Mapping the Multi-instrumental Approaches to Teaching at Primary (Lower Secondary) Schools

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Abstract. This article describes the results of the phone interviews across the Czech Republic at primary (lower secondary) schools focused on mapping the multi-instrumental approaches to teaching physics at primary schools. It was examined whether schools own some Computer-aided Assessment System or Online Homework System and if these systems are used. Equally, ownership of measurement systems using a computer and its use was checked. The use of a combination of these systems and their impact on the quality of education has been also examined. Results show that most schools do not use a combination of these systems and consequently this multi-instrumental approach but they think it might have benefits.

1 Introduction

Connecting of system CAA (Computer-aided assessment) [1] and SMPSL - measurement systems using computers [2] forms multi-instrumental tool as an element of change in the approach to the teaching of physics. The aim of this research is, with the help of interviews, to map the use of these systems and their combinations.

2 Used Instruments

Systems CAA (Computer-aided assessment) are suitable for testing and practicing mathematical knowledge. CAA platforms can help consolidate student´s understanding, support self-directed learning and make it easier for instructors to manage growing class sizes. These systems also contain special features such as working with graphs, series and mathematical symbols. In addition to practicing mathematical knowledge it is also available to use CAA platforms in physics. [3, 4]

SMPSL (measurement system using a computer) enables using sensors connected to the hardware of the system to a PC evaluation program. The evaluation is created using a graphical representation of values from the computer. It is a system that enables the collection, management and processing of data obtained with the measuring device that is connected to the computer. Such experiments are also called computer-aided experiments. [5, 6]

2.1 Research Methodology

Analysis was performed using a telephone interview at randomly selected primary schools in each region of the Czech Republic. For each region 3 schools were randomly selected. There are 13 regions plus capitol city. The list of schools was selected from the register of schools of the Ministry of Education, Youth and Sports. [7] A random analysis was conducted in scientist calculator from the list of schools.

The exact procedure for finding schools was as follows. There has to be contacts with teachers of physics. First, researcher finds a list of Czech primary schools on the website http://rejskol.msmt.cz/, where under "Type of school / facility" "B Primary-schools" is selected, then under "county / district:" the schools from particular regions can be found. After the list of schools was created, a scientific calculator was used to select 3 schools randomly from each region (plus Prague). These schools were subsequently searched on the Internet (to locate the physics teacher´s phone number or teachers' lounge).

Questions for the interview were determined as follows:
1. Do you own any CAA (Computer-aided assessment) systems? If so, which one?
2. Do you use these systems?
3. Do you have any Measurement systems using computers? If so, which one?
4. Do you use these systems?
5. Do you use the combination of these systems in teaching? (Multi-instrumental approach) Or a combination of other “educational” systems in teaching physics?
6. How often do you use this multi-instrumental approach?
7. Do you think that this approach affects the quality of pupils´ knowledge of physics?

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6. ALT: If not, would you consider this approach, and why?

The following explanation was added for the first question. Explanation of what "CAA" is. Computer-aided assessment automatically creates and evaluates tasks (immediate feedback for students).
6. ALT means alternative question if this multi-instrumental approach was not used.

3 THE RESULTS

The results are processed using quantitative-qualitative research methods and are shown in the following tables and graphs.

Table 1 shows the results of question whether schools own any CAA (Computer-aided assessment) systems. If so, which one?

Table 1. Do you own any CAA (Computer-aided assessment) systems? If so, which one?

