USANDO UNOS DISPOSITIVOS DE RESPUESTA REMOTA (*CLICKERS*) PARA LA EVALUACIÓN ENTRE PARES: UNA EXPERIENCIA DOCENTE EN LA ASIGNATURA DE FÍSICA MÉDICA EN LA FACULTAD DE MEDICINA DE LA UNIVERSIDAD DE CASTILLA-LA MANCHA

E. Arribas†, R. Ruiz, A. Nájera[A], J. M. Villalba[A] y M.J. García-Meseguer[B]

Centro de Aplicaciones Tecnológicas y Desarrollo Nuclear (CEADEN), Cuba. lorenzo@ceaden.edu.cu†
a) Instituto de Cibernética, Matemática y Física, Ciudad de La Habana, ernesto@icmf.inf.cu
b) Centro de Aplicaciones Tecnológicas y Desarrollo Nuclear, C. de la Habana, darias@ceaden.edu.cu
†autor para la correspondencia

La Facultad de Medicina de la Universidad de Castilla-La Mancha (UCLM) inició en 1998 un innovador método de enseñanza y aprendizaje. Los estudiantes se dividen en grupos de 25 personas como máximo, y se les anima para que enseñen a sus compañeros de clase todos los conceptos sugeridos y programados por sus respectivos profesores, generalmente mediante presentaciones multimedia. Durante esas sesiones, los profesores tienen que observar y evaluar la actividad realizada. La asignatura de Física Médica es cuatrimestral durante el primer año del grado. En este contexto, hemos utilizado unos dispositivos de respuesta personal (clickers) no sólo para aumentar la participación sino también para permitir a los estudiantes evaluar a sus compañeros de clase. Un total de 95 estudiantes participaron en la encuesta.

The Faculty of Medicine at University of Castilla-La Mancha (UCLM) started in 1998 an innovative method of teaching and learning. Students are divided into groups of 25 people maximum, and they are told to teach their classmates all concepts suggested by their teachers, generally using multimedia presentations. During these sessions, the teachers have to observe and assess the activity. Medical Physics is a four-month long subject taught during the first year of the degree. In this context, we used personal response systems (clickers) not only to increase participation but also to allow students to evaluate their classmates. A total of 95 students participated in the survey.

Palabras claves. Physics education, 01.40.-d; teaching methods, 01.40.gb

INTRODUCCIÓN

Several studies in literature, from a variety of fields, have studied the effectiveness on student learning of using personal response systems (PRS), also called interactive electronic devices, class response systems, personal response units or simply "clickers" since these devices were first used in 1960s; find a review in Judson and Sawada[1]. Also there is a large body of literature on the student and professor perceptions when using these devices2-6.

Clickers were first used in the University of Castilla–La Mancha in the course 2009-10, in the Faculty of Medicine by the professors of Radiology and Medical Physics. Despite of several demonstration sessions to other colleagues, these devices have been used only in two subjects: Informatics, Information and Medical Docu-mentation and Physical Basis of Medicine, both are taken during the first year and taught by the professors mentioned above.

The aim of our work was to evaluate students' perceptions, participation and attention when using clickers. In this study we used Turningpoint® (Turning Technologies, LLC., Youngstown, OH, USA) radiofrequency response cards. This system allows faculty to pose multiple choice questions to the class. The system records individual responses from students through small personal response units and a small USB receiver (Fig.1). It provides immediate feedback on the screen through histograms and other graphics (Fig.2) completely integrated with Microsoft PowerPoint. Responses can be recorded anonymously, but during the sessions we recorded individual information to check the evolution of each stu-dent, and

to use that information in their marks. Firstly, we used infrared clickers (they are cheaper) but we changed them for radiofrequency devices because of students have to point their clickers at an infrared receiver and the system did not registered all responses in large classes.

The system also allows generating automatic reports by student, question, session, etc. The software can be freely downloaded from Turningpoint web page. All response cards must be configured (joined) in the same channel, and if there is another session in a nearby class, the channels must be different to avoid interferences. Channel configuration is extremely easy, and this problem can be immediately solved.

Teaching method in the Faculty of Medicine of the University of Castilla–La Mancha is developed in five stages: introduction of objectives, autolearning, expositions by students, tutorship learning and evaluation. These five stages period is called a module that takes 3 weeks. A four-month subject has normally six modules. To develop this method, students are divided into five groups, no more of 25 students in each group.

During the first stage, the teacher, using a PowerPoint presentation, presents the objectives that students have to learn in the module. All concepts have to be clear, and clickers were used to evaluate previous knowing and to emphasize more important aspects. Students use to read notes and documentation before this session. This material is offered to students through Moodle two or three days before the module starts.

In the second stage, students have to work by themselves and to prepare oral presentations to explain the proposed objectives to their classmates during the stage 3. In this third stage we used clickers to allow students to assess their classmates. To do so, we provided a slide through Moodle that students had to copy and paste at the end of their oral presentations. Ten marks from 1 to 10 were available on that slide.

