EFFECTIVENESS OF COGNITIVE DIGRESSIONS IN CLASSES OF GENERAL TECHNICAL DISCIPLINES IN INSTITUTIONS OF HIGHER EDUCATION OF AGRO-TECHNICAL DIRECTION

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Abstract. The article presents the results of pedagogical research on the impact of the inclusion of cognitive information in educational classes in the study of general technical disciplines on the example of teaching technical mechanics at the College of Agricultural Engineering. The main purpose of the work is to study the impact of involvement in the explanation of cognitive information on the effectiveness of theoretical classes and the quality of knowledge acquisition by students. The study was conducted in the educational process of studying the discipline Technical Mechanics in parallel groups. Before the research in the control and experimental groups, the level of residual knowledge on previous topics of the course and partly on related disciplines was measured. Methodological materials were developed for the experimental group with the inclusion of cognitive information, which to some extent relates to the topics studied. Whereas in the control group teaching took place in strict accordance with traditional teaching materials. As a result of the study it was found that the involvement of cognitive digressions in technical mechanics increased the overall activity of perception and assimilation of educational material, which is expressed in better improvement of both qualitative and quantitative results in the final test in the experimental group compared to control. The results of the study showed that in the groups in which “interesting” explanations were used compared to the initial data of the level of residual knowledge, the efficiency of learning increased by 96.4%, while in the control group this figure was only 25.6%. Thus, the study confirmed the hypothesis that the cognitive presentation of technical sciences may contribute to a more attentive mastery of the subject and, consequently, better learning of the material.

Keywords: cognitive information, retreat, activity in class, technical mechanics, residual knowledge, final control.

Introduction

In the modern educational environment, which has already accumulated a huge amount of knowledge, the important task of teaching and education – to pass on the experience of mankind to posterity - has become very difficult. Almost every field of knowledge that humanity must continue and pass on through educational institutions, has already absorbed everything that could be discovered, although again and again something new is opened and crowned science opens more and more reserves, absorbing various theories and discovery. Unfortunately, this cannot be said of educational programs, which strictly regulate the list of issues to be addressed within the allotted number of hours. Often such information is quite rich, which causes the effect of formalizing the presentation due to the need to contain huge amounts of information (we are talking about creative teaching and not the translation of the textbook) in the meager framework of training sessions. Of course, there is such a form of studying the material as student independent work. However, in order for a student to really earn money himself, he needs to be charged during face-to-face meetings. Such a charge can be provided as deep but useful knowledge for the student, or vivid examples from practice, or other means and techniques. In our opinion, the last of these factors is the best to improve – to involve in the presentation of vivid cognitive information.

Analysis of recent research and publications on the problem. The question of the need for quality improvement of teaching in modern higher education was raised in a huge number of dissertations. Most authors offer their own solutions to this problem. However, we can identify some groups of scientists for whom the increase of cognitive activity is through the management of their activities in the classroom, including attracting interesting digressions. These are in particular A. I. Gridenko, G. O. Ball, O. I. Lyashenko, A. M. Sohor, O. K. Filatov and others [1-9].

As you know, students divide all disciplines into boring and interesting. To a large extent it depends on the skills and pedagogical skills of the teacher. The ability to create interesting lessons, logical chains of explanations that attract students’ attention and nurture the desire to continue to study the material of the subject, has a positive effect on the process of learning the material. Research indicates that when a student’s curiosity or interest is activated (what Dewey refers to as “catch”), the student is more likely to engage with the material and look forward to more, which, in turn, increases potential learning benefits [10-13]. This suggests that ideally, educative experiences should attend to the aesthetic as well as the rational and logical [13]. However, studying the aesthetic dimension of learning experiences has been largely ignored in research on the exact sciences and is an area of need [14].

Finding a way out of a difficult situation when students stop perceiving educational material is not an easy task, especially when it comes to presenting such disciplines, which are full of complex mathematical calculations, rules, definitions and inferences. Almost all disciplines of physics, mathematics and general engineering have such properties. The search for possible methods of "interesting" lessons continues and in some areas there is already some experience. In particular, research in the field of attracting interesting information in mathematics lessons can be called close to our topic [15; 16].

