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Opinions on “Classroom Response System” by first-year engineering students

José Luis López-Quintero[a]*, Marta Varo-Martínez[a], Ana Mª Laguna-Luna[a], Alfonso Pontes-Pedrajas[a]

[a]*Departamento de Física Aplicada, Campus de Rabanales, Universidad de Córdoba, Córdoba 14014, Spain*

Abstract

The aim of this research is to gather students’ opinions about an implementation of Classroom Response System in university lectures. The study covers the thoughts of first-year undergraduates enrolled in an introductory physics course belonging to an engineering degree. The teaching methodology consisted on Concept-Test questions which were answered by all the students using a Classroom Response System, followed by small discussions leaded by the teacher. Opinions were collected through an on-line survey that was delivered to participants at the end of the academic year. The questionnaire consisted in nineteen Likert scale items that covered three categories: the tool, attitudes and learning. A final open-ended question was also added. Data was interpreted using descriptive statistical methods. Findings show that students gave an overall positive evaluation of the tool, as well as to its advantages as an enhancer of: (a) attention, (b) participation, (c) classroom dynamics, and (d) learning, with a special remark on the role it plays on real time self-evaluation of their own learning during lectures.

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Keywords: Science education; Classroom Response System; Clickers; Students’ opinion

1. Introduction

Several methodologies are grouped under the name of Interactive Engagement. They were developed with the aim of solving common problems concerning traditional teaching methods where the student role is set to a merely listener. This brings, consequently, that lectures at universities do not produce the learning goals that are presumed

* Corresponding author
E-mail address: f92loquj@uco.es

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to achieve (Mazur, 1997). To increase these learning gains, as well as the participation of undergraduates into the classroom environment, a considerable number of new methods have been incorporated into lectures with most of them relying on electronic resources. These methods make use of activities such as group discussions about theoretical concepts, grouped problem solving or electronic devices like Classroom Response Systems (CRS).

Classroom Response System (CRS) consists in small transmitters that allow each student to answer in a short period of few seconds to multiple-choice questions formulated by the teacher. Current systems consist in credit card sized wireless devices powered by batteries. These devices adopt different names within literature, sometimes referred as *'clickers'* or *'personal response system'*. In addition to *'clickers'*, a computer system is also required to record the answers submitted by the students. A common choice is a laptop computer with specific software installed to collect and store the responses. The receiver is a small antenna which is plugged into an USB port. This computer is also connected to a video projector where questions are presented as slides of a presentation, allowing students to receive instant feedback of their responses during class time (Varo, 2014).

Numerous studies have shown that these methodologies may bring benefits toward learning. Chen et al. (2010) found that the rapid feedback obtained with CRS may increase learning. Bunce et al. (2010) recommend this kind of student centered pedagogies to increase attention, as they found that attention is not kept during a whole traditional lecture.

Several student-oriented researches have been done for finding their opinion and attitudes toward CRS. Prather and Brissenden (2009) found that undergraduates thought that this methodology contributed to increase their learning and exam performance, as well as enhanced the participation and motivation during lectures. Students usually give positive feedback about the advantages that CRS brings toward learning (Cortright et al., 2005; Giuliodori et al., 2006). Hoekstra (2008) found that students manifest that CRS helps to decrease the anxiety related to learning new concepts, due to the laid-back attitude adopted in classroom. Anonymity related to CRS has also been covered by literature. Berry (2009) found that students believed that a system where there is no record of individual responses made them more prone to answer to the questions, and on the other hand, while being recorded they sometimes avoided voting rather than giving a possible incorrect answer. As a summary, studies which cover opinions from students state that about a 70% of the undergraduates give positive reviews for the tool when they are asked about the resource itself, on the other hand positive reviews are also found, but with lowest rates, when they are asked about the relationship between the methodology and their learning (DeBourgh, 2008; Patry 2009; Perkins & Turpen 2009; Prather & Brissenden 2009; Nájera, et al., 2010; Varo et al., 2015).

2. Design

This study examined undergraduates' opinion on the use of CRS. Participants were 68 first-year students of an Electric Engineering degree at a Spanish university, where the methodology was implemented in all the lectures of its annual introductory physics course. The data had been collected by surveying undergraduates at the end of the course by using an on-line form hosted at Google Drive platform.