1. Do you own any CAA (Computer-aided assessment) systems? If so, which one?	
Yes	No
2	40

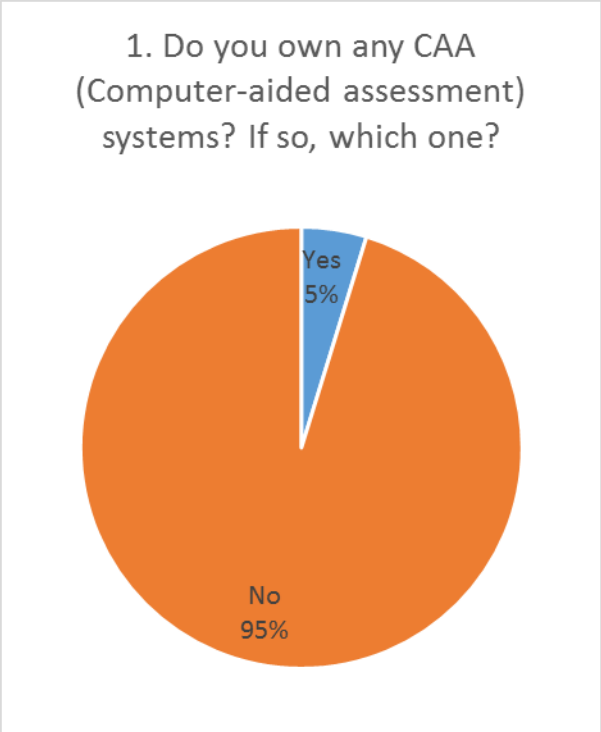

Fig. 1. Do you own any CAA (Computer-aided assessment) systems? If so, which one?

It is clear from Table 1 and Figure 1 that 95% of schools do not possess any CAA (Computer-aided Assessment) systems. In two cases, the answer was positive for system Moodle [8]. Learning Management System (LMS) Moodle is not a typical CAA system but under certain circumstances it can be considered as CAA system when Moodle quiz module is used.

Table 2 then shows the answer to the question 2 whether these systems are used at schools.

Table 2. Do you use CAA systems?

2. Do you use CAA systems?	
Yes	No
2	40

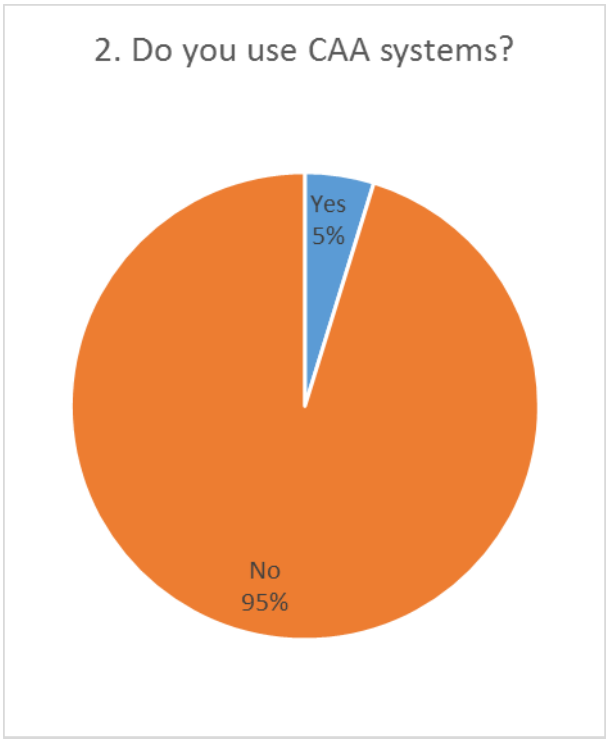

Fig. 2. Do you use CAA systems?

Table 2 and Figure 2 clearly indicate that if a school owns the CAA system, then it is used. The answer therefore directly follows the previous question. Although, it is just LMS Moodle which is used for CAA.

The third question dealt with the second component of the multi-instrumental approach in teaching physics. So, whether schools own any Measurement systems using computers. If so, which one?

Table 3. Do you own any Measurement systems using computers? If so, which one?

3. Do you have any Measurement systems using computers? If so, which one?	
Yes	No
7	35

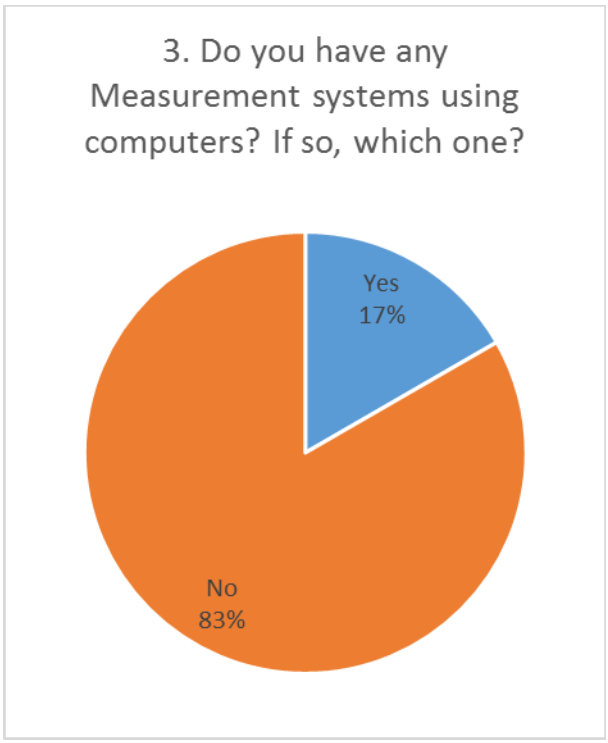

Fig. 3. Do you own any Measurement systems using systems? If so, which one?

