Hands-on Experiments in the Interactive Physics Laboratory: A Study of Student's Intrinsic Motivation

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Abstract. Experiments in different forms can be suitable tools how to increase students' interest in physics. However, educators discuss which forms of experimenting are the most beneficial for these purposes. At our department, two different forms of physics experiments are offered to upper secondary students – students' hands-on experimental work and physics demonstration shows where the students watch experiments conducted by a lecturer. Our research aims primarily at students' feedback about their immediate attitudes towards the hands-on experimenting and differences in perception of this experimenting and watching the lecture demonstrations. For collecting data we used questionnaire research based on Intrinsic Motivation Inventory.

1 Introduction

Physics belongs to science school subjects that are evaluated as the least favourite, difficult and boring subjects by upper secondary school students all over the world. The decline of students' interest in and popularity of physics over the period of secondary education concerns many science educators and researchers [1, 2]. For this reason, the researchers are focusing on finding ways how physics might be made more attractive to students, e.g. [3].

The Interactive Physics Laboratory (IPL) established by the Faculty of Mathematics and Physics of Charles University provides upper secondary school students a space for conducting physics experiments in the form of structured inquiry [4]. The main goal of the laboratory is to allow its visitors to grasp physics with their own hands, both in the literal and the metaphorical sense (see figure 1). While students are led to maximal autonomy, they perform all activities independently, including preparing measurements, recording data or evaluating them.

The IPL was put into regular operation in 2012 and since that time, the number of visitors has been continuously growing up to the present, when more than 800 students go through the laboratory every year. The permanently increasing interest of upper secondary school teachers and their students became a motivation to start a research on how the visit of the laboratory influences the students.

Fig. 1 Students in Interactive Physics Laboratory

2 Research purpose

While the literature search shows that the researchers are still searching for suitable instructional strategies supporting students' situational interest, we decided to deal primarily with students' intrinsic motivation and related attitudes towards practical work in the IPL. We were naturally interested in the most positively/negatively perceived aspects of experimental work in the IPL concerning students' attitudes/motivation. We also decided to compare students' feedback about their immediate attitudes to the hands-on activities in the IPL with their attitudes to watching physics demonstration shows (DEMOS) where the experiments are conducted by a lecturer.

Together, data from more than 1000 upper secondary school students at the age from 15 to 19 was collected. Nevertheless, the sample is represented by those students who have visited the IPL or the DEMOS by the decision of their teachers. From this point of view, the selective effect must be taken into account, so this sample couldn't be considered representative.

As a research tool, the Intrinsic Motivation Inventory [5] was used. This multidimensional measurement device is grounded on the Self-Determination Theory and its primary goal is to assess participants' subjective experience related to activities performed in laboratory experiments.

3 Results

The results of the research shows that the two projects (IPL and DEMOS) do not exhibit significant differences in students' interest and perceived usefulness, nevertheless the students feel the need of significantly higher effort and experienced tension during their work in IPL.

Gender differences appeared to be only minor with an exception of perceived competence where boys declare stronger feeling of competency and self-confidence when independently experimenting.

An interesting finding, which goes against our original hypothesis, is that grades in physics are quite a strong predictor of students' assessment of the projects – better grades stand for more positive assessment and for lower pressure felt during hands-on activities in the IPL.

Acknowledgements

This work has been supported by Charles University Research Centre No. UNCE/HUM/024.

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