THE ASSESSMENT OF STUDENTS’ UNDERSTANDING AND MISUNDERSTANDING IN PHYSICS LEARNING AT TECHNICAL UNIVERSITIES

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Motivation

• Physics and Engineering are often considered to be difficult subjects. The fundamental laws are expressed in the language of mathematics - the method that provides the bridge between the theory and an experiment. Teachers constantly work on improving students’ understanding of various phenomena and fundamental laws.

• Students are less interested in studying Mathematics and Physics because they consider them difficult to learn, to understand and to pass the final school leaving examination.

• As a result, most of the students enrolling to technical universities have only theoretical knowledge about physical phenomena, several preconceptions and misconceptions.

• Therefore, we decided to turn our research attention to the problems of Physics education in order to face the pivotal challenge of retaining students who would be interested in Science, Technology, Engineering and Math (STEM) study programs even if their knowledge of Physics is not satisfactory and help them to overcome this gap and continue in their studies without dropping out during their first term.
• Students in Slovakia attended compulsory Computational Physics exercises and lectures that were optional. The subject named ‘Introduction to Physics’ consists of 2 - 1 - 0 (lectures - exercises - labs) lessons per week. One lesson lasts 50 minutes. The term in Slovakia consists of 13 weeks.

• In Russia the subject named ‘Introduction to Physics’ consists of 1 - 1 - 1 (lectures - exercises - labs) lessons per week. Each lesson lasts 1.5 hours. The term in Russia consists of 16 weeks.
METHODOLOGY - ANALYSIS OF RESULTS

• We used Force Concept Inventory (FCI) test to verify prior students’ knowledge of Physics (Kinematics and Dynamics).
• It contained 30 qualitative multiple choice tasks that focused on conceptual understanding of Newtonian mechanics.
• FCI was given to students at the two technical universities in different countries to find out prior knowledge level of physics at the beginning of the academic year 2018/2019.
• The pre-test was carried out at the beginning of the term during the first week and it was attended by 200 students in Slovakia and 102 students in Russia.
• Post-test was carried out at the end of term (after finishing the term course ‘Introduction to Physics’ in Slovakia and in Russia).
The results of pre-test indicate that there is statistically significant difference between the mean pre-test FCI score of the students in Slovakia (University of Žilina (UNIZA), Faculty of Electrical Engineering and Information Technology) and Russia (Ryazan State Radio Engineering University named after V.F. Utkin (RSREU), Electronics Faculty) at the beginning of term.
The results of the post-test indicate that there is no statistically significant difference between the mean post-test FCI score of the students in Slovakia and Russia at the end of the term.
EVALUATION AND DISCUSSION, RESULTS

• The common misconception is connected to these questions: “The movement always requires a force acting to the direction of movement”.

• Detailed analysis of questions is done in the paper.
CONCLUSIONS

• Our research has pointed out the fact that students entering the both universities do have difficulties with understanding basic concepts of mechanics.

• First deep analysis of answers in pre and post FCI test shows us that there are differences at universities which can be connected with preparation of students at secondary schools for study at university and also with the method of teaching.

• Deeper analysis of misconceptions can help us to find and eliminate the misconceptions of the students and also to improve teaching methods and students’ level of knowledge in the introductory courses of general Physics, mainly in the field of mechanics.

• A detailed analysis of FCI tests can help us to detect preconceptions, misconceptions and problems in conception of basic principles of Physics. It can be useful for future study of STEM.
REFERENCES