From Table 3 and Figure 3, it is seen that in this area there is already an awareness of existence of this system. 17% of teachers from survey own Measurement systems using computers. It was system Vernier [9] or Pasco [10].

The fourth question, as well as question 2, follows the previous one. The question is: "Do you use Measurement systems using computers?"

Table 4. Do you use Measurement systems using computers?

4. Do you use Measurement systems using computers?	
Yes	No
6	36

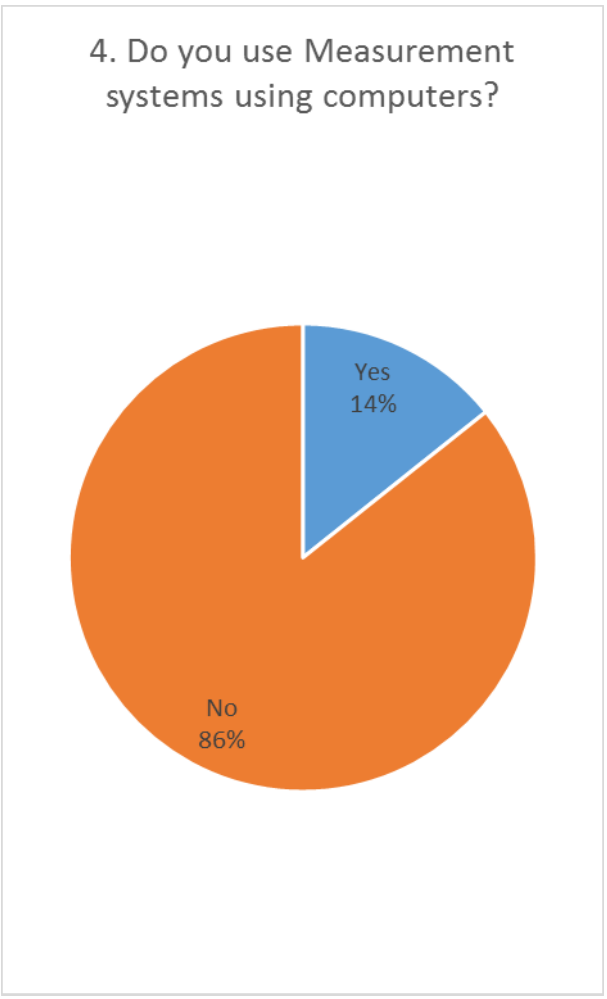

Fig. 4. Do you use Measurement systems using systems?

Table 4 and Figure 4 show that if a school owns the system, it is not used in all cases. See Table 3 or Figure 3.

The fifth question was: "Do you use the combination of these systems in teaching? (Multi-instrumental approach) Or a combination of other "educational" systems in teaching physics?"

Table 5. Do you use the combination of these systems in teaching? (Multi-instrumental approach) Or a combination of other "educational" systems in teaching physics?

5. Do you use the combination of these systems in teaching? (Multi-instrumental approach) Or a combination of other "educational" systems in teaching physics?	
Yes	No
2	40