The work of students in classes on technical mechanics in higher educational institutions of I-II academic years usually requires a significant amount of willpower and attention. Thus, when studying it in the first semester of the second year, according to the work program, students must study all theoretical mechanics (see Figure 1), knowledge of which has been accumulated since ancient times (the term "mechanics" was introduced by the great ancient philosopher Aristotle/384-322 BC/) and throughout history has been constantly enriched, even in the Middle Ages, when the development of science was hampered by the church. Thus Galileo Galilei/1564-1642 /, being cursed by the church for his astronomical discoveries, resisted the materials, believing that it was the safest and least seditious object that could only then be imagined [17]. And add here such names as Archimedes, Robert Hooke, Isaac Newton, Leonardo da Vinci - none of them left technical mechanics without a huge scientific achievement. Of course, the discipline, which is studied during the course of 216 hours, of which a little more than 100 classroom, if even a touch of all its reserves, will turn into a teacher speaking the necessary material – no time for conversation, discussion, and even more role play [18]. However, there are great doubts about the effectiveness of such classes – cognitive activity will not be stimulated enough, even the most inquisitive.

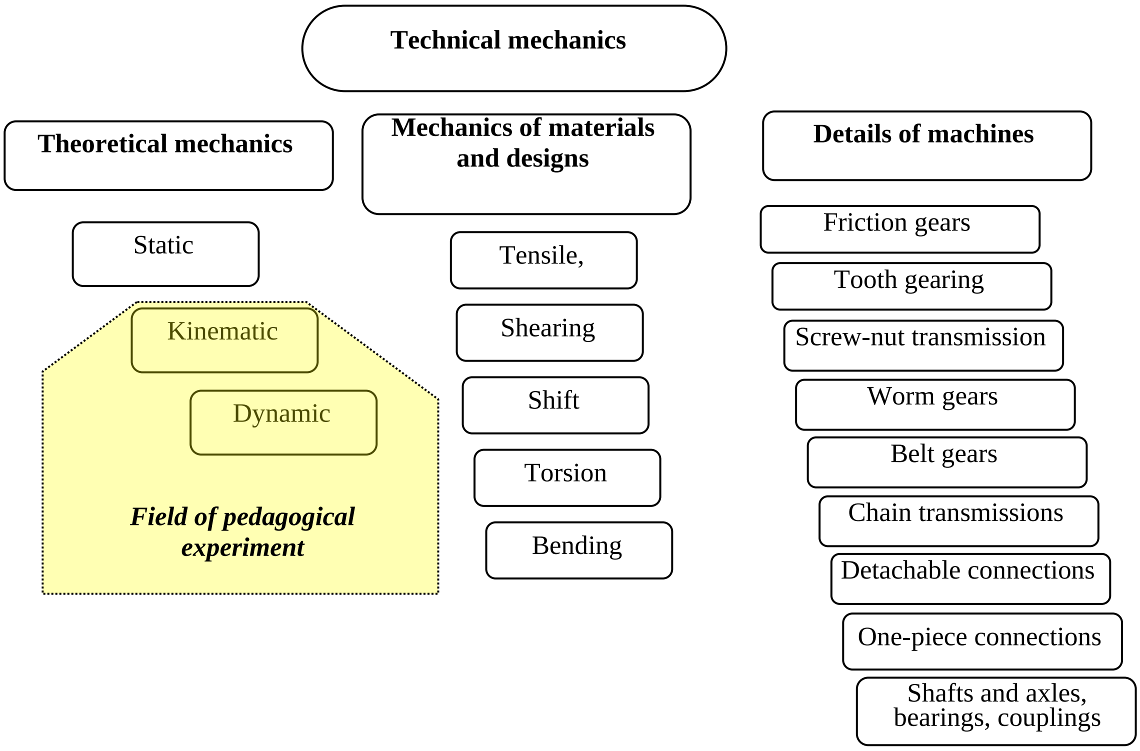


Fig. 1. **Structure of sections of the discipline Technical Mechanics**

We hypothesized that the effectiveness of technical mechanics can be significantly increased by involving a variety of information of cognitive content. An experimental program was developed to test this assumption. To do this, "Abstract of interesting lectures" in all sections of theoretical mechanics: statics, kinematics and dynamics is presented [19; 20].

Materials and methods

This development is designed to localize the problem of improving the efficiency of learning material on an interesting presentation of the material on the subject of technical mechanics at the level of educational institutions I-II levels of accreditation, which is not found in the works of other scientists.

