

RESPONSE DEVICES IN TERTIARY EDUCATION

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Abstract. The goal of this paper is to introduce the potential of the use of response devices in teaching at university level. The research question of this study is how response devices can be used in teaching at university level, what advantages and disadvantages its use brings and how pre-service teachers feel about the use of this technology both during their pre-service training and in their future teaching practice.

Keywords: response devices, clickers, teacher training, discrete mathematics, tertiary education, experiences

Mathematics Subject Classification: Primary 97B50, 97U70; Secondary 97B40

1 Introduction

The goal of this paper is to introduce the potential of the use of response devices in teaching at university level. It builds on experience with using this technology in teaching the subject Algebra in Computer Science and Discrete Mathematics at Faculty of Education, Charles University in Prague. Both of these subjects are taught as a part of bachelor studies of Mathematics for Education. Response devices have been used in these courses for several years both in regular and distance form of studies. The research question of this study is how response devices can be used in teaching at university level, what advantages and disadvantages its use brings and how pre-service teachers feel about the use of this technology both during their pre-service training and in their future teaching practice.

The paper first recapitulates research on the use of ICT and response devices in education and then presents examples of how response devices are used at the Faculty of Education, Charles University. This is followed by findings from of a questionnaire survey among pre-service teachers on their attitude to response devices and on the way they plan to use it in their teaching practice.

Thus effective ways as well as potential drawbacks of the use of this system are outlined as well as examples of efficient uses discussed.

2 ICT and teacher education

The role of technologies and ICT tools has been growing in importance ever since its appearance at schools. Technologies are nowadays easily available both to teachers and pupils. However, easy availability is not a synonym to quality and does not guarantee better results in education. The question that educators and teachers must naturally ask is how to use these technologies in education effectively for the benefit of pupils and the learning process. Current research in the Czech Republic, e.g. Robová, Vondrová ([1]), Novotná ([2]); Jančařík and Novotná ([3]) shows that Czech in-service teachers lack the confidence, efficacy and skills to be working with ICT to its full potential, feel to be at loss and often use it “for show”. The conclusions speak of missed opportunities. Moraová ([4]) points out issues very important for teacher training – pre-service teachers need to be trained not only to be able to use technologies but also to consider how to use if effectively and for their pupils’ benefit. They must be shown examples of good practice.

Without any doubt teachers must be able to use technologies meaningfully, must use them as a means of support, not burden. Having little or no experience with technology supported lessons from their school years and thus have nothing to build on, they have to learn how to use technologies efficiently during undergraduate studies as well as within in-service teacher training.

Mishra and Koehler ([5]) describe the set of knowledge a teacher must have (see Fig. 1.) and named it the Technological Pedagogical Content Knowledge (TPACK).

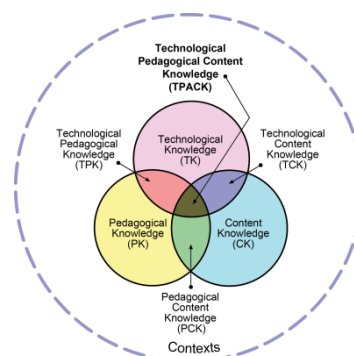


Fig. 1. TPACK (from <http://matt-koehler.com/>)

It is not enough for a teacher to have knowledge of technologies. They need specific knowledge on the relations and connections between technology and their own subject (e.g. of specific mathematical programmes) as well as pedagogical knowledge and skills connected to the use of technology in lessons. The intersection of these areas is the area of knowledge known as TPACK. In connection to mathematics, it is the subject didactic knowledge of the specifics of the use of ICT in teaching mathematics. That is why introduction to and work with modern technologies must be an integral part of pre-service teacher education (see [6]).

Learning on how to use modern technologies cannot be the matter of subjects where technology is a topic as such exclusively. It is essential that future teachers of mathematics get hands-on authentic experience with the use of ICT tools in mathematics lessons. That is why modern technologies are used in various courses of mathematics with the aim not only of improving teaching in the courses but also of giving pre-service teachers the chance to see

and experience ICT supported teaching. The lecturers use computers, visualizers and projectors as well as less common technologies such as response devices.

