TECHNICAL AND NATURAL SCIENCES TEACHING AT ENGINEERING FACULTY OF FPTM UJEP

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Abstract. The content of teaching of technical education at various levels is the task of creating the students' relationship to the work, materials, labor and equipment manufacturing practice. It creates the basic skills and habits while working with simple tools and machines used also for small home maintenance. Yet, it is also necessary to instill in students the relationship and attitude towards technical and natural sciences as a whole. Now there is catastrophic lack of interest in this type of education. Qualitative interdisciplinary instruction linking the technical and scientific fields is the basic field of education. It creates a relationship with the students in these fields when deciding on the level of study and on the choice of their profession. This article deals with physics applied into technical practice by means of the technical teaching subjects. Application of technical physics to technical problems gives good study results and it increases technical creativity and technical thinking of students. Usages of methods of applied physics are a good decision at technical universities. This hypothesis leads to increasing of the adoption level of technically oriented curriculum, what is mentioned in the research description of this article.

Keywords: technical and natural science, technical education.

Introduction

The content of teaching of technical education at various levels is the task of creating the students' relationship to the work, materials, labor and equipment manufacturing technology. Yet, it is also necessary to instill in students the relationship and attitude towards technical and natural sciences as a whole. Now there is catastrophic lack of interest in this type of education. Qualitative interdisciplinary instruction linking the technical and scientific fields is the basic field of education. It creates a relationship with the students in these fields when deciding on the level of study and on the choice of their profession. To secure active development of the students' creative abilities the educational process must be deliberately and systematically prepared.

1. Methods and materials of research

The research method is based on comparison of two different groups of students – experimental and control group. The students in the control group are taught by "ordinary" methods, without any integration of other new methods. The students in the experimental group are taught by means of new methods, using applied physics into technical practice. All study results are known from the students' evaluation on their students' agenda. All data are treated by the statistical method and the result supports the hypothesis.

2. Teaching of physics at technical universities – experiment description

Technical Physics at a university of technical nature is definitely passed to students in a different form than Physics taught at the Faculty of Science. One of the good ways of teaching the abilities is connection of the theoretical part of the training challenging the curriculum with practical and easily verifiable practical examples. Educational effect of remembering is then considerably higher. Finally, practical examination of the patterns of the subject matter has a significant impact on the understanding of the issue and on the development of technical thinking.

The basic consideration gave rise to the experiment. This experiment was focused on the quality of the subject matter physics and technical skills of student's knowledge applied to engineering practice.

As a research scale served the student's evaluation in several classification levels:

- in a theoretical study of technical physics;
- when applying this knowledge to other technical subjects such as mechanics or engineering technology;
- application of theoretical knowledge in engineering practice.

2.1. The principle of theory curriculum linking to the engineering practice

It was constantly emphasized during the experiment, that the experimental operation was closely connected with engineering practice.

These were mainly the main topics in the field of mechanics and engineering technology.

Each area of study has to be defined by characteristic educational areas, which define the status and importance of educational areas in technical education. The integration of educational content must respect the logic of construction of the study fields. The basic condition for functional integration is a qualified teacher. Cooperation of individual teachers is very important.

During the experiment several of classical themes enriched by the connection with engineering practice were used.

2.1.1 Mechanical stress

The method of determining polaroscopic tension in specific components and its possibilities of using in the teaching of physics at the technical universities is not new. Photo elasticity is one of the simplest, fast and yet slowly forgotten methods to determine the mechanical stress in the models of loaded parts. However, such methods used in technical education are substantially increasing the level of the acquired knowledge and skills. Simultaneously with the proper mentoring a teacher can achieve a significant impact leading to increased technical thinking of students.