2.1. Teaching methodology

Teaching methodology consisted in conceptual questions embedded in several multimedia presentations that contain the subject contents. These presentations served as both: (a) a script for teacher's development of lectures, as well as (b) a content reference resource for students and for their further studying toward exams. Each session incorporated a number of between 4 and 10 conceptual questions which were related to the contents of the lectures. This methodology had been used in all the lectures of the year, starting from the beginning of the course.

During lectures the methodology followed the next steps: (a) a concept was explained by the teacher, (b) a question was projected on the screen and the teacher read it, (c) students answered this question by using the Classroom Response System (CRS) within an interval of ten seconds in which they could check if their answers were recorded by the receiver by looking at a number list in the screen, and (d) a bar chart was displayed where the correct option was highlighted with a different color. After each question, a small discussion was started where students were asked about their reasoning to reach the correct answer. Finally, the process ended with a small repetition of the contents by the teacher, which was focused on supporting or refuting students' arguments.

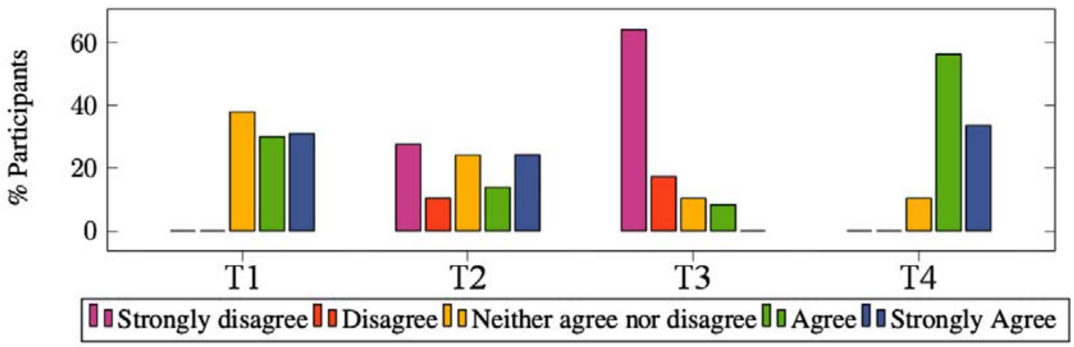
2.2. Survey

The survey consisted on twenty questions where nineteen of them were items of a Likert scale and the final one was an open-ended question. The questionnaire was designed by classifying its items into three blocks that aim to cover three main categories: (a) the tool itself, its usage and its general benefits, (b) the attitudes of students toward the methodology and (c) the way it relates to their learning. The collected data, therefore, consists in opinions from students rather than in external measures. The interpretation had been done through descriptive statistical methods, without trying to find the causes that originated these results.

3. Results

3.1. Likert items

Figure 1 shows bar diagrams representing some of the responses to the items regarding the tool. Results show that 62% of the students believed that the communication between them and the teacher was enhanced due to CRS (T1), although this should be interpreted with some caution as the most repeated answer was set to a neutral opinion. There is no preference found for anonymity (T2), with a 40% of participants stating their preference for classroom lists associated to their answers and a 38% who did not want them to be recorded individually. Again, the neutral point of view holds a representative number of responses. It becomes clearer that students found that there were no difficulties related to the adoption and usage of the tool (T3), finding a 79% of participants who stated in favor of the ease of its use. The global evaluation of the tool (T4) obtained also a high rank by undergraduates, with a 90% of participants who gave positive opinions.



T1	Enhances communication with teacher	**T3**	Is difficult to use
T2	I prefer anonymity	**T4**	Global rating

Fig. 1. Likert answers to tool related items

Figure 2 shows the responses to the Likert questions regarding attitudes. Students gave positive reviews to all the items within this block. A 79% of participants stated that the CRS increased their participation in class (A1). Similar values were found between the opinions for the attention (A2) and motivation (A3), with an 81% of students stating that this methodology helped them to increase their attention, as well as a 75% stating an increase of motivation. Students were even more determining in evaluating the role that CRS played in making lectures more dynamic and enjoyable (A4), obtaining a total of 93% of responses located in the positive values of the scale. It was found that, when being asked about attitudes, students trended to give strong positive opinions. In fact, the most repeated answer always corresponded to the highest value of the scale.