Formulation of the goals of the article. The main purpose of the work is to analyze the effectiveness of the presentation of theoretical material with the involvement of interesting information. To achieve this goal, it is necessary to solve the following tasks:

- identify similar knowledge groups for the experiment;
- control the residual knowledge of the course of physics;
- after presenting the material in two groups according to different methods to conduct a final control;
- analyze the results and draw conclusions.

The experiment was conducted on the basis of the College of SAEUP, where for several years two groups of second-year students of the mechanical department were selected: M-211, M-221. The number of students was identical, but, unfortunately, there was no absolute equality in the level of knowledge. In order to obtain more obvious results, the group whose initial knowledge was lower was chosen as the experimental one. The nature of learning material by different methods from the sections “Kinematics” (8 hours of theoretical classes) and “Dynamics” (6 hours) was studied.

Results and discussion

Before the experiment, students were asked to answer a number of questions that students studied while studying physics in the section “Mechanics”. The results of the assessment of residual knowledge confirmed a qualitatively higher level of preparedness in the control group compared to the experimental – the average score of 3.25 and 2.09, respectively. In group M-211 the material was submitted according to the usual method. In the experimental group, teaching was conducted by another teacher according to the above-mentioned “Synopsis…”, which in addition to the main material contained the following information:

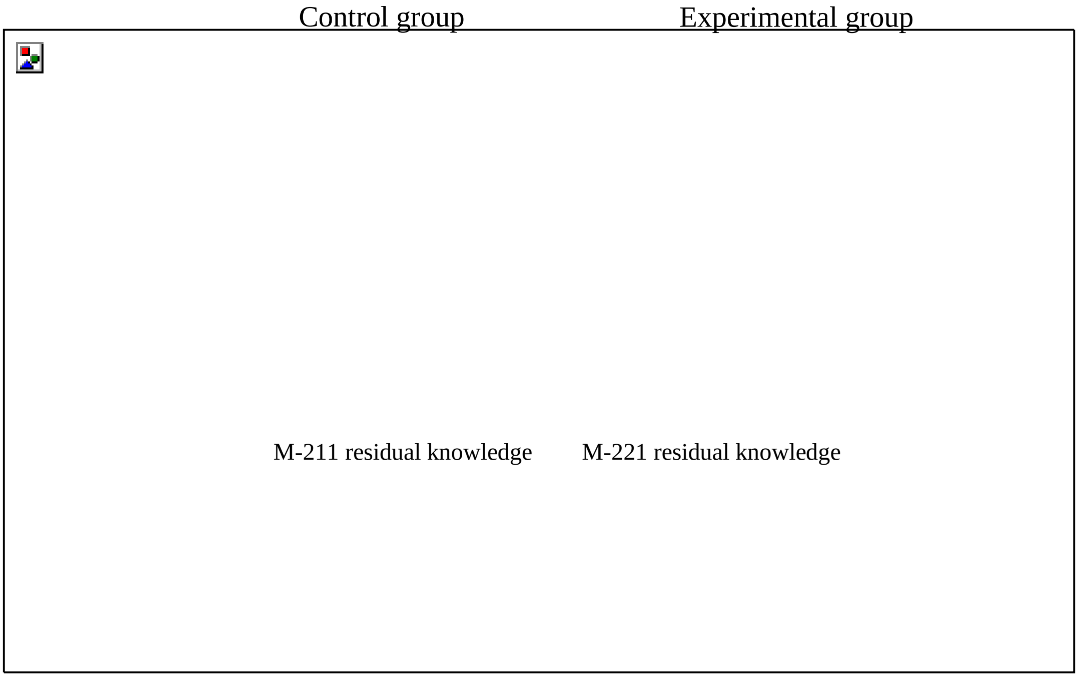
- in the study of speed - speed from the theory of relativity of Einstein;
- in the study of constant and uniform movements – analysis of the movement of a parachutist or a drop of rain (why it falls from a great height at g = 9.81 and does not injure a person);
- in the study of complex motion - the case of a French pilot who caught a bullet in his hands;
- when studying the theorem on the addition of velocities - the motion of the train wheel is analyzed, in which there are points moving in the opposite direction to the destination.

This is by no means a complete list of cognitive issues that have been proposed to be addressed. This information was provided as students grew tired, to attract attention and return the lesson to its natural course. During such retreats, there was usually a revival of the audience. Students were often asked to cite more such examples, but due to lack of time, they had to limit themselves to one or two, and for a lesson up to five such indentations, which took up about 20% of the study time.