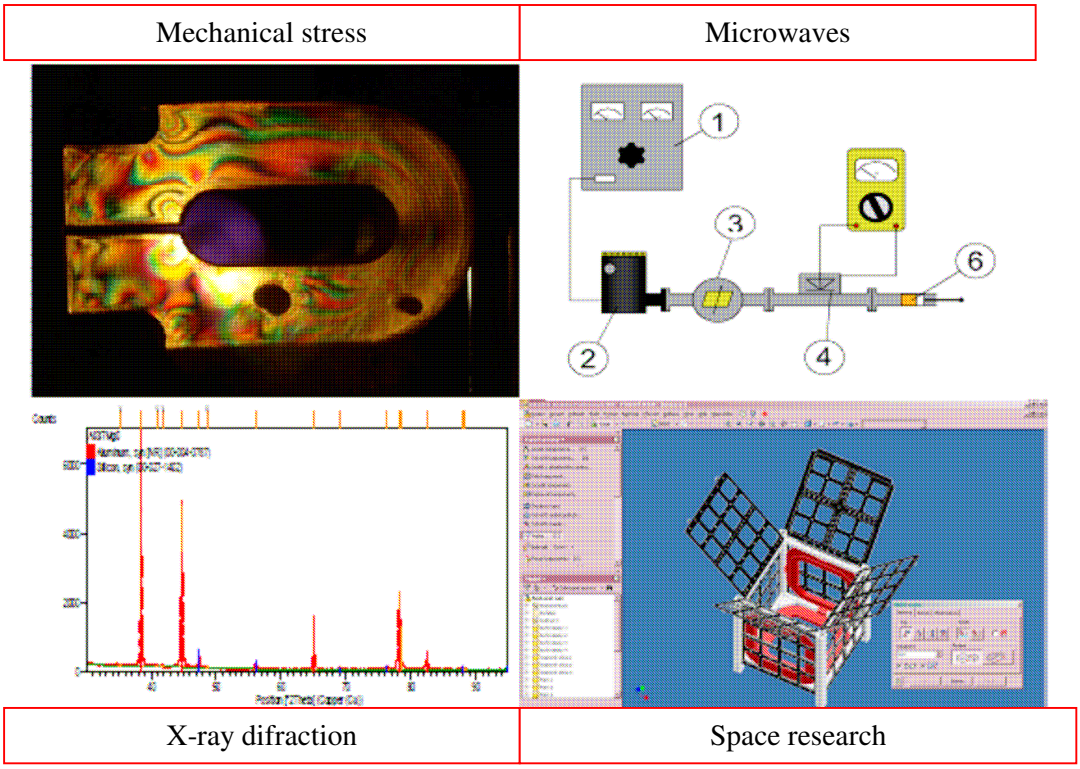

Fig. 1. **Activity samples**

2.1.2 Space research

Research of space orbit can be very interesting for all students in technical schools. Especially, their own small satellite construction. It is a working satellite which will be sent to a space orbit. This project was implemented in Production Technology and Management, J. E. Purkyně University. Students are participating in this unique space research project by means of their project works.

The project aim is to build and launch a small satellite. Modular satellite technology concept to the orbit of the Earth. The purpose of the event is to verify the feasibility of construction of satellites in Czech conditions and testing of all components and their functions necessary for successful mission spacecraft.

2.1.3 Analysis of materials by means of X-Ray Diffraction

X-ray diffraction has a significant role in the analysis of crystal composition. They are complementary techniques for extraction and electron diffraction. While an electron microscopy is enabling study of the structure on the level of nanometers, X-ray diffraction can provide the parameters on 10-10 m. X ray diffraction allows to research the crystal system of the lattice parameters in high definition. Nowadays, X-ray diffractometers can be found not only in research, but also they can be observed in factories or at educational institutions. An x-ray habitat base is an integral part of plenty of modern technological lines, where the means of X-ray diffraction continuously control the parameters of the manufacturing process.

Likewise, this device is no longer uncommon in laboratory equipment of technical colleges. In order to support material research and teaching the subject Physics of Metals at FPTM UJEP an X-ray machine is being used, which is operating on the principle of X-ray diffraction on the atomic lattice. The apparatus for X-ray diffraction has been useful not only for scientific research purposes, but it has also increasingly wider application in teaching of specialized subjects.