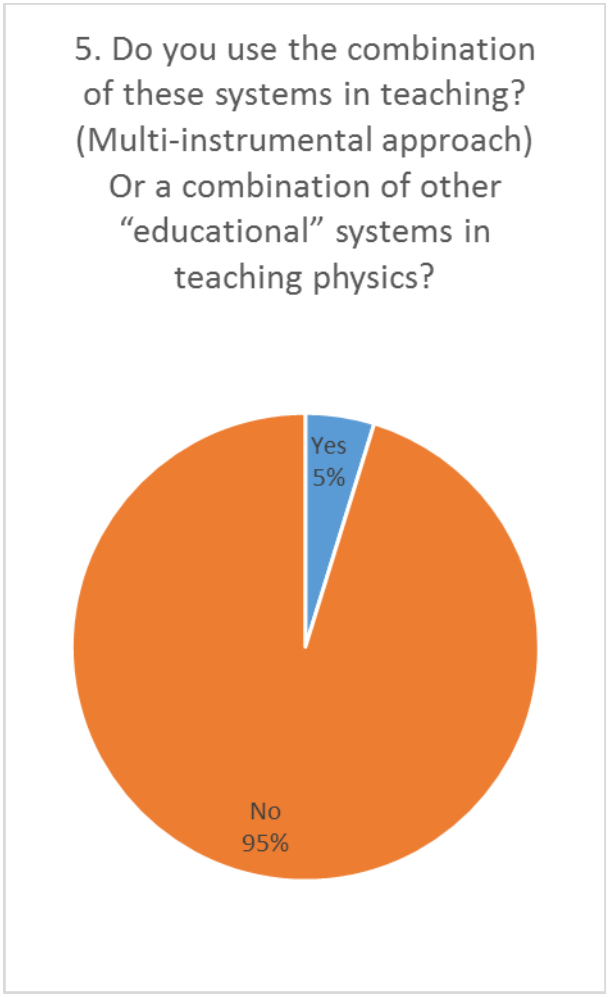

Fig. 5. Do you use the combination of these systems in teaching? (Multi-instrumental approach) Or a combination of other "educational" systems in teaching physics?

Table 5 and Figure 5 present a combination of these systems. From the results it is seen that in 95% it is not used. From straight answers of interview even in this 5% it is not a direct combination of SMPSL and CAA systems. The interviewees use internet applets. In these applets there is a partial use of the CAA and in terms of Measurement systems using computers it is a virtual laboratory.

Question 6 (How often do you use this multi-instrumental approach?) was not answered in any of the cases. It is therefore a thing that does not take place.

The seventh question (Do you think that this approach affects the quality of pupils´ knowledge of physics?) is purely subjective. There also appears the idea that teachers do not know: Alternatively, they developed answers as follows:

For clarity or understanding of pupils it should effect.

It has a positive effect.

I hope this can help with understanding of graphs.

Each new technology will help.

It is individual.

It's interesting to learn with that.

While drawing graphs and measurement addiction, it is more illustrative.

It's fun.

Good feedback.

Conversely:

The classical education is better.

It's too complicated.

See Table 6 and Figure 6.

Table 6. Do you think that this approach affects the quality of pupils´ knowledge of physics?

7. Do you think that this approach affects the quality of pupils´ knowledge of physics?		
Yes	No	I do not know
31	3	8

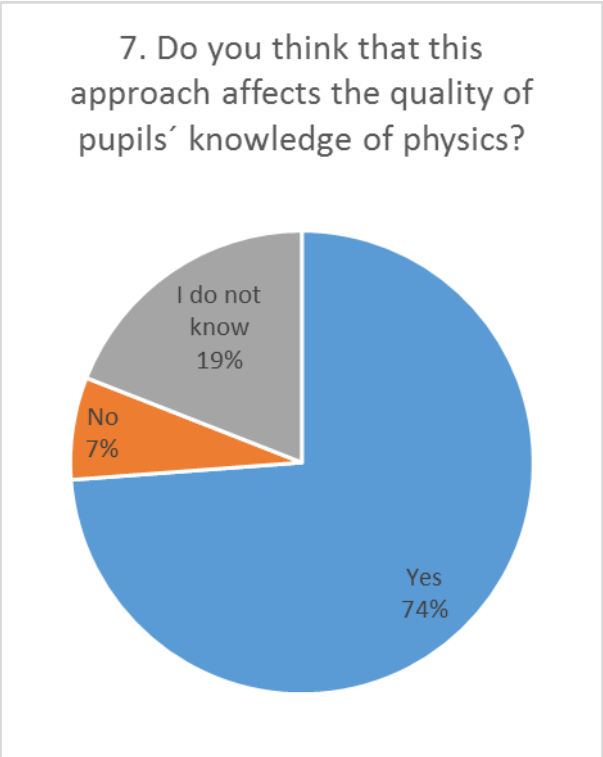

Fig. 6. Do you think that this approach affects the quality of pupils´ knowledge of physics?

As a last question, the alternative question to the question 6 followed: "If not, would you consider this approach, and why?"

Table 7. If not, would you consider this approach, and why?

