Lodz University of Technology, Lodz, Poland
Faculty of Electrical, Electronic, Computer and Control Engineering

Interactive question based learning methodology and clickers: Fundamentals of Computer Science course case study

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Question Based Learning

- The idea of question based learning is known at least from the times of Socrates .
- This style of interaction, however, becomes very difficult as class size increases.

Socrates
c. 469 BC – 399 BC

What are Clickers?

Clickers are the handheld small transmitters commonly used in an **audience response systems (ARS)**

Wireless infrared clicker used at the WEEIA Faculty at TUL for immediate voting responses during Faculty Council meetings

Background of the Project

Clickers technology was introduced to teaching of ***Fundamentals of Computer Science*** for the following reasons:

- The size of lecture group is about 150 students
- Students active participation in lectures and exercises in large groups is poor
- Opportunities for feedback during the lectures are limited

Advantages of Clickers

- Active engagement of all students in the lecture
- Anonymous answers
- Allows the lecturer to monitor class progress

Internet-based ARS at TUL

- An Internet-based ARS application for learning support was developed.
- ARS software is used in lecture rooms with Wi-Fi access
- Students use their laptops or mobiles
- The system is based on Joomla content management system (CMS) and its JVoteSystem component.

Clickers software at TUL

Student question panel in the Internet-based ARS application

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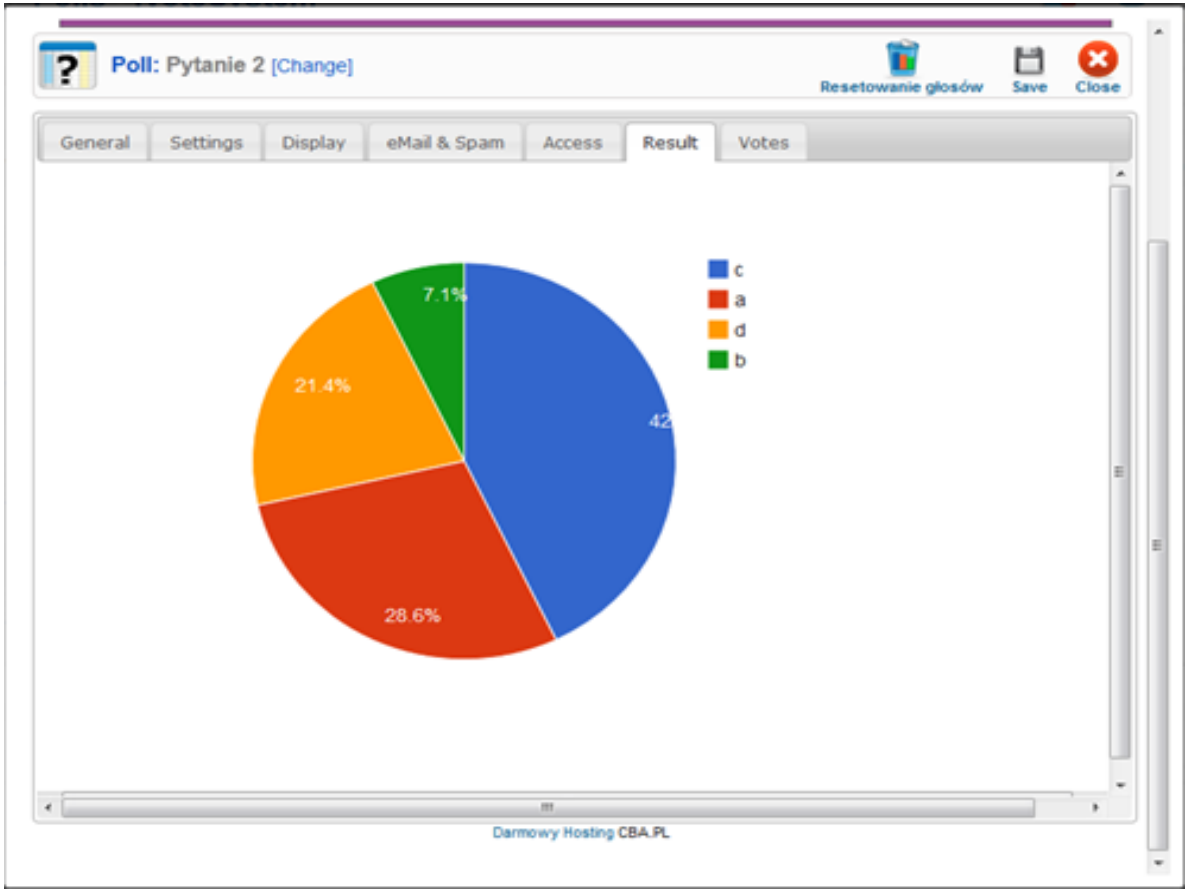
Clickers software at TUL