Fig. 1. Personal Response Card and the USB receiver.

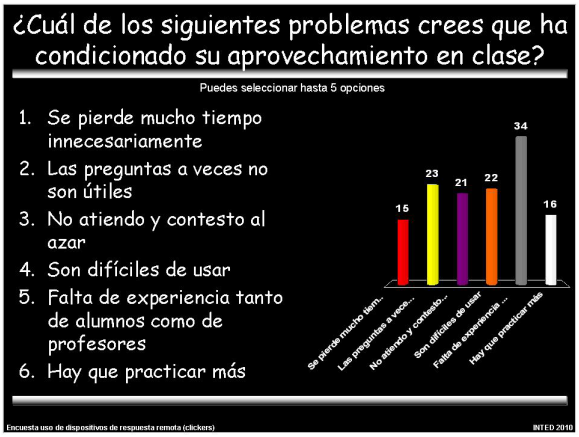

Fig. 2. Screenshot of PowerPoint showing an automatically generated histogram

Fourth stage is designed to solve problems and questions guided by faculty. Finally, the fifth stage is the evaluation of the module. No clickers were used during these two sessions.

We only have one set of 30 response cards. Each card is registered to one single student in each group, so list of each group have to be loaded before each session. Results are saved at the end of every session.

SURVEY METHOD

The aim of this study was to determine student satisfac-tion when using clickers. After using these devices in three completed modules in Physical Basis of Medicine (approximately 2 months), we developed a 12 question opinion poll divided in 4 categories that students an-swered using the clickers anonymously. The survey was conducted during stage 1 of module 6, in January 2010.

A total of 95 students (N=95), that is all assisting students in the five groups answered the survey and percentages of responses in each category and group were calculated. Groups 1 (N=20) and 4 (N=18) are taught by the same professor, groups 2 (N=21), 3 (N=18) and 5 (N=18) are taught by different professors. Students were given a list from which to choose, so they might not have to write about a particular factor in the opinion they were expressing. At the end of the survey, they were asked to add any comment or experience about this new technology-base intervention introduced in the class.

The survey was divided into four categories with a total of 12 questions. In questions 4 and 12 up to five options could be selected.:
Category 1: General satisfaction.
Question 1: What is your satisfaction using the clickers? A. Very satisfied. B. Satisfied. C. Neutral. D. Dissatisfied. E. Very dissatisfied.
Question 2: Do you think that clickers have improved or deteriorate the sessions? A. Improve. B. Neutral. C. Deteriorate.
Question 3: Would you recommend clickers to be used in other subjects? A. Yes, to all of them. B. Depends on the subject. C. No.

Question 4: Witch uses do you think that have been more fruitful? Select up to 5 options. A. To keep attention. B. To mark our classmates. C. To facilitate our participation. D. To check our understanding. E. To evaluate previous knowledge. F. Clickers are useless.
Category 2: Attention and participation.
Question 5: Do you think that clickers have made sessions more enjoyable? A. Yes. B. No. C. Don't know.
Question 6: Do you think that clickers have made you to pay more attention? A. Yes. B. No. C. Don't know.
Question 7: Do you think that clickers have improved your participation during the sessions? A. Yes. B. No. C. Don't know.
Category 3: Evaluation.
Question 8: Do you think that clickers have been useful for peer evaluation? A. Yes. B. No. C. Don't know.
Question 9: What was your attitude when you assessed your classmates' activities? A. I always tried to be objective. B. I always gave good marks. C. At the beginning I gave good marks, but at the end I was objective. D. I marked randomly. E. Don't know.
Question 10: To be assessed by your classmates, have made you to improve your works? A. Yes. B. No. C. Don't know.
Question 11: Have you made a pact to assess your classmates? A. Yes. B. No. C. Don't know.
Category 4: Problems.
Question 12: Which possible problems do you think that have to be solved or improved? Select up to 5 options. A. It is an unnecessary waste of time. B. Some questions were useless. C. Don't pay attention, I an-swered randomly. D. Clickers are difficult to use. E. More practising in needed.

RESULTS

The present data shows that student perceptions were positive. 48 students were satisfied or very satisfied (50.5%), 44 students (46.3%) qualified their satisfaction using clickers as neutral, and only 3 students (3.2%) were dissatisfied (Fig. 3A). 53.7% consider that using clickers has improved the sessions, and 41.1% were neutral; only 5.3% (5 students) considered that clickers have deteriorate the sessions (Fig. 3B).

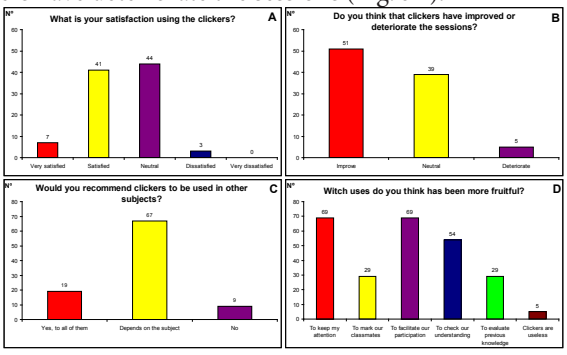

Fig. 3. Answers to Category 1: Satisfaction.

