PROBLEMS
OF EDUCATION
IN THE 21st CENTURY
Volume 35, 2011

E-ASSESSMENT OF STUDENTS BASED ON PERSONAL RESPONSE SYSTEM

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Abstract

Tools for electronic assessment are being developed mainly with growth of distance learning platforms. However, the possibility of electronic testing seems to be valuable also in the classroom, which is not usually equipped with computers. For this purpose, systems of remote controllers have been in development for over ten years. The first versions of controllers were operating in infrared technology which significantly limited the amount of data that could be transferred from remote controls to computers. That allowed only using simple multiple-choice and single number questions. Those limitations excluded those systems as an effective assessment tool.
In recent years new versions of systems were presented. Modern remote controls are operating in radio technology and possess their own memory that makes it possible to code and send more complex questions. Also, new controllers can operate in asynchronous mode which creates the opportunity for personalization of students' work. Thanks to new functionality, modern response systems can potentially be used as assessment tools. This fact creates new opportunities and challenges for educators in developing a methodology of use of this tool during various types of courses. Presented results were obtained during the pilot implementation of the Personal Response System - PRS RF during laboratory classes for first year students of Biophysics in years 2009-2011 at Jagiellonian University.
Key words: *electronic assessment, Personal Response System, interactive learning environment.*

Introduction

Recent rapid development of information and communication technologies creates new opportunities and challenges for teachers and lecturers. The technological revolution in the classroom has begun with the introduction of interactive whiteboards, tablets, e-panels and electronic response systems. In a complete interactive classroom (so-called interactive learning environment) we can find all those elements. One of the latest devices to have been put into use is the Personal Response System – PRS (Draper, Cargill, & Cutts, 2002), (Abrahamson, 2002). The primary PRS system operated in infrared technology. That device was similar to a TV remote. It allows the lecturer to present a question and gather answers from students. Unfortunately this tool worked only in synchronous mode – the teacher presents a question and then collects responses from all students. After all students answer or a given amount of time has passed, the teacher can submit another question and collect the next answers. This form of work can be successfully used during interactive lectures in which the involvement of listeners (Shaffer & Collura, 2009) as well as the attractiveness of the lecture are raised (Cue, 1998). Similar results were obtained using the system on various subjects (D'Arcy, Eastburn, & Mullally, 2007), (Shaffer & Collura, 2009). Unfortunately that tool doesn't allow dividing students into groups, so all students have to answer the same question at the same time. Additionally, the teacher has to define the tempo of answers and it cannot be personalized. IR technology, which was also used, implies restrictions on the type of questions that can be used and coverage of the classroom. The primary PRS has been used for more than ten years but

because of its limitations it could not be effectively used as an assessment tool. A novelty of the recent years was the implementation of PRS systems operating in radio frequency – PRS RF (Jefferson & Spiegel, 2009). The modern PRS RF system includes, inter alia, working in synchronous, asynchronous and homework modes and various forms of questions – tests, fill in the gap, true/false tests, numerical questions etc. Working in asynchronous mode ensures individualization of system users' operations, so students can answer test questions in random order and work at their own pace. RF technology ensures a better range of operation so the possibility of problems receiving answers is much lower. Also, the variety of question types is greater, which makes the system much more useful. New functionality creates possibility to use the system as an assessment tool (Bernard, Broś, & Migdal-Mikuli, 2008). Unfortunately the methodology of its application doesn't exist, and its effectiveness is unknown. For these reason studies of system's usefulness for assessment were established. The aim of research was to check the efficiency of the PRS RF system and identify its weaknesses and limitations. Also, the attractiveness and complexity of the system was evaluated.

Methodology of Research

In the academic years 2009-2011 the Department of Chemistry Didactics of the Jagiellonian University implemented a PRS RF system during laboratory classes. The system was tested on a group of 36 students (12 in the academic year 2009/2010 and 24 in 2010/2011) during 11 consecutive laboratory classes on 'General Chemistry with Elements of Physical Chemistry' for 1st year students of Biophysics. Before the students began the laboratory experiment, there was a short test assessing whether the students' theoretical knowledge was sufficient to commence laboratory works. The lecturer allowed the students to start the experiment only after achieving a positive score on the test. Time limitations required the lecturers to conduct a short test and to assess it immediately. Due to such limitations, a decision was taken to introduce the PRS system during laboratory classes.

