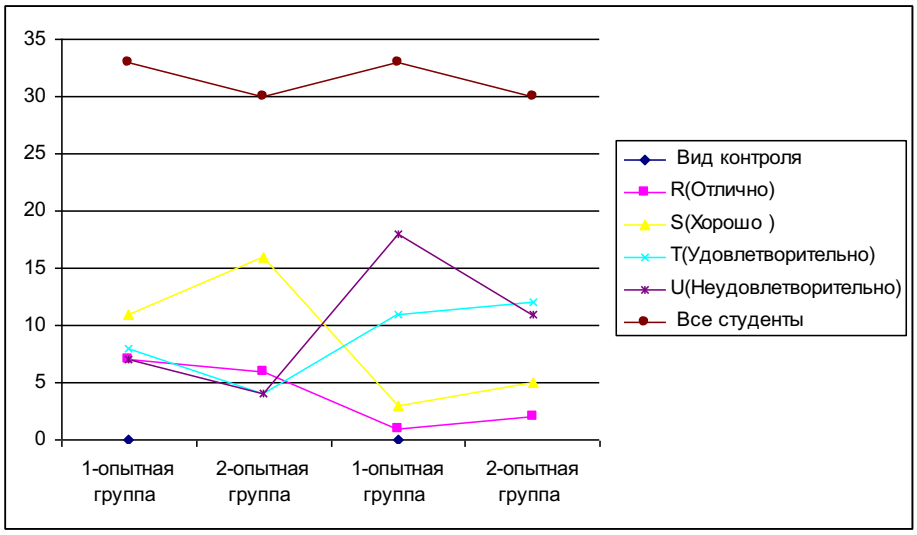
$$F = \frac{n * 100\%}{N} \quad (2)$$

N – number of questions, , n – sum of correct answers. Below are the groups that passed the test based on the created program. 1-table.

1 - table

Group name)	Type of control	R (Excellent)	S (Good)	T (Satisfactory	U (Unsatisfactory)	All students
1-experimental group	Results of the questionnaire	7	11	8	7	33
2-experimental group		6	16	4	4	30
1-experimental group	Test results	1	3	11	18	33
2-experimental group		2	5	12	11	30

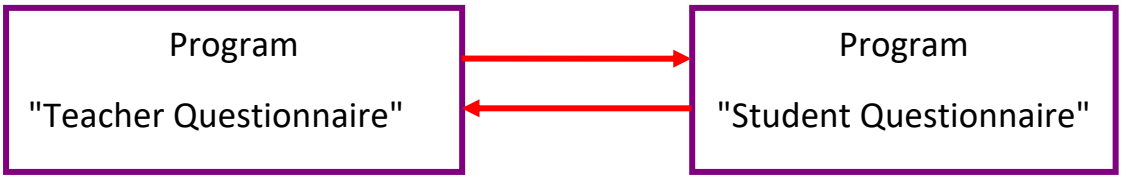
As can be seen from the table above, the results of the Questionnaire belong to the highest categories R(Excellent) and S(Good), and the results of the Test are lower. The indicators of students belonging to the T (Satisfactory) and U (Unsatisfactory) categories according to the test results occupy positions relatively higher than 1 - Fig.



1-fig. Comparison chart of experimental groups

Taking all this into account, an automated software system for determining interests, abilities and initial knowledge in the educational process was created, that is, the "Questionnaire" software. The software consists of two parts: "Teacher Questionnaire" and "Student Questionnaire". The automated software system is designed to work on the network; the "Teacher Questionnaire"

program is loaded into the server. The Student Questionnaire program is installed on other computers on the network. After installing the “Profile-teacher” program, it finds all computers with installed “Profile-student” programs and establishes a connection with them. The connection between the “Profile-teacher” and “Profile-student” programs is displayed in the following form: 2-Fig.



2-fig.

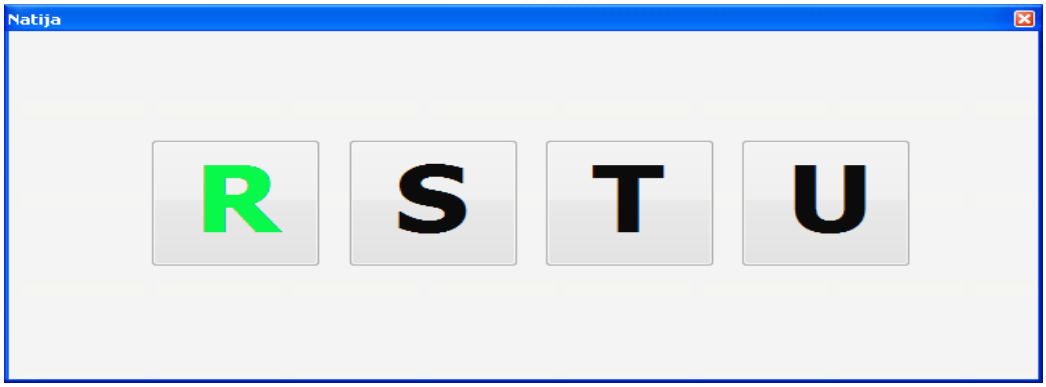
All data is stored in the “Teacher Questionnaire” program and is transferred to the “Student Questionnaire” program. This software can be used to monitor the interests, abilities and knowledge of students as a “Test” and “Questionnaire”. In the questionnaire-questionnaire given on the subject, the interests, abilities and knowledge of students are divided into 4 types using questions asked on the subject. 1) R-high degree, that is, knows how to think creatively; S - good degree, meaning he can think partially creatively; T - satisfactory degree, has simple concepts in the subject; U - unsatisfactory degree, does not have simple concepts in the subject.