After working on all topics, students wrote a final test, which included the test questions provided by the program. The results of data processing are presented in histograms of Figures 2, 3. Thus, Figure 2 shows the results of the scores in the control and experimental groups. The values are given as a percentage of students who scored 1, 2, 3, 4, etc., respectively, points. The histograms above clearly show how much the results have changed during the knowledge test and the final control. These data show that at the initial stage, the training of students in the control group significantly prevailed. The average score was 3.25, while in the experimental only 2.09. When passing the topics by different methods, the test showed the following results:

- the control group from 3.25 the average score decreased to 3.04,
- the experimental group increased from 2.09 to 3.39.

These figures fully confirm the correctness of the chosen method.



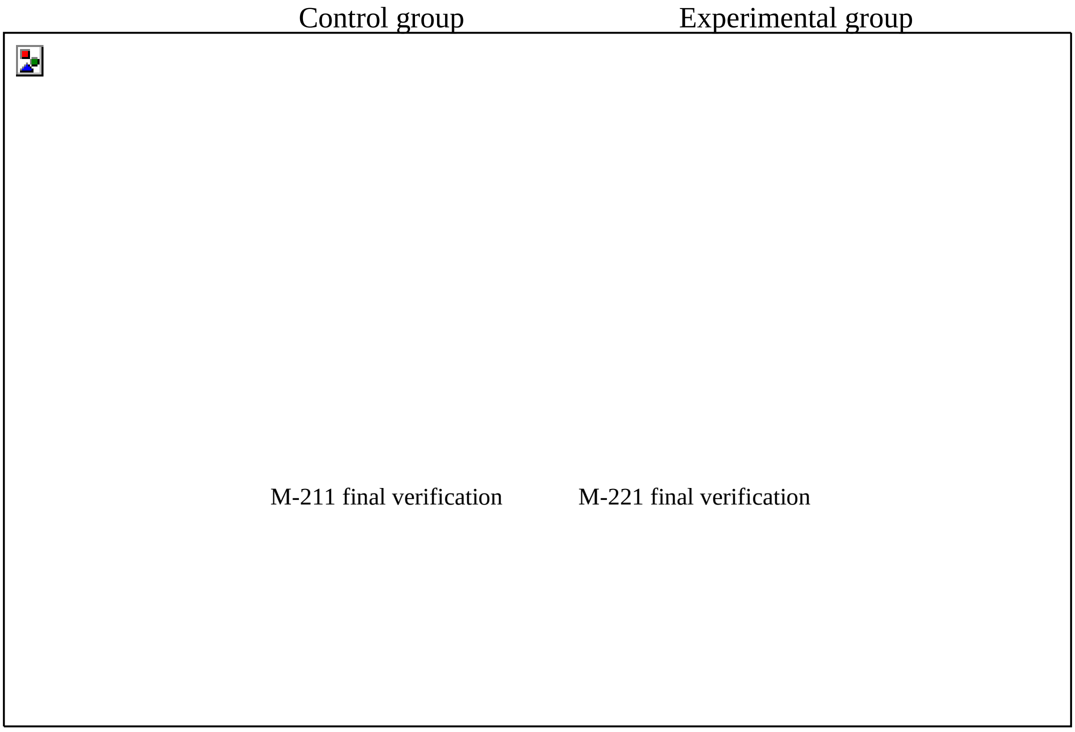


Fig. 2. **Histogram of the test results of residual knowledge and final control:** figures in the legend show the number of correct answers, the percentage on a scale of the percentage of students who received the corresponding result

The results of the work were analyzed and the following pattern was observed, illustrated in Fig. 3.