Before the laboratory test, students were trained in using PRS remote controls. During the test students always had instructions on how to use controllers. Each test consisted of six diverse questions, including computational questions. It was allowed to answer each question once, with no chance to change the choice. Students were responding using PRS RF in asynchronous mode. Besides the electronic test students were filing out classical paper answer sheets. They were asked to fill the paper version first and then send answers by PRS. The time of the test was always 20 minutes, including time for coding answers in controllers. Students' scores obtained via PRS and in the traditional way were compared. Evaluation survey questionnaire was conducted after first use of system and repeated at the end of semester. In the survey students could assess the attractiveness and usefulness of the system using 1-to-5 bipolar scale. Students also estimated the time necessary for coding answers. The results were analysed statistically on the basis of the STATISTICA 9 software.

Results of Research

Results were obtained for two groups of students in academic years 2009/2010, 2010/2011. All data were analysed together. For each laboratory class, the answers given in the traditional and the PRS form where compared. Any discrepancy between the paper and electronic version score was treated as an error.

Number of errors is expressed by the percentage of students with identified errors. The results are shown in Figure 1.

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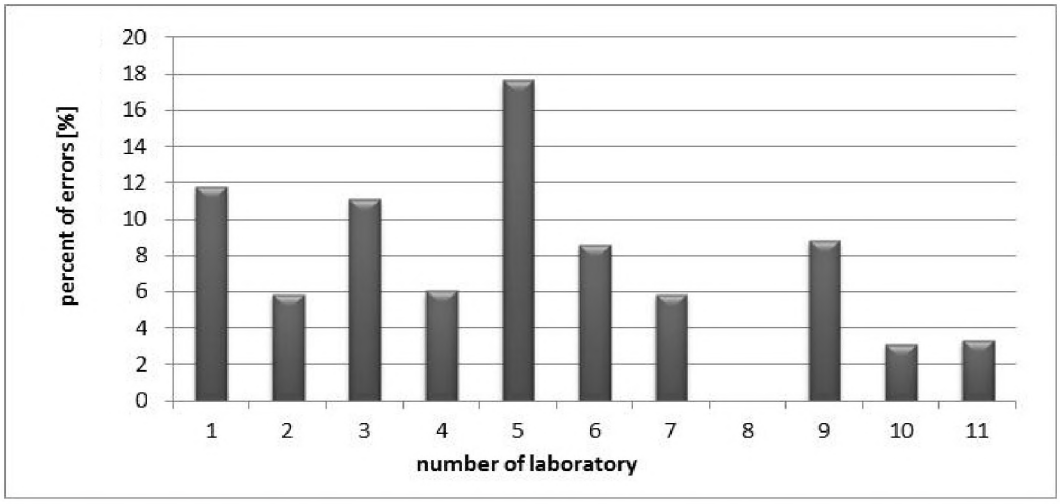

Figure 1: Percent of discrepancies in answers given by students in paper and electronic version during next laboratories.

During first uses the percent of errors is in the range 6-12%. Detailed analysis of answer sheets lets us define three main groups of errors:

1. No transfer of results.
2. Missing symbol of the test group, system cannot assess answers.
3. Discrepancies in results of traditional and electronic test.

Errors divided by type are shown at Figure 2.