2.1.4 Microwaves as a humidity measurement device

At the present time the constantly increasing demands for quality and precision in the manufacture and development of new materials are increasingly important for faster and reliable inspection of testing methods. Therefore, it is advisable to pay attention to technological and even in the chemical industry, physical methods using microwaves in the laboratory and industrial technology. Microwave usage is not really new, but it is bad to marginalize them, despite the fact that these technologies create still huge potential for use in the technical industry. The use of microwaves and specialized research on this topic has at the Jan Evangelista Purkyně University big tradition and it is appropriate to conduct in this tradition in materials research at the Faculty of Production Technology and Management.

3. Research description

The educational effect of remembering is considerably higher, when teaching of challenging curriculum is reached with practical and easily verifiable practical examples.

This research deals with the use of interconnection challenging curriculum teaching with practical and easily verifiable practical examples. Thus, the learning effect of remembering is considerably higher. The main aim is to map the basis assuming the usage of such methods as a means for effective technical education. The main objective is to verify that such methods in technical education are a tool for efficient retrieval of knowledge. The research validates the hypothesis by means of the research activities conducted in tertiary education in the subject Technical Physics.

The main area of the research activity is: gaining affectivity of knowledge and persistence of the gained knowledge in the use of interconnection challenging curriculum teaching with practical and easily verifiable practical examples.

3.1. Hypothesis

Hypothesis H. Usage of linking methods of teaching challenging curriculum with practical and easily verifiable practical examples in technical education leads to increasing of the adoption level of technically oriented curriculum.

Tools and characteristics of the research

For hypothesis verification the experimental method was chosen, “Technique of parallel groups.” It works with six groups. The groups in which the independent variable is “manipulate” we call as experimental. The groups where there is no experimental intervention are control groups. The control groups are taught by the traditional way of teaching. In the experimental groups teaching runs by using of the new methods.

3.2. Implementation stages of the research

- *The first stage.* Group distribution (experimental and control group). Input knowledge testing by means of the entrance test.

- *The second stage.* Teaching in groups, changes inducing.
- *The third stage.* The last phase of the research activity includes the final output knowledge testing of the students by means of the output test.

4. Experiment evaluation

The graph shows that the total number of points obtained in the entrance test of the control group corresponds to about 56 % of the success rate on the total number of possible earned points.

