Software *Socrative* and Smartphones as Tools For Implementation of Basic Processes of Active Physics Learning in Classroom: An Initial Feasibility Study With Prospective Teachers

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Abstract
Many physics professors have difficulties to know and assess in real time the learning of the students in their courses. Nevertheless, today, with Internet and the new technology devices that the students use every day, like smartphones, such tasks can be carried out relatively easy. The professor pose a few questions in *Socrative*, the students answer them by means of the Smartphone. In this way, the professor knows what students learned and can promote the cooperative learning joining students who think differently, with the purpose to give them chance to discuss their answers and argumentations and, eventually, to improve both answers and arguments. In this article, we present the results of an initial feasibility study of using Socrative and smartphones carried out with prospective teachers. The effects on the students were: they help them to understand concepts; they facilitate the argumentation and the exchange of opinions. In addition, the use of this technology is, generally, easy for students and turns out to be interesting in the classroom. In conclusion, by using efficiently *Socrative* and students' smartphones, professors might achieve jointly three different goals: real-time assessment of the students' learning, motivation of the students and increased opportunities for active learning.
Key words: active physics learning, smartphones, real-time assessment, software Socrative, motivation, forming group of students.

Introduction

The physics teachers face daily a great challenge in the classroom: they have to achieve that their students extract the major possible learning results in the class. Therefore, the teacher must motivate the students in order that they learn and take part in class.

Nevertheless, in many occasions, the students neither reveal their doubts nor answer to the questions that the teacher has formulated publicly, only a small percentage are those who take part. In consequence, the teacher only controls the pace and quality of learning of these students.

In other occasions, another thing happens. The teacher presents a physics problem or situation, gives students time to think about the answer and, later, he asks one or several students about what they have thought or how they have solved it in order to manage to know the pace of these students. However, in both cases, the teacher only manages to know thinking and learning performances of a small part of the students in the class. In addition, such ways take away an important part of the class time.

Sequences of active physics learning (Meltzer & Thornton, 2012) consist of tasks in which students reveal, discuss and improve their ideas about physical phenomena. Such sequences are easier to be implemented with the help of new technologies. Taking advantage of ever-more-

sophisticated features and the proliferation of devices that exist today, it is possible to promote basic processes of active physics learning with naturalness.

Almost all students, for not saying all, use smartphones, use of laptops is usual and employment of tablets is increasing. Portability makes mobile devices very useful for education because students can access Internet and stay connected to others all the time (Melhuish & Falloon, 2010). The familiarity of students with the electronic devices can be a great help in the field of education. In fact, the Smartphone is one of the devices that are starting to change the process of instruction (Eisele-Dyrli, 2011). For instance, in United States 98% of students between fourteen to eighteen years old own a cell phone and 70% own a laptop, tablet or netbook (Project Tomorrow, 2010).

These technologies carry an attraction for the student and can be an element that_promotes motivation. Moreover, in United States, "93 percent of parents like the idea of an online textbook and 47 percent feel that online textbooks would be good investments for schools to make to improve student achievement" (Project Tomorrow, 2010: 25). For the teachers, the integration of the new technologies in the classroom can appear initially as an extra work, but the instructional advantages they have can do that eventually their use is a saving of time and an increase of efficiency in their profession. For example, there is no need to consume class time teaching students to use new instructional hardware and software (Kolb, 2011).

What is *Socrative*?

Some webpages exist which can facilitate teacher's question-giving and answers-receiving tasks. Namely, all students can answer several questions very fast and the teacher knows the answers immediately. Among these webpages is, for instance, *Poll Everywhere* (www.polleverywhere.com/), *Go Soapbox* (www.gosoapbox.com) and *Socrative* (www.socrative.com) (Matthew, 2012). In addition, *Socrative* has free access.

These pages are smart student response systems. One only needs connection with internet and a device like laptop, tablet or smartphone. Teacher designs the activities or problems and controls the flow of questions. Students simply log in with their device and interact in real time with the content. Students' responses are visually represented for multiple choice and opened questions. For preplanned activities, a teacher can view reports online as a Google spreadsheet or as an excel file.

These pages have the following advantages: it is not necessary to use neither any software nor any extra electronic device, one only