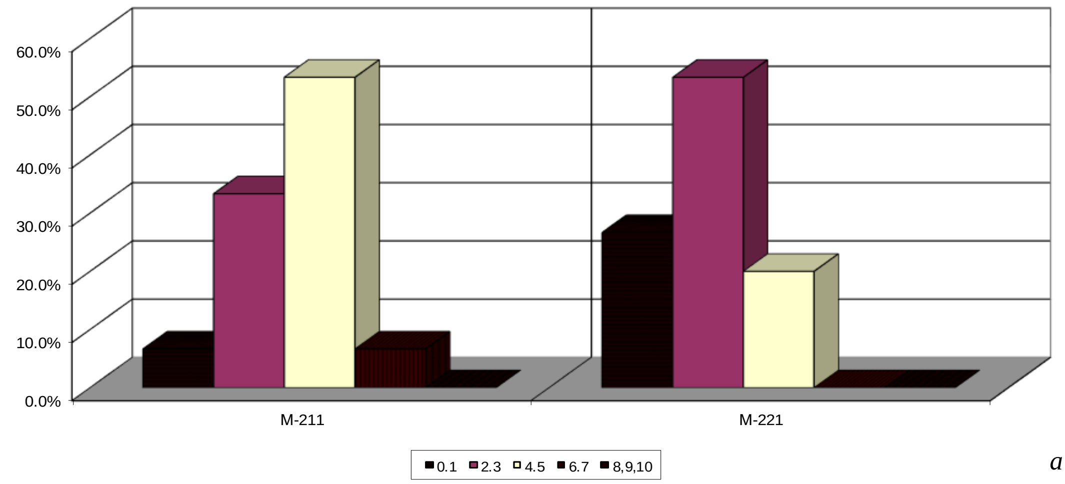
If during the first test students were reluctant, and perhaps fearful, to answer questions, as evidenced by the large number of submitted works with completely unfilled fields, then at the end they became much bolder and more willing to answer the questions. This is especially noticeable in the control group. If in the test of residual knowledge in the experimental group there were 26% of students who actually passed a blank sheet (in the control - 7%) and 53% (33%), who showed an extremely low level of activity within 2-3 answers, then at the final control there were no unanswered forms at all (in the control remained at the same level), and low-active decreased to 14.3% (12.5%).

Here are the following data:

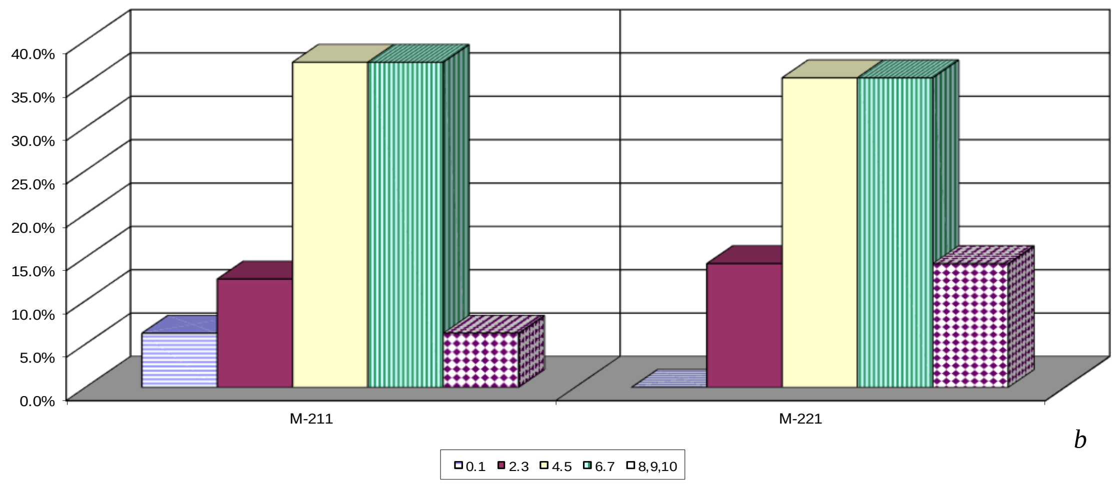
- control group from an average of 3.9 correct answers rose to 4.9,
- the experimental group increased from 2.8 to 5.5.

All this testifies to the acquisition of students' confidence in their knowledge, which also characterizes their informational knowledge and ability to apply it.

Control group Experimental group



a



b

Fig. 3. **Histogram of the number of answers (correct and incorrect)**:
a – when checking the residual knowledge; b – during the final control

Conclusions

Thus, the experiment conducted on the basis of the College of SAEUP fully confirmed the hypothesis that the cognitive presentation of technical sciences can contribute to better learning. The results of the study showed that in the groups in which "interesting" explanations were used compared to the initial data of the level of residual knowledge, the efficiency of learning increased by 96.4%, while in the control group this figure was only 25.6%. However, we note that such a big difference is also due to the fact that the "interesting" lessons intensified those students who were initially passive and gave answers to selected questions.

After repeated qualitative testing of such classes, we could talk about the possibilities of this theory – in particular, the wide involvement in the educational process of cognitive information.

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