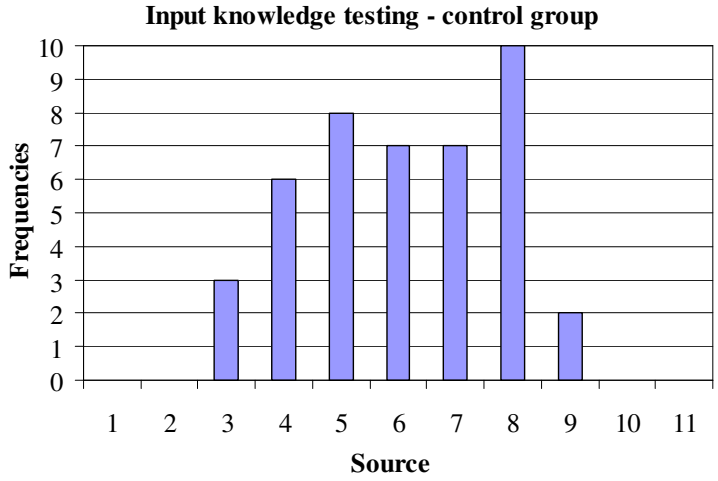

Fig. 2. **Input knowledge testing score frequencies**

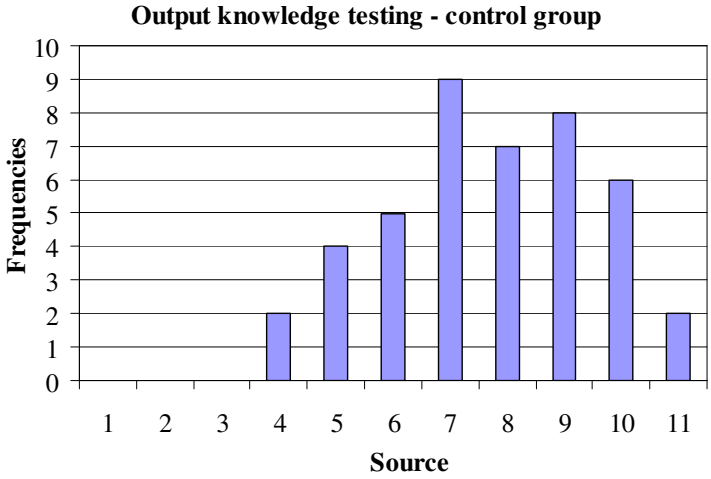

Fig. 3. **Output knowledge testing score frequencies**

The total number of points of the output test in the experimental groups corresponds with 69.5 % success rate of the total number of possible earned points. In the control groups it was compared to only 67 %.

4.1. Verification of the hypothesis, research discussion

Hypothesis H. Usage of linking methods of teaching challenging curriculum with practical and easily verifiable practical examples in technical education leads to increasing of the adoption level of technically oriented curriculum. According to the test results, the final summary is shown in the graphs. It can be concluded that the hypothesis H is confirmed. There were actually higher levels of growth of mastery in technically oriented curriculum than in the experimental groups. Higher levels growth is about 2.5 %.

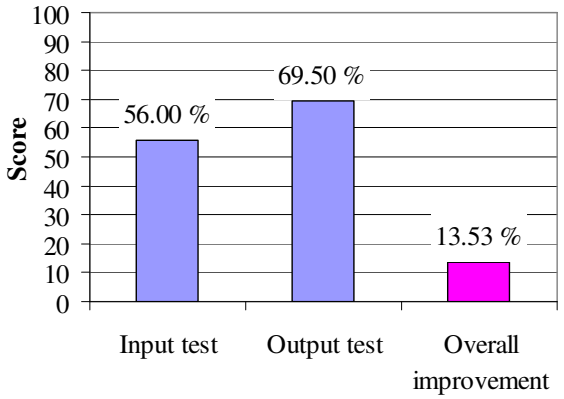

Fig. 4. **Results of the test – the control group**

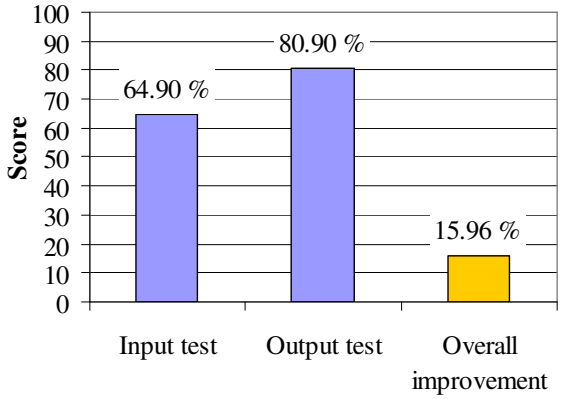

Fig. 5. **Results of the test – the experimental group**

Conclusions

Transformation of the teaching subjects in technical schools is not and certainly will not be easy. But it is necessary to do it. Technical university today is not only the source of information. It faces competition from more attractive media and electronic resources. Therefore, also transformation of the teaching subjects in our schools is not and certainly will not be easy. But it is necessary to do it.

Schools must give information to students and keep it for understanding.

One of the ways is through such methods, as usage of linking methods of teaching challenging curriculum with practical and easily verifiable practical examples. Integration of educational content could be the way. The task of a technical school is to provide a systematic and balanced structure of the basic concepts and relationships that will allow the student to include new information in a meaningful context, knowledge and life experience. The educational system must respond to previously unknown risks – the superficiality of some of the information, imbalance and fragmented knowledge, inability to focus and evaluate, and last but not least, the information overload.

All obtained study results of both groups are known from the students' evaluation on their students' agenda. All data are processed by the statistical method and the result supports the hypothesis. We can say that usage of linking methods of teaching challenging curriculum with practical and easily verifiable practical examples in technical education leads to increasing of the adoption level of technically oriented curriculum.

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