Classroom Response System as wave physics misconceptions gathering tool

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Abstract. The aim of this project is to introduce an interactive methodology based on Classroom Response System ('clickers') in introductory physics courses belonging to engineering degrees. The methodology had been introduced in both theoretical and problem-solving lectures. This allows students to think and discuss about topics at classroom. This article focusses on the first state: using clickers to gather students' misconceptions regarding fundamentals of wave propagation. A brief discussion of those misconceptions is included.

1 Introduction

1.1 *Interactive methodologies*

Several new methodologies had been introduced in the last decades with the aim of solving common difficulties in physic teaching to avoid rote learning and algorithmically problem solving among students. Most of these methodologies rely on electronic resources. Among these resources, Classroom Response Systems (CRS) (also known as 'clickers') had experienced a rise in popularity. CRS are credit card sized wireless devices that allow each student to reply anonymously and instantly to teacher's questions projected on a screen. Some of the benefits are the increase of attention and the better understanding of physics concepts [1]. Also, students give strong positive opinions on CRS based methodologies [2].

1.2 Wave physics teaching

Wave physics is a key topic in scientist education. It allows to describie many topics such as light, ICT, sound and common matter properties. Nonetheless, students often present misconceptions on its understanding. Among these, some students argue that wave propagation depends on the characteristics of the wave source and not on the properties of the medium in which the wave propagates [3]. It's also found that students believe that sound is produced by traveling particles that move along with the wave [4].

2 Methods

This project focuses on the use of interactive methodologies on an introductory physics course belonging to the first year of an engineer degree. The goal is overcoming the common difficulties regarding to physics teaching. This paper shows some early results from 33 students that attended the course on 2016/2017 year and who completed a 12 multiple-choice questions survey covering common misconceptions on wave physics.

2.1 Teaching Methodology

Lectures were divided in several topic units. All of them were followed by a multiple-choice Concept Test embedded in PowerPoint slides that students had to reply using CRS. These

questions covered common misconceptions extracted from physics teaching researches and were ended with a small discussion directed by the teacher. Clickers were also introduced in problem solving lectures, allowing student to plan and draw their own conclusions before starting the solving steps [2][5].

In addition, every unit was started with an initial test aimed to gather students' misconceptions. This allows the teacher to plan the unit contents accordingly to the group learning difficulties. The same set of questions was repeated at the end of the unit, with the aim of measuring the knowledge gains among students. Both test were answered with CRS.

3 Results

Figure 1 shows results from the initial test. When students were asked about the traveling speed of a wave on a string, 44.2% of them answered that is a consequence of the properties of the wave (frequency, wavelength...), as extracted from responses A and D. Only the 18.6% answered that the speed depends on the properties of the medium (response B). On the other hand, in a different question regarding the movement of the particles of air where a sound wave propagates, it's found that 39.4% of the participants replied that the air particles are displaced towards propagation and carried by the wave.

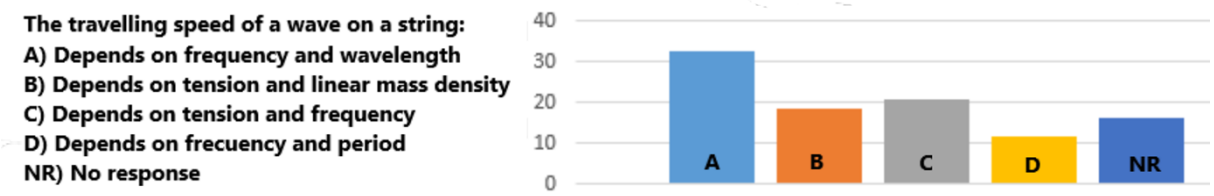

Fig. 1 Students' responses on initial test

4 Conclusions

This research is part of a project to implement an interactive methodology based on Classroom Response System in an introductory physic course. Since collected data is similar to the ones of previous researches [3][4], it's possible to assume that this tool is an effective resource to gather students' misconceptions before lectures, allowing the teacher to plan contents according to students' difficulties. Nonetheless, due to extension of this paper, the complete analysis of misconceptions on wave physics has not been included here.

References

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