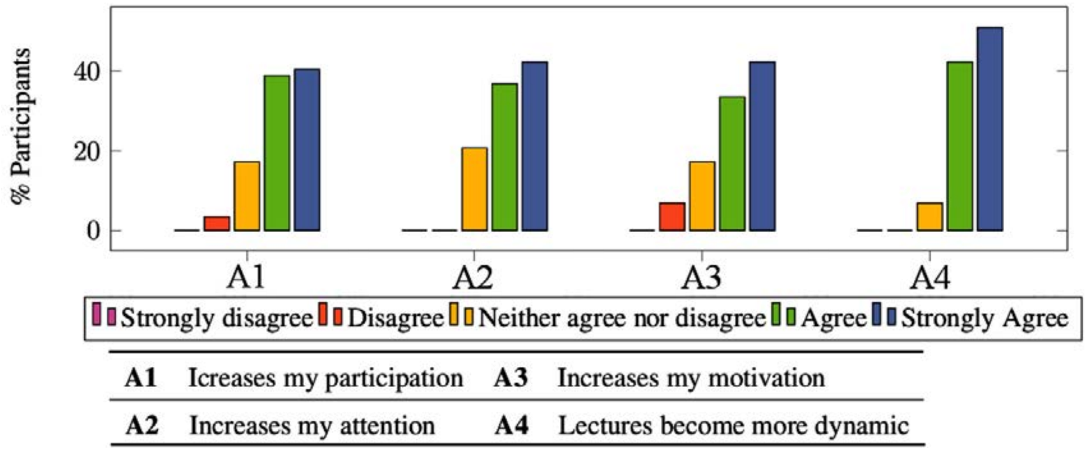


Fig. 2. Likert answers to attitude related items

Figure 3 shows the answers for the learning block. A positive evaluation was found related to both: the self-evaluating aid that CRS brings to lectures (L1) and the lack of hindrances applied to the learning process (L2). Obtaining a total of 96% and 87% of positive responses respectively. It becomes less clear for participants, but still getting overall positive reviews, that CRS helped them to achieve a better understanding of physics concepts (L3) as well as to increase their problem solving skills (L4).

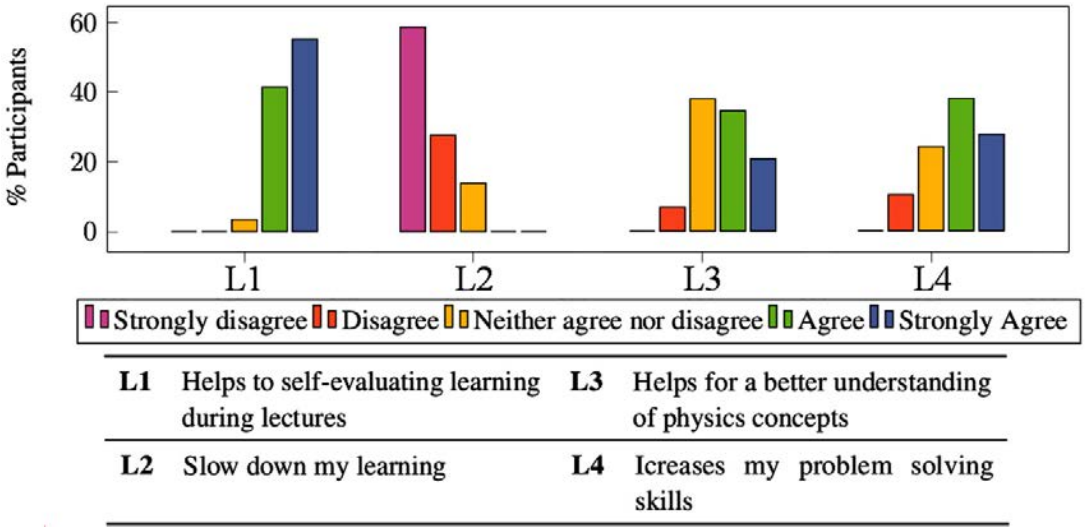


Fig. 3. Likert answers to learning related items

Table 1 shows common statistical values extracted from the selected Likert items responses, following the labels assigned in previous figures. These values are: (a) the most repeated answer (mode), (b) the median, (c) the arithmetic mean and (d) and the standard deviation (SD). For allowing calculations, numbers from 1 (Strongly disagree) to 5 (Strongly agree) had been assigned to each ordinal element of the Likert scale. On the other hand, on a bivariate analysis, a meaningful correlation had been found between the questions relatives to the difficulty of the tool usage (T3) and the difficulty toward learning (L2), having this pair a Spearman's Rho coefficient of 0.751.