3 Response devices in education

Response devices (Clickers) are a tool that allows learners to send answers to questions asked by the teacher electronically. Response devices are used especially for getting immediate feedback and for evaluation of students ([7]). Use of clickers in teaching mathematics has been the subject of several studies (e.g. [8], [9]), which include also studies focusing on university education (e.g. [10], [11]). Research shows that clickers boost students' motivation. They are also an efficient tool for getting feedback both from the students and from the teacher. In some cases clickers can be used for peer assessment of students' performance ([12]). Special hardware (clicker) may be substituted by mobile phones or tablets ([13]). It is also possible to get answers from students using a website ([14]).

3.1 Response devices on Faculty of Education, Charles University

Faculty of Education, Charles University, purchased response devices into the newly equipped multimedia seminar rooms at the Department of mathematics and didactics of mathematics. The number of the devices bought is such to ensure that the devices are available to all students in one year. Currently response devices are used regularly in the subjects Discrete Mathematics and Algebra in Computer Science. PowerPoint presentations were developed for these subjects, which involve study check questions to be answered by students using response devices (see Fig. 2.). The used technology allows to respond only by selecting from multiple choice items and does not allow to send e.g. a more digit number as the answer. When all the responses are submitted, the system offers immediate portrayal of the answers in the form of a histogram or by name of each student. The first possibility is used in the seminars at the Faculty, answers of individual students by names are not presented. However, all students get immediate feedback on what the correct answer is. In case of erroneous answers, the teacher analyses the solution and looks for sources of mistakes in the answers. Immediate remedy is possible.

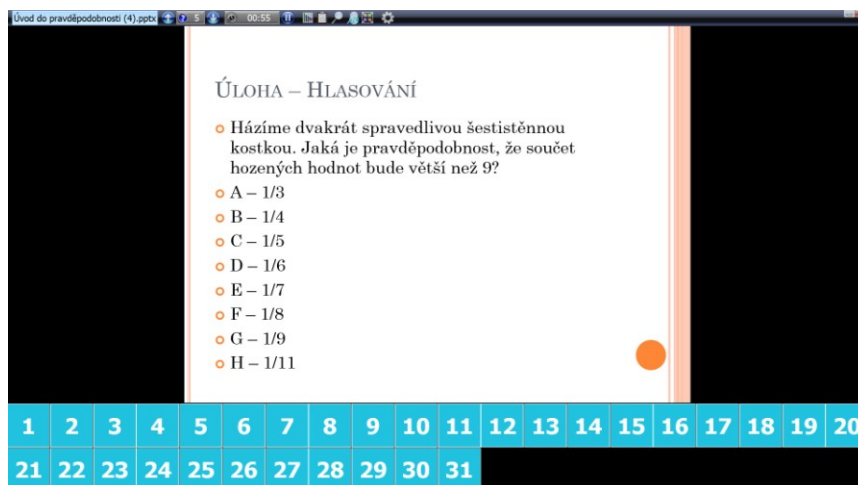


Fig. 2. Screenshot from the presentation with questions.

Results from students' responses are collected continually the whole semester. The system enables creation of various overviews (see Fig. 3.). These overviews are a useful basis for a student's evaluation at the end of the course.

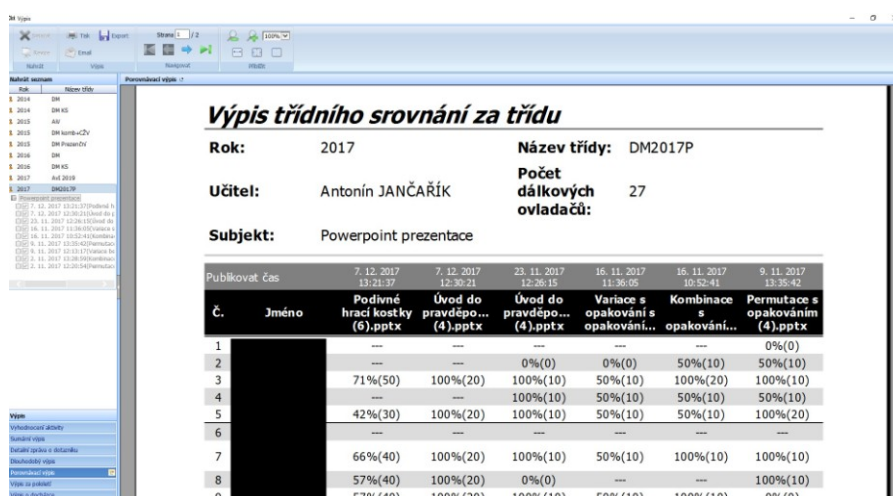


Fig. 3. Overview of the course.

