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Newly Designed MBL Activities Perceived by Slovak and Czech Secondary School Teachers (A Comparative Study)

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Introduction

Implementation of the microcomputer based laboratory (MBL) seems to be beneficial for students as well as teachers to learn (or teach) some phenomena and themes of science education. Benefits of the technology has been discussed by many authors (e.g. Lavonen et al., 2003, Thornton & Sokoloff, 1990). For example, the enhancement of scientific competencies (Tinker, 1996) or development of abstract thinking (Hamne & Bernhard, 2001) were proved for pupils using MBL. MBL approach also well reflects current state when employment of various sensors in many applications in industry and in common life, e.g. in smart devices (Škopek, 2013), becomes very frequent. Despite its benefits, the implementation of MBL in the Czech Republic and Slovakia suffers from some problems, where price and availability of the sensors or MBL systems needn't to be the most important. The acceptance of the technology by students as well as teachers is influenced by further factors, they can be for example (possible) technical problems or a lack of well-designed research based MBL materials (what to do reasonably with sensors). To contribute and support the implementation of MBL into schools, in the framework of European project COMBLAB, new inquiry-based MBL activities on chemistry, biology and physics were designed and developed (Stratilová Urválková et al., 2014) and, the courses on MBL implementing the newly developed activities were held for Czech and Slovak teachers. Some teachers also implemented the activities directly in the schools. The developed activities and the structure of the courses are published and available at COMBLAB project webpage www.comblab.eu. In this contribution, we acquired and statistically treated opinions and attitudes of teachers on the created activities (on chemistry and biology) to get an appropriate feedback to the prepared activities and to identify the possible didactical and technical problems. We also compared opinions and attitudes of teachers from the Czech Republic and Slovakia.

Methods

To acquire and evaluate the opinions and attitudes of teachers, a special newly developed tool (39-item questionnaire) has been administered after performing each activity (implementation). 42 teachers participated in the questionnaire research (26 Czech and 16 Slovak), from 23 secondary schools (19 in the Czech Republic, 4 in Slovakia). Totally, 197 evaluations have been made (74 in the Czech Republic, 123 in Slovakia) and all teachers evaluated more than one activity (3-8). Totally, the teachers evaluated 16 different activities (10 activities focused on chemistry, 6 on biology). For this study, the following questionnaire items were selected to be discussed in more detail: (Item 1) *Overall, how satisfied are you with the activity as a teacher?*; (Item 2) *The difficulty of the activity is adequate to students' knowledge*; (Item 3) *The duration of the activity is optimal*; (Item 4) *The activity fits to our state educational curriculum*, (Item 5) *The objectives of the activity are well designed*. All the items are positive declarative clauses where teachers expressed their level of agreement on 4-point Likert scale – items 2 - 5 (1 = I totally agree, 2 = I agree, 3 = I disagree, 4 = I totally disagree) or 6-point Likert scale – item 1 (☺☺☺ - ☺☺ - ☺ - ☹ - ☹☹ - ☹☹☹). The data were processed by several statistical methods, such as descriptive statistics, analysis of frequencies and comparative analysis. The significance was determined by non-parametric Mann-Whitney U test or Kruskal-Wallis H test at 0.05 level.

Results

The results indicate that, in overall, the teachers appreciate the activities and the application of MBL in the activities. They expressed some satisfaction with ca 98% of activities evaluations, in more than 65% evaluations, they were very satisfied (☺☺☺ ranking). Only 4 evaluations (of 197) showed dissatisfaction, nevertheless, there were no rankings in the most negative part of the scale (☹☹ or ☹☹☹). Majority of teachers also stated that the objectives of the activities are well designed (99% of evaluations), the difficulty of the activity is adequate to students' knowledge (94% eval.) and that the activity fits to their state educational curriculum (ca 93% eval.). Also duration of the activities was considered to be absolutely optimal in ca50 % of evaluations and appropriate in 41% of evaluations. Despite different experience with MBL and possibilities and equipment at various schools, there were not principal differences between Czech and Slovak teachers (ITEM 1: $U = 5\,084.000$; $z = 1.632$; $p = .103$; $MR_{CZE} = 91.80$, $MR_{SVK} = 103.33$; ITEM 2: $U = 4\,335.500$; $z = -.625$; $p = .532$; $MR_{CZE} = 101.91$, $MR_{SVK} = 97.25$; ITEM 3: $U = 4\,996.500$; $z = 1.280$; $p = .201$; $MR_{CZE} = 92.98$, $MR_{SVK} = 102.62$; ITEM 4: $U = 4\,821.500$; $z = 1.158$; $p = .247$; $MR_{CZE} = 92.53$, $MR_{SVK} = 101.20$; ITEM 5: $U = 4\,949.000$; $z = 1.221$; $p = .222$; $MR_{CZE} = 93.62$, $MR_{SVK} = 102.24$). On the other hand, there were statistically significant differences among the activities regarding difficulty

(ITEM 2: $\chi^2 = 39.700$, $p = .001$), optimal time duration (ITEM 3: $\chi^2 = 29.584$, $p = .030$), and suitability for the state educational curriculum (ITEM 4: $\chi^2 = 43.547$, $p = .000$). On the basis of the results, the activities were sorted into three groups: Activities recommended for start with MBL which well fit the curriculum, have an optimal duration and have appropriate difficulty (Antacids, Acid Rains, Wine Titration, Germination, Blood Pressure, Fermentation, ECG), well evaluated but more difficult activities for experienced teachers and students (Photosynthesis, Greenhouse, Crap Metal, Fire Extinguisher) and time demanding, difficult activities (open IBSE) for advanced users of MBL and talented students (CO_2 in the Sea, Eutrophication). This classification should make the implementation of activities smoother.

Conclusions

The questionnaire research showed that all tested activities prepared in the framework of the COMBLAB project were evaluated very positively by the teachers and from their point of view, the activities are well applicable in their lessons. The objectives are defined adequately, instructions are clear and activities have logical structure. Difficulty, duration of the majority of the activities and contents (with respect to school curriculum) are appropriate, nevertheless, in some cases, there was statistically significant differences among the activities. Therefore, in some cases, some changes were made to make the activities shorter and less difficult. Czech and Slovak teachers evaluated the activities very similarly and the results showed no statistically significant difference between Czech and Slovak teachers in the case of all evaluated items of the questionnaire.

Acknowledgements

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