This questionnaire is carried out at the beginning of the educational process and determines students’ interest in the subject “Computer Graphics” and initial knowledge. In order to conduct the automated “Questionnaire” program, 3 groups with an equal number of students were selected for experiments and experiments were conducted on the subject of automated software “Computer Graphics” based on the “Questionnaire”. According to the results of this experiment, categories were identified that determined the degree of interest in the subject “Computer Graphics”, abilities and initial knowledge of students and are shown in the table below.

2-tab.1 -таблица

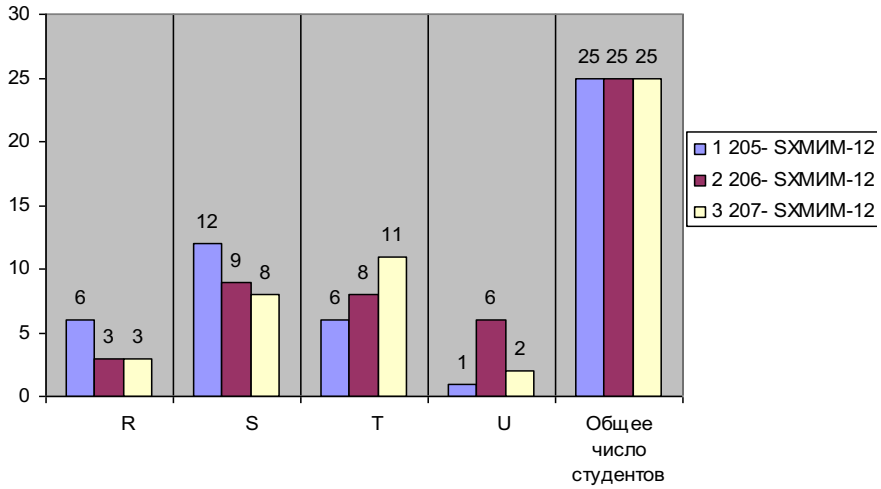
№	Group name	R	S	T	U	Total number of students
1	205- SHMIM-12	6	12	6	1	25
2	206- SHMIM-12	3	9	8	6	25
3	207- SHMIM-12	3	8	11	2	25

Based on the data given in Table 1. Group 1 has a high degree of academic achievement, interest in the subject, ability in them is high and the group is considered to have more opportunities in an atmosphere of creative thinking. In the 2nd and 3rd groups, the R-category indicator is the same, but as we see in the other groups, the results indicators show S2<S3 T2< T3 and U2 > U3, these signs, as mentioned above, are a kind of indicators of the categories S2 < S3 T2< T3 and U2 > U3. These results show that the performance of group 3 is higher compared to group 2, but if you pay attention to S2 < S3, you can see that the number of students with a good level in group 2 is greater than in group 3. This means that in group 2, the number of students who have the opportunity to achieve good academic performance may increase. These results give the teacher the opportunity to predict the degree to which students have mastered the subject. In 2-fig. shows a comparative diagram of the results of experiments carried out in three groups. The results of the experiments show that conducting an automated “Questionnaire” at the beginning of the educational process helps in determining attitudes and interests in the subject, their abilities and initial knowledge. 3-Fig.



3-fig. Software test result

In 2-fig. shows a comparative diagram of the results of experiments carried out in three groups. The results of the experiments show that conducting an automated "Questionnaire" at the beginning of the educational process helps in determining attitudes and interests in the subject, their abilities and initial knowledge.



4-fig. Diagram comparing 3 experimental groups

In the educational process through the use of a questionnaire, you need to pay attention to the following:

- the composition of the questions in the questionnaire, the focus on determining interests, abilities and initial knowledge;
- analysis of the results of the groups in which questionnaires were administered;
- determination by the teacher of the organization of the educational process based on these results.

The above factors are considered necessary means in increasing the efficiency of the educational process and serve as the foundation for the education system when introducing an automated assessment system.

Conclusions

Therefore, it is necessary to develop spatial imagination in students and create their skills in working with graphic programs, which is the main problem in the educational process of the subject "Computer Graphics".

To implement this during your studies, you need to use the following:

- determine students' interest and abilities in the subject using automated software systems;

- determine the educational methodology in certain groups, based on the results obtained (for example, the results of a “questionnaire” of group students);
- development of theoretical and practical topics based on 2D and 3D modeling;
- development of a software-pedagogical tool based on 2D and 3D modeling and implement it in the educational process;
- when mastering graphic programs, use methods for performing graphic tasks of the curriculum on a computer;
- establish automated multivariate test control;
- organize independent education.

Instead of concluding, we can say that the use of computer technologies at different stages of graphic education, helping future specialists to become excellent experts in their field, also provides them with modern knowledge and skills.

So, when compiling tests of varying degrees of complexity in the discipline “Computer Graphics,” the main role is played, first of all, by the requirements for the knowledge and skills of students, as well as the students’ compliance with these requirements. These are regarded as the above factors. As a conclusion, it can be noted that the use of tests of varying degrees of complexity in the objective assessment and development of students’ knowledge and skills will bring positive results and raise the effectiveness of training to a new level.

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