4 Research methodology

For the needs of this study a questionnaire survey was conducted with 2nd year pre-service teachers after they had finished the lectures and seminars in the course of Discrete Mathematics – Combinatorics. What is specific for this course is that presentations for each of the topics are available to students in advance in the LMS system Moodle. The presentations contain study check questions to be answered by response devices. Within the block, seminars and lectures on 7 topics were supported by response device use. The course was finished by a credit test.

The questionnaire consisted of 6 closed and 3 open questions. Due to the low number of respondents (15) the results were evaluated only with descriptive statistical methods and qualitatively.

Questions were related to the following areas:

- Technical difficulties
- Experience with clickers from other subjects
- Preparation for education
- Advantages and disadvantages of the system
- Use in teaching practice

The results will be presented in the next section.

5 The findings from the study

5.1 Technical difficulties

Technical problems are usually quoted as one of the frequent obstacles that make use of ICT in lessons difficult. Technical problems may be of various nature, sometimes as simple as flat batteries in clickers (batteries in clickers should be changed once a year). However, in this

survey only one of the respondents claimed he had encountered technical problems while using response devices in his lessons. The rest of the respondents (14) do not have this experience.

5.2 Use in other subjects

None of the students has experience with use of clickers from other subjects. A vast majority of students (see graph 12-1-2) state at the same time they would appreciate if this technology were used in other subjects as well, since its use is very subject specific.

5.3 Study of materials

Presentations that are used in the lectures and seminars in the course are available to students prior to each seminar or lecture. This enables the students to prepare for the lecture or seminar if interested. This possibility was used by one third of the students enrolled in the course, out of whom 80% claim that the use of response devices was the reason that made them want to go through the presentations prior to the lectures and seminars. In other words it is the use of response devices that seems to be the most powerful students' motive to prepare for seminars and lectures.

5.4 Advantages and disadvantages of the system

Open questions were used for assessment of the advantages and disadvantages of the system. The following are considered to be advantages of the use of response devices by the respondents:

- Active involvement in the lesson – the need to think deeper about the solution. This answer was given in some formulation by 60% of the respondents.
- “Anonymity” – the respondents appreciate they do not have to tell the results out loud and do not have to go to the board. The replies to this item imply that it is very stressful for students to present their solutions in front of their classmates.
- Immediate feedback – the respondents appreciate that they get immediate feedback. The respondents are also aware of the fact that teachers get information about the real level of understanding and thus can react to the situation. One of the students wrote the following: “This is followed by gratification from the correct result → motivation to further studies.”

The respondents refer to much fewer disadvantages than advantages. The most often stated disadvantage is not enough time for some answers and unclarity in how to respond in Yes-No questions. Three students claim they select both possibilities in a yes-no question, one states that in case of any doubts he prefers not to respond at all.

5.5 Use in teaching practice

The last two questions in the questionnaire focus on the potential of the use of response devices in the respondents' future teaching career. All students stated they regarded response devices as a good tool in mathematics lessons on both primary and secondary school levels. The reasons for this belief were partly analogical to what was listed as advantages of response devices but several new ideas were presented as well.

- “Weaker pupils have the time to think before the better pupils give away the result.”
- “We can get a reply for each pupil even in the case that we cannot ask each of them individually because there are too many in the group.”
- “It forces everybody to join in and calculate.”
- “It makes pupils pay attention.”
- “It captures their attention.”

6 Conclusion

The findings from the survey among pre-service teachers of mathematics show that their experience with the use of response devices is positive. Based on their personal experience they state they regard clickers as a useful tool that they will want to use in their future teaching practice. Thanks to the active use of the device in mathematical courses which are part of their undergraduate studies they gain hands-on authentic experience with this modern technology, which enables them to assess its advantages as well as limits of its use in lessons. Clickers are a simple tool that boosts pupils’ motivation. Thanks to the immediate feedback and the necessity to pay attention to the subject matter clickers contribute to deeper understanding and performance.

Further research among in-service teachers and pupils should be conducted to see how efficiently and to what extent clickers are used in everyday school practice and how pupils assess lessons supported by response devices.

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