Table 1. Statistical values for Likert items

Item	Mode	Median	Mean	SD	Item	Mode	Median	Mean	SD	Item	Mode	Median	Mean	SD
T1	3	4	3.93	0.84	**A1**	5	4	4.17	0.85	**L1**	5	5	4.52	0.57
T2	1	3	2.97	1.55	**A2**	5	4	4.21	0.77	**L2**	1	1	1.55	0.74
T3	1	1	1.69	1.04	**A3**	5	4	4.10	0.94	**L3**	3	4	3.69	0.89
T4	4	4	4.24	0.64	**A4**	5	5	4.45	0.63	**L4**	4	4	3.83	0.97

3.2. Open-ended question

After a selection of the meaningful responses within the open-ended question it's found (as shown in Figure 4) that a half of sentences refers to the tool (51%), while the other half is related to attitudes (23%), learning (23%) and a remaining amount of sentences that did not match any of the previous categories (3%). Some negative statements appear for the tool, *"some answers are lost"*, and for the learning process, *"I think CRS is not the best way to learn physics"*, on the contrary, only positive sentences are found for topics related to attitudes.

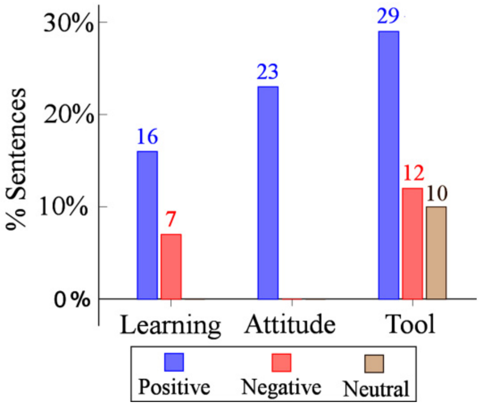


Fig. 4. Appearance of categories within open-ended question

Table 2 shows the most repeated sentences from different participants within the open-ended question. A general positive review was done by students, with a considerable amount of vague content statements among them, such as *"they are nice"* or *"it's a good tool"*. A significant coincidence between participants is found when it comes to remark the role that CRS represented to enhance the dynamism of lectures. It is also found, with a slightly less coincidence, aspects like: (a) the increase of participation and (b) attention, (c) the positive role toward learning and (d) its utility to enliven lectures. A recurrent negative sentence had also been found referring to the fact that sometimes answers are lost without reaching the receiver.

Table 2. Most repeated sentences within open-ended question

Answer	Frequency	Answer	Frequency
CRS is nice	18%	CRS enlivens lectures	8%
CRS does lectures more dynamic	10%	CRS fosters attention in class	7%
CRS increases participation	8%	I have no critique	7%
CRS is a nice method for learning	8%	Some answers are lost	7%

In addition to this, some of the sentences revealed by participants did not match any of the previous categories. One student commented, *"the tool helps the teacher to measure the percentage of students which are understanding* *the contents"*, while others remark the novelty of the methodology: *"it's a very innovative tool"*, *"it's a very original idea"*. An opinion on the frequency of use had also been found *"they are nice, though is not good to abuse"*.

4. Conclusions

This study evaluated the opinions of undergraduates about CRS accompanied by in-classroom discussions. Participants were part of an introductory physics course corresponding to an Electric Engineering degree. Findings show that students consider that CRS improved classroom dynamics within the theoretical lectures. A 93% of participants gave a strong positive opinion about the fact that lessons became more enjoyable. Additionally, undergraduates also manifested that the methodology increased their participation during the lectures. They also expressed favorable opinions about the role of CRS in enhancing the motivation they felt toward the course contents.

No clear evidence has been found about the student preference regarding the use of *'clickers'* as an anonymous tool. Consequently, both opinions, the ones agreeing the use of a classroom list associated with responses and the ones agreeing with anonymity, were found with no significant difference between them. On the other hand, almost all students had agreed with the affirmation that CRS is easy to use, although some of them had warned that the receiver does not always record their responses.

About the relationship between CRS and learning, almost all students had reported that the tool allowed them to get rapid feedback about their responses, giving an instant monitoring of their learning during lectures. None of them had expressed that this methodology brought any kind of obstacle to their learning, and a majority of participants considered that at some degree this methodology contributed to a better knowledge of theoretical concepts.

Data collected is consistent with other similar studies where undergraduates gave their most favorable opinions to the evaluation of the resource, and still positive, but not so strong, to the relationship between the tool and their learning. Nonetheless, since these last conclusions have been obtained from students' thoughts, and being the methodology in an early state of implementation, no generalization may be assumed.

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