They were asked about if they would recommend clickers to other subjects (Fig. 3C), 19 students (20%) will recommend them to all subjects, 70.6% (67 students) would recommend clickers depending on the subject; 9 students would not recommend clickers. They were asked to say why they do not recommend clickers to all subjects and they, majority, said that clickers could be used in all subjects, but the main reason to select only some subjects was because of the attitude of some teachers, that should condition its use. After analyze every subject, only one subject was eliminated because of the teacher who does not develop teaching method described above and teacher does not promote participation.

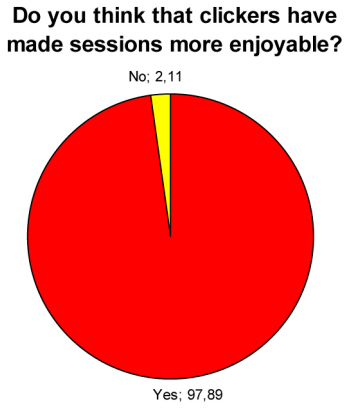

Fig. 4. Answers to question 5.

Six main uses were proposed to student and they could select those that they considered more fruitful: to keep attention (27.1%), to mark classmates (11.4%), to facilitate participation (27.1%), to check understanding (21.2%), to evaluate previous knowledge (11.4%) and an option to indicate if they thought that clickers are useless (2.0%). A total of 255 answers were registered because students could select up to five options (Fig. 3D).

Question 5 about if they consider that clickers have made sessions more enjoyable was answered positively by 97.9%, and only 2.1% answered negatively (Fig. 4).

Most of students considered that clickers were useful to evaluate their classmates (65.3%) against 31.6% of students that answered negatively. Main differences be-tween groups were observed when asking about their attitude when assessing their classmates. 45.3% said that they tried to be objective, but normally they marked better than teacher did, 17.9% at the beginning gave good marks but at the end they tried to be objective. 31.6 % always gave good marks independently of the quality of works. But students of group 3 mainly answered that always gave good marks and also answered positively to question 10, they made a pact .

Finally, we show main possible problems that have to be solved or improved when using clickers. Students could select up to 5 options and a total of 150 responses were recorded. No student found clickers difficult to use. Most students (14) of group 1 considered that clickers are an unnecessary waste of time. In that group the teacher reported technical problems with the computer and the projector, not with clickers, that delayed the sessions during 30 minutes in two occasions. Despite

students were told not to consider those situations, results are completely different to other groups in this aspect. Only 3 students of that group considered that more practising is needed, compared to a total of 66 students of groups 2, 3, 4 and 5 that selected this option.
Other problems are that some multiple-choice-questions were useless (20.0%) and some students answered randomly to question proposed during the classes (12.3%).

DISCUSSION AND CONCLUSIONS

This study is one of many showing that active learning using clickers increases student performance in science courses[7-11]. For a good discussion about if clickers are useful or not, see Bugeja[12] and Hake[13].

Classes are more enjoyable and most of students believe that clickers have improved their attention and participation. This was the first time that this technology was used in the University of Castilla–La Mancha but only during two months. No support was provided by the Institution, so teachers had to solve any problem that could appear, and also prepare questions and design possible uses. This was the first contact not only to students but also to teachers, so we believe that in next courses the main problems, such as to design more useful questions or to control random answering, could be solved, probably, registering answers and taking them into account in global marks.
Using clickers for peer evaluation have to be improved. A possible solution could be to consider classmates marks in global qualification and also to assess how classmates evaluate their colleges.

Recent studies have shown no difference between clicker use compared to discussion with hand raising14, supporting the notion that this technology may not be necessary in some circumstances. A recent review of 56 studies related to clickers in college-level science education15, found mixed support for enhanced student learning associated with clickers use.

We have to analyse final marks in this subject, but in the time this paper is written, final examination does not take place yet, so we are not able to evaluate impact of clickers. Poirier and Feldman16 found that grades were higher for students using clickers, contrarily to Freeman et al17 findings. We did not evaluate if using clickers helped with understanding course material or to prepare examinations[18].

Some students suggested the possibility of including questions in their oral presentations in stage 3 and allow-ing their classmates to participate and to control their comprehension; not only to use clickers for peer evaluation or during stage 1. Some students also suggested that we have to offer more different uses. But teachers must be careful about gimmicky use of technology without specifically tailoring use of the devices to clear learning objectives.

In conclusion, these data suggest that teaching with the clickers was effective in terms of student satisfaction with the technology. Effective use of clickers has the potential to increase student engagement, participation and may serve to facilitate student learning. The present study clearly illustrates students' positive views about clickers, particularly with regard to the perceived usefulness of clickers in terms of making more enjoyable classes.

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