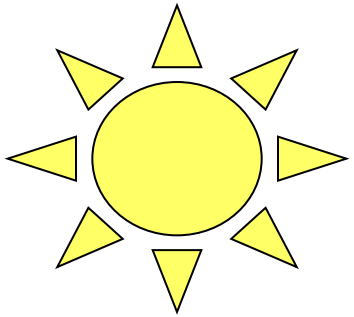


A pie chart of students' answers

Question Based Learning

Exercise1

Test C1



```
int a = 2;
int b = 5;
float x,y;
```

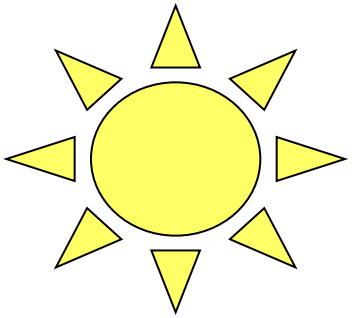
Calculate:

1. `x = a / b;` // x = 0.0
2. `x = 1.0 / a;` // x = 0.5
3. `y = (float)a / b;` // y = 0.4
4. `x = y + 1 / a;` // x = 0.4 + 0 = 0.4

Question Based Learning with ARS

Exercise1

Test C1



```
int a = 2;
int b = 5;
float x;
```

Calculate and mark the result of the expression: x = a / b;

a) x = 0.0

b) x = 0.5

c) x = 0.4

d) x = 0.6

Question Based Learning

Test C2 ang

Question 8

The following program:

```
#include <stdio.h>
main()
{
  int a [3][3]= { { 1,2,3} , { 4,5,6}, {7,8,9}};
  printf("%d" , a[2][1]);
}
```

results in:

a) 8
b) 9
c) 7
d) none of the above

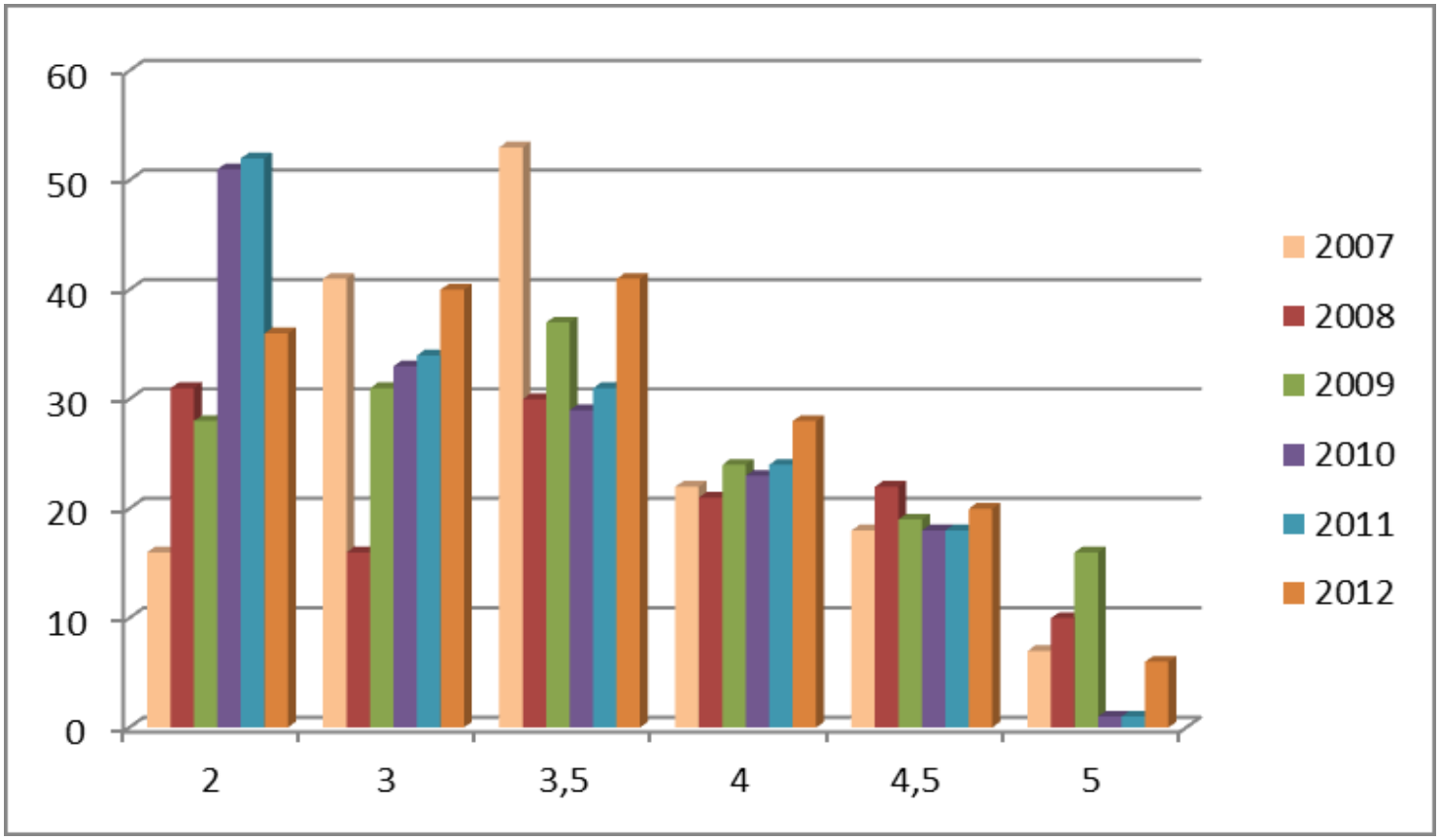
Examples of the interactive lecture questions for Test C2