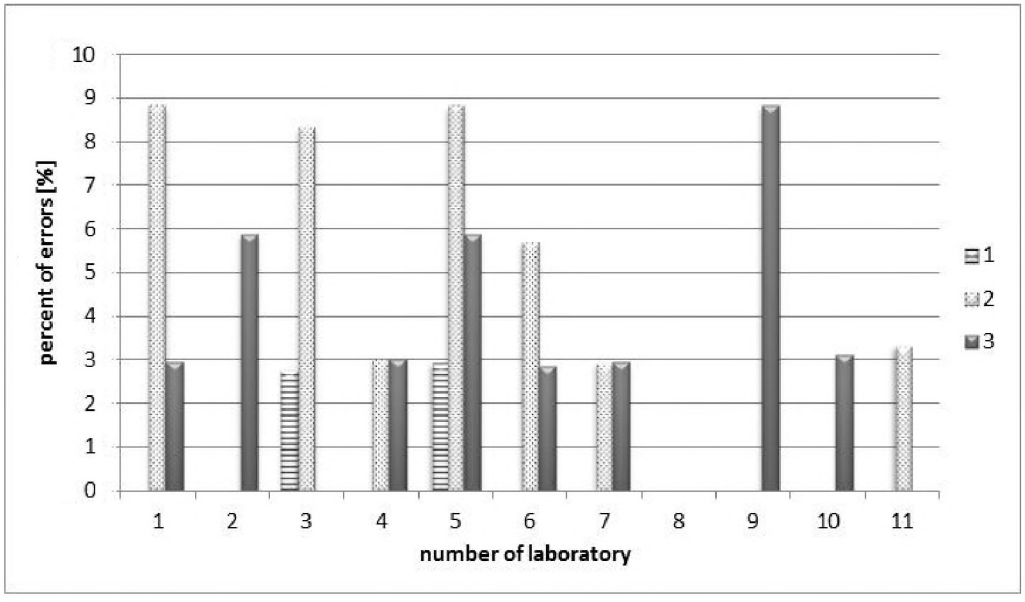

Figure 2. Percent of discrepancies in students' answers in paper and electronic version. Series: 1 - no tansfer of results, 2 - missing symbol of the test group, 3 - discrepancies in result of classical and electronic test.

Questions and results of the evaluation surveys are given in Table 1. The percentage

score is a weighted average from answers of both groups.

Table 1. Questions and results of the evaluation survey, A – results after first use, B – results after all course (system used 11 times).

Question	Answers Percentage score [%]					
Hove do you like the PRS system as a form of assessment?	I like it very much		Yes, I like it	I rather like it	I don't like it	It's hard to say
	A	40.00	20.00	26.67	6.67	6.67
	B	35.83	32.89	23.80	7.49	0.00
Do you think that using the PRS system as an assessment tool during future classes will be a problem for you?	Yes		Rather yes	Rather no	No	It's hard to say
	A	5.88	23.53	35.29	29.41	5.88
	B	8.82	0.00	46.26	40.37	4.55
How difficult was it to use the PRS controller?	Very difficult		Difficult	Rather easy	Easy	Very easy
	A	18.75	0.00	12.50	62.50	6.25
	B	0.00	2.94	13.37	53.48	30.21
Is the user tutorial understandable?	Yes		Rather yes	Rather no	No	It's hard to say
	A	75.45	24.65	0.00	0.00	0.00
	B	80.75	19.25	0.00	0.00	0.00
How long does it take you to operate the PRS controller?	2 – 3 minutes		3 – 5 minutes	5 – 7 minutes	More than 7 minutes	It's hard to say
	A	58.82	35.29	5.88	0.00	0.00
	B	59.89	31.02	0.00	0.00	9.09

Presented results can be considered as reliable. Questionnaire survey is internally consistent, calculated Cronbach's alpha equals: 0.94 (Cronbach, 1951). Calculation based on split-half method (Raju & Guttman, 1965) with correlation between first and second half: 0.98.

Discussion

Despite training in the use of the PRS system and the positive assessment of the written tutorial, difficulties in using controllers are noticeable. The number of errors in coding answers is in the range 6-12% and a general tendency in decreasing the number of errors is shown. Errors described as 1st and 2nd group are caused by troubles with use of remote controllers. It can be noticed that the number of those errors is decreasing over time and are eliminated after about the 6th use of the system. Errors of 3d group are occurring randomly. In this group incidental mistakes were counted. Discrepancies in the result of traditional and electronic tests can also be connected with changing answers on the written test. The established methodology of use of the PRS system did not allow changing answers that were sent electronically, unfortunately students can change answers on paper sheets. The nature of other errors indicates that students should be allowed to send at least one correction response for each question.

The results of survey show that students positively appraise the PRS system used as an assessment tool and this rating seems to be constant. About 7% of students do not like using the system, and also this judgment did not change over time. A similar amount of students predict that operating the PRS system during future classes may cause them problems. It may be surprising that negative opinion is not correlated with difficulties in operating the system. After the first use almost 20% of students assessed using controllers as difficult and this percentage is

decreasing in time by up to 2%. This effect is typical due to forced practice in using the system. The estimated time needed to encode six responses by a skilled user is less than 5 minutes. However, students pointed out that most of this time is necessary for connecting the controller to a PC, encoding answers is quick and they claim that this time should be enough to encode up to 15 answers. Tutors conducting classes assessed the time needed to manipulate the system in comparison to time spent on test verification is very beneficial. In addition, the PRS electronic gradebook that automatically gathers scores from all tests was described as very convenient.

Conclusions

System of remote controllers (Personal Response System - PRS RF) working in the radio frequency was implemented as an assessment tool at the university level. System was operated in asynchronous mode and various types of questions were used. The studies carried during pilot implementation of PRS RF system show that its functionality makes it valuable and effective tool that can improve process of students' testing. Due to the occurring response coding errors by inexperienced users, it is advised to use both classical and electronic test versions initially. Despite those problems the system is attractive and positively appraise by students.

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Received: *September 21, 2011* Accepted: *October 24, 2011*

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