6.ALT: If not, would you consider this approach, and why?		
Yes	No	I do not know
15	15	12

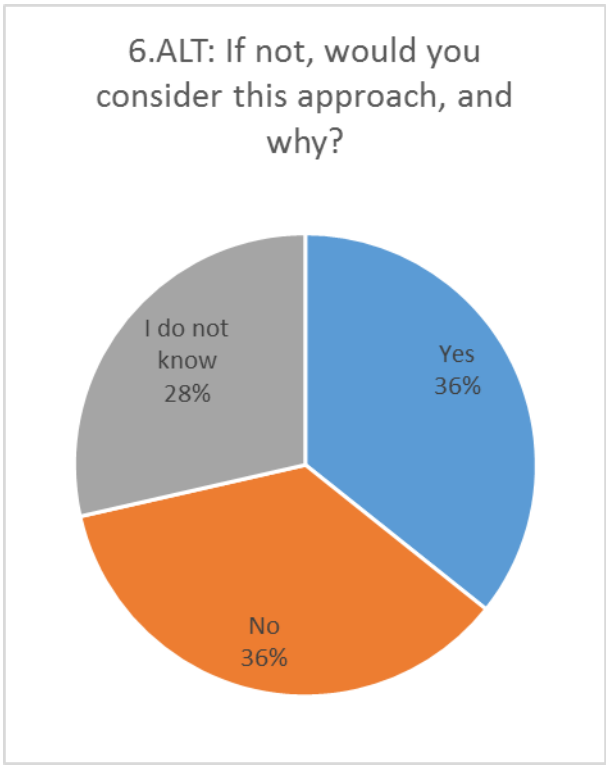

Fig. 7. If not, would you consider this approach, and why?

4 Conclusion

The results show that the system CAA (Computer-aided assessment) at primary schools in teaching physics is not used. Alternatively, the schools own and use LMS system Moodle. On the other hand, Measurement systems using computers are used or owned by 17% of respondents. In terms of combination of these systems in teaching or combination of other "educational" systems in teaching physics (Multi-instrumental approach) in 95% is disuse. The remaining 5%, however, does not use this combination directly, but the web applets. In terms of subjective opinion on this multi-instrumental approach, ¾ of opinion prevails that it could affect the quality of physics teaching at primary schools. Whether schools should consider this approach, it is based on 1/3 of "yes", 1/3 of "no" and 1/3 of "don´t know".

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References

1. Berkova, A. (2015) Pocitacove hodnoceni matematickych znalosti studentu ve vyuce matematicke analyzy (Computer-aided assessment of students' mathematical knowledge in the subject of Mathematical analysis). *Media4u Magazine*. ISSN 1214-9187.
2. R. Nemec, J. Triska, J. Sedivy. System for Measurement Using a Computer in the School Laboratory. *International journal of education and information technologies*. 2014, 8(8), pp. 37-47. ISSN 2074-1316.
3. R. Nemec, A. Berkova, P. Hanzalova, (2016) The Connection of System SMPSL (System for measurement using a computer in the school laboratory) and CAA (Computer Aided Assessment) for Demonstration of Mathematical Modeling of Angle. *WSEAS Transactions on Information Science and Applications*. ISSN 1790-0832.
4. A. Berkova, J. Kulicka, (2015) Modelling and Simulation in Teaching of Future Teachers of Mathematics, *ICERI 2015 Proceedings* (*8th International Conference of Education, Research and Innovation)*, IATED, Seville, pp. 7525-7533.
5. R. Nemec, A Berkova, S. Hubalovsky, The Use of Method of Multidisciplinary Approach, Modeling and Simulation in Learning of Gear Ratios. *International Journal of Mathematics and Computers in Simulation*, volume 10, 2016 ISSN: 1998-0159
6. R. Nemec, S. Hubalovsky. Influence of Systems for Measurement using Computers to Popularity of Subject Physics at Elementary School – Some Results. In: *13th International Conference on Data Networks, Communications, Computers* (DNCOC 2015), Zakynthos Island, Greece, ISBN: 978-1-61804-355-9.
7. MŠMT. *Rejstřík škol a školských zařízení* (*Index of schools and school facilities)* [online]. 2016 [cit. 2016-03-01]. http://rejskol.msmt.cz/
8. *Moodle*. [online]. 2016 [cit. 2016-03-26]. https://moodle.com/
9. *Vernier*. [online]. 2016 [cit. 2016-04-01]. http://www.vernier.com/
10. *Pasco*. [online]. 2016 [cit. 2016-01-01]. https://www.pasco.com/