Results of Question Based Learning

Test C1 results

Year	Mean Grade	Std. Dev.	No. of students
2007	3.47	0.74	157
2008	3.45	0.98	130
2009	3.48	0.92	155
2010	3.10	0.90	160
2011	3.10	0.89	168
2012	3,32	0,86	171

Results of Question Based Learning



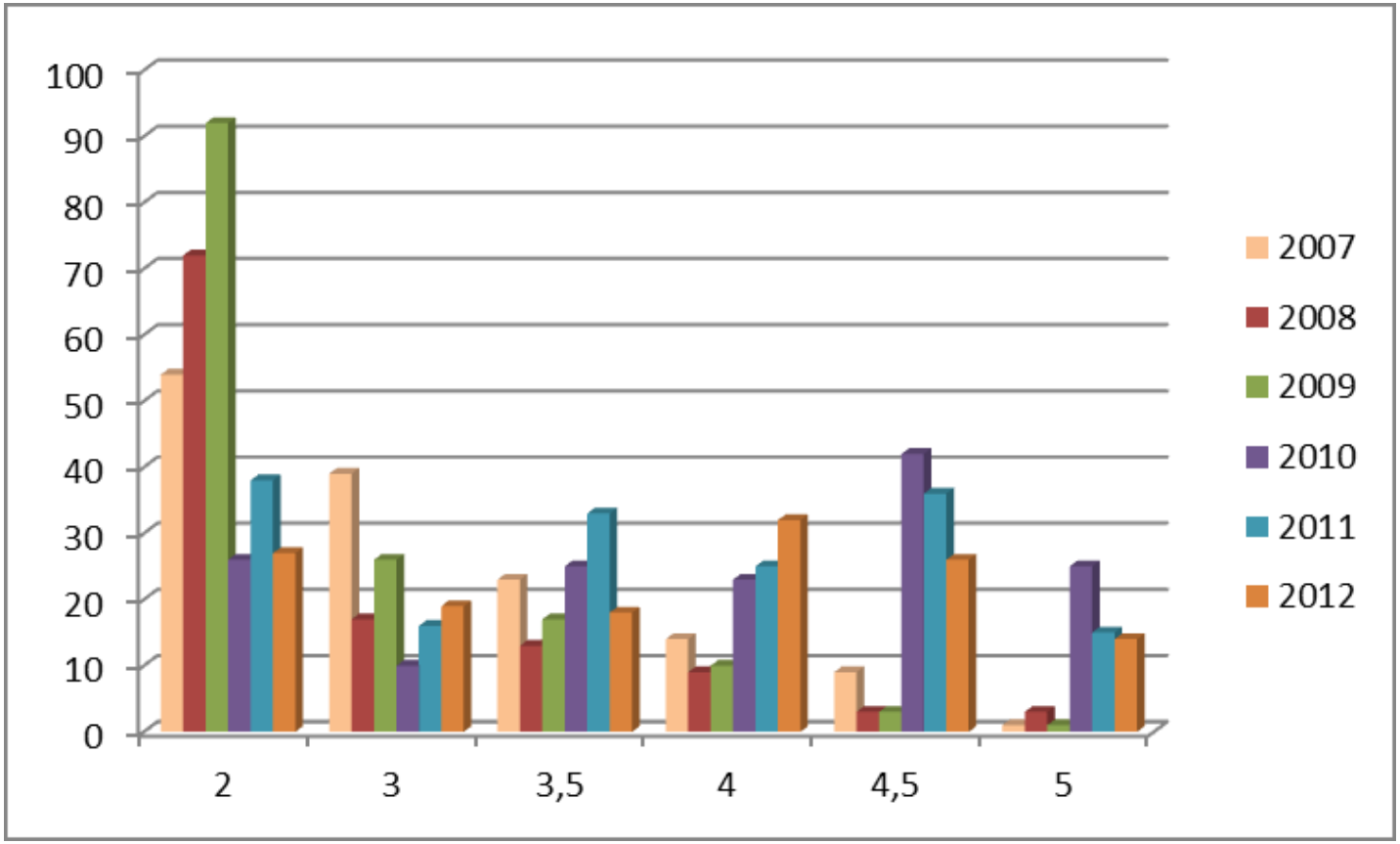
The histogram of student grades of Test C1

Results of Question Based Learning

Test C2 results

Year	Mean Grade	Std. Dev.	No. of students
2007	2,92	0,83	140
2008	2,61	0,86	117
2009	2,55	0,77	149
2010	3,81	1,00	151
2011	3,53	1,01	163
2012	**3,60**	**0,98**	**136**

Results of Question Based Learning



The histogram of student grades of Test C2

Conclusions

- Question based learning methodology has strongly improved students learning outcomes (comparison of tests C1 and C2)
- Clickers technology encourages students to active participation in the lecture