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Comprehending Newly Designed Activities for Computer Based Science Lab by Slovak and Czech Students

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Introduction

Computer aided experiments represent a popular way of experimenting in science education. Moreover, this kind of experimenting was confirmed beneficial for the process of learning by many prominent authors and their studies (Aksela, 2005, Lavonen et al. 2003).

Our contribution deals with an implementation of a set of 18 newly designed research-based computer supported laboratory activities for Chemistry (12 activities) and Biology (6 activities), which were proposed by an international team of researchers from 5 European countries: Spain, Czech Republic, Austria, Finland and Slovakia (Tortosa et al., 2013). More specifically, the partial results from Czech and Slovak part of the research is presented. The main aim of the study is to answer the questions related to understanding the objectives of proposed and implemented activities by the secondary school students. All activities have the uniform structure inspired by the previous study (Tortosa, 2012). They are designed to be student-centered reflecting the IBSE principles and POE sequence (Predict – Observe – Explain) suggested by White & Gunstone (1992).

Methods

During the process of implementation with secondary school students (mean age 16.97; SD 1.20) 1408 evaluations were performed with 664 students from 15 participating schools (11 in Czech Republic, 4 in Slovakia). The most of the implementations (919) were realized in the university laboratories (Charles University in Prague, Czech Republic and Matej Bel University in Banská Bystrica, Slovakia) because of the lack of necessary equipment in the schools.

In order to gain a relevant feedback about the quality of tested activities a special tool (a 20-item questionnaire) has been administered to the respondents after performing each activity (implementation). For this study five following questionnaire items were selected to discuss in more detail: (Item 1) *I understood the objectives of the activity*; (Item 2) *List the objectives of the activity*; (Item 3) *I need my teacher's help to understand the activity*; (Item 4) *Computer measuring system helped me interpret the results* and (Item 5); *I think the activity could* *be done without computer measuring system*. Items number 1, 3, 4 and 5 are positive declarative clauses where students expressed their level of agreement on 4-point Likert scale (1 = I totally agree, 2 = I agree, 3 = I disagree, 4 = I totally disagree). In open item number 2 the accuracy of the responses was evaluated on the 4-point scale as follows: 1 = correct answer, 2 = more or less correct answer, 3 = not sufficient answer, 4 = totally erroneous answer. Data were processed by several statistical methods, such as descriptive statistics, analysis of frequencies and comparative analysis (gender, subject, country, age, place of implementation). The significance was determined by non-parametric Mann-Whitney U test or Kruskal-Wallis H test at 0.05 level.

Results

Analysis of frequencies revealed that the most students (94.7%) think that they understand the objectives of implemented activity (cumulative percent for all answers of agreement with the declarative clause has been taken into account). However, when they were asked to list the objectives, only 58.1% of correct (scale point 1) or more or less correct (scale point 2) answers were provided. As these results didn't distinguish between the activities we also compared them and identified the most difficult ones to be revised. Comparisons based on different place of implementation showed that students performing in university not only felt more competent but also reported more correct answers than students working in the schools (ITEM 1: $U = 251\ 102.000$; $z = 6.356$; $\boldsymbol{p = .000}$; $MR_{school} = 757.25$, $MR_{university} = 643.06$; ITEM 2: $U = 251\ 102.000$; $z = 6.356$; $\boldsymbol{p = .000}$; $MR_{school} = 726.75$, $MR_{university} = 596.35$). About 45% of the students declared the need of their teacher's help in understanding the activity objectives. Interestingly, students performing in university reported significantly less frequent need of the teacher's help then students implementing in the schools ($U = 178\ 029.000$; $z = –5.486$; $\boldsymbol{p = .000}$; $MR_{School} = 612.51$; $MR_{University} = 730.13$). In ITEM 4 the most students reported that computer measuring system helped them interpret the results. Moreover, students working in universities considered computer measuring system helpful more often than students in the schools ($U = 250\ 486.000$; $z = 5.916$; $\boldsymbol{p = .000}$; $MR_{School} = 765,95$; $MR_{University} = 647,80$). Surprisingly, when we asked students if they think the activity they are just performing could be also realized without computer measuring system, more than one third of them (35.4%) reported positive answers.

Conclusions

The actual study uncovered that most students tend to perceive their level of understanding the activity more overrated then reality. This fact is one of the important one to help us refine the activities. Furthermore, the study also showed an interesting impact of place of implementation on student's level of engagement.

It seems that students working in university probably felt more competent to figure out the activities then students implementing in the schools. They also reported less need of their teachers help in understanding the activities. The level of help of computer measuring system in interpreting the results was declared more notably by the students working in university as well. We can presume that new and serious environment like university and its laboratory could influence students in their behaviour and make them more engaged and active for learning. It is promising that almost all students considered computer measuring system helpful in solving the experimental problem they were working on. A bit surprising is that about one third of responses haven't recognized the importance of computer measuring system support in the activities. In some activities students thought they could be performed without computer measuring system. We suppose that such opinions could be influenced by not sufficient experience of our students with computer based experimenting. Namely, it was the first experience with computer measuring system for the most respondents. In conclusion, our findings suggest that tested research-based laboratory materials could be useful and of quality for the most of the students. However further research is needed to comprehend all relations recorded by this study.

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References

Aksela, M. (2005). *Supporting meaningful chemistry learning and Higher-order thinking through computer-assisted inquiry.* Academic Dissertation. University of Helsinki.

Lavonen, J., Aksela, M., Juuti, K. et al. (2003). Designing user-friendly datalogging for chemical education through FA of teacher evaluations. *Int. J. Sci. Ed.*, 25(12), 1471–1487.

Tortosa, M. (2012). The use of MBL in chemistry second. education: Present state of the art and ideas for research-based practice. *Perspective. Chem. Educ. Res. Pract. 13*, 161–171.

Tortosa, M., Guitart Mas, J., Skoršepa, M. et al. (2013). Los objetivos de actividades de laboratorio diseñadas para la adquisición de competencia científica mediante experimentos en tiempo real: visión del alumnado. *Enseñanza de las ciencias*, (num. extra), 3547-3553. ISSN 0212-4521.

White, R. & Gunstone, R. (1992). *Probing understanding.* London. The Falmer Press.

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