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Increasing efficiency of the learning process by an active cooperation between universities and industry

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Abstract

Education at the technical universities has demanding requirements for the technical laboratory equipment and a high level of teaching staff knowledge. The use of laboratory exercises in the education process increases the efficiency of the learning process and prepares the graduates of technical universities for their real job. Effective cooperation between technical universities and companies from the industry synergistically increases the knowledge and the level of practical skills of the graduates and their rapid adaptation for the job. Employers can use the laboratories at the technical universities for further education of their employees as well. The paper describes the experiences of cooperation between University of Zilina and railway companies in the railway transport laboratory and at the technical practices and excursions.

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1. Introduction

University of Zilina is the only university in Slovakia which is specialized in the all means of transport in research. The original name of university was the University of Transport and Communications. Nowadays the University of Zilina consists of seven faculties. Six of these faculties are directly oriented on transport problems in the sphere of operation and economics, mechanical engineering, electrical engineering, civil engineering, informatics and solution extraordinary situations. Practical knowledge of the graduates of the University of Zilina is at a very high level, because of a very good long-term cooperation between the university and the industry. Students

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from the Department of Railway Transport from the University of Zilina are a good example of this cooperation. The Department of Railway Transport can be found at the Faculty of Operation and Economics of Transport and Communications.

2. Didactic principles

By their experiences the teachers have found out that upon applying some principles in education process, their students reach better results. The basic didactic principles are an outcome of these principles summarization. The teacher has to apply these didactic principles at education process.

The basic didactic principles are (Špánik, 1998):

- principle of consciousness,
- principle of scientism,
- principle of gradualness,
- principle of activity,
- principle of visualisation,
- principle of adequacy,
- principle of systematic,
- principle of never-ending.

Applying these principles is no simple process. It is necessary to apply these principles by the different forms of teaching process to make the education process more effective. The basic teaching forms at the university are:

- lectures,
- computing exercises,
- laboratory exercises,
- technical practice,
- excursions.

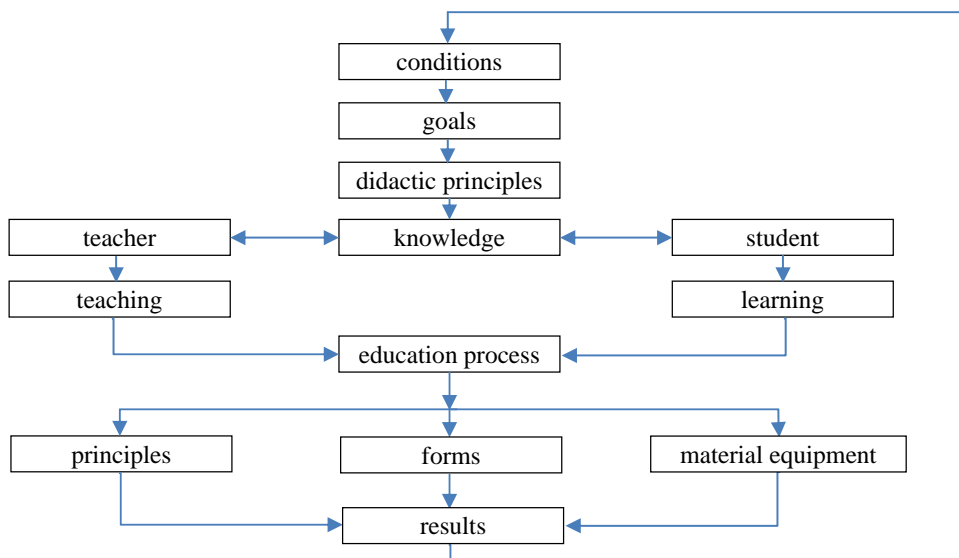


Fig. 1. Didactic system of the technical subjects (Pavlásek, 1998)

We can reach synergistic effects by an appropriate combination of all these principles and forms in the education process to make knowledge more attractive, understandable and memorized for a longer time.

Most of these didactic principles are applied by the education process in the transport laboratory for students from Department of Railway Transport.

3. Application of the didactic principles at department of railway transport

3.1. Transport laboratory – a simulation tool for transport operation

At the Department of Railway Transport there is a transport laboratory available with an arrangement of train lines simulation model for student laboratory exercises. This transport laboratory is unique and the only such one in Slovakia. It is possible to make simulation of the transport process operation in the railway stations and at the track lines with different type of signalling systems (Nedeliaková, E., Dolinayová, A., Nedeliak, I., 2013).

The lab provides a modern arrangement of train lines with a total length of 100 m of tracks. The design of the tracks forms a simple oval with the area of 50 m x 2.5 m. There are five railway stations.



Fig. 2. Scheme of railway model in transport laboratory

The scale of model is H0 (1:87). The equipment of the transport laboratory allows to make an almost ideal simulation of the real railway transport operation. The students are able to learn how to operate with different types of railway station and track line signalling systems which are used in the Slovak Republic and in some other countries in Europe.



Fig. 3. Equipment in transport laboratory

The main advantages of the railway transport simulation model are (Barta, Mruzek, 2014):

- the work environment is identical with the real workplace,
- the research and education processes run at different type of operation places (including the most modern ones),
- the theoretical research and tuition is complemented by practicing the model transport situations with stochastic processes,
- management of the transport processes in real conditions is trained,

- extraordinary transport situations, errors etc. may be trained.

An application for modelling logistic centres is also projected in the area of the transport laboratory. It is possible to make a simulation of a logistic centre, consisting of the following three different modules and their combinations (Meško, Gašparík, Lalinska, 2012):

- module of a marshalling yard,
- module of an intermodal terminal,
- module of a warehouse.

Each of these modules can be rendered in a different window. To create a new model of a logistic centre, the user of the simulation model will choose which modules will be used in the model.

3.2. Education process in the transport laboratory

The transport laboratory of the Department of Railway Transport provides also laboratory exercises for the students in the fourth semester of the bachelor degree course. During the first three semesters the students get theoretical knowledge of the transport management and operation, necessary to make the railway transport continuous and safe, by the means of lectures and computing exercises. In the fourth semester they continue with their practice in the transport laboratory. These laboratory exercises are obligatory for them.



Fig. 4. Education process in transport laboratory

Each of the students has to pass 13 obligatory laboratory exercises, for two hours each. They have to prove their ability to practically operate every type of the signalling systems. The education process itself is arranged in such a way that every student is able to make practice at each work place with different signalling system minimal two times through the semester within a short time gap. It is very important to have a chance to repeat it for the student, as he or she gets a better understanding and a chance of a long-term remembering of the new knowledge and skills.

The students can continue with the laboratory exercises in the transport laboratory in the fifth and sixth semesters, too. They can develop their knowledge and skills in the management of the railway transport operation under extraordinary situations, accidents, operation closures and under difficult working conditions.

3.3. Usage of the transport laboratory by students from secondary schools and people from the industry

They are not only university students who can use the transport laboratory. It is open also for students from technical secondary schools for practical exercises (especially from schools with an interest in the railway transport), as well as for the new employees in the railways companies for trainings, excursions for public etc.

The new employees of the railway infrastructure manager in Slovakia (Železnice Slovenskej republiky, ŽSR) employ the transport laboratory the most. They employees are engaged in regular laboratory exercises after passing the theoretical exams but before being allowed to operate the railway transport independently.

Students of technical secondary schools are also frequent visitors of the transport laboratory. One of the advantages of this cooperation is also promoting the university in the public area. Many students, who visited the transport laboratory during the secondary school, continue their study at the Department of Railway Transport as well.

3.4. Cooperation between the university and the industry

The laboratory exercises are by no means the only opportunity for the students of the Department of Railway Transport to get new practical skills. The Department of Railway Transport have a very good long-term cooperation with the railway infrastructure managers, railway operators, forwarders and other companies from the railway business in Slovakia and in the Czech Republic. The students are able to take advantage of this cooperation and may take part at:

- additional lectures with the industry experts,
- technical excursions,
- obligatory technical practice,
- optional technical practice.

Additional lectures with the industry experts are usually organized for each technical subject at the end of the semester. The lecturers are often former students of the University of Žilina who have become successful managers in the railway or forwarding business. The students are very interested in these lectures although they are not obligatory.

The technical excursions are provided for all the students through the whole academic year. The focus of these excursions is in those areas which are not possible to practice in the transport laboratory. For example the technical excursions are organized in the areas of:

- production of rails,
- unconventional transport systems,
- forming of trains in the railways yards,
- loading, fixing and unloading of goods,
- logistics,
- testing of the railway vehicles,
- operation of undergrounds,
- and others.

Each student has to pass obligatory technical practices. It is realised at the railways stations and at the workplaces which ensure the railway transport. Each student has to pass a technical practice at different workplaces for 13 weeks. For every week, a minimum of four hours of the technical practice is obligatory.

In case that the student is interested in the technical practice for a longer time, he has an opportunity to do it individually. The Department of Railway Transport has signed bilateral agreements with the railway infrastructure manager in Slovakia (ŽSR) and with the passenger and freight railway operators (ZSSK and ZSSK Cargo), where the students are able to pass their technical practices.

3.5. Final works of students

The very good cooperation between the Department of Railway Transport and the industry reflects also in preparing the students' final works. Many final works become topics inspired or directly brought from the industry.

The students solve therefore specific problems for a specific railway or forwarding company in their final work. The students are able to apply all the theoretical knowledge and practical skills in their final works. The feedback from these industry companies is very positive. Some students continue a job directly in these companies, immediately after the final state exams.

The practical skills of the graduates from the Department of Railway Transport are significantly better after establishing the technical excursions, technical practice and the laboratory exercises in the transport laboratory. The graduates are more adaptive in their jobs for practical solving of problems. The demand for graduates from the Department of Railway Transport is therefore constantly increasing, and there is nearly zero unemployment among them.

4. Conclusions

Applying the didactic principles in education process is very important. The students remember 10% of reading, 20% of hearing, 30% of seeing, 40% of combined seeing and hearing, and 90% of their practice (Špánik, 1998).

Educating the competent experts for the railway transport involves necessarily gaining both the new theoretical knowledge and the practical skills. The Department of Railway Transport allows for achieving these important goals. Specifically it publishes study literature for the students, organizes laboratory exercises in the transport laboratory, additional lectures, technical practices and excursions. All this is possible only thanks to the very good long-term cooperation between the Department of Railway Transport and the industry. This way, firm conditions for educating top-level experts with complex theoretical knowledge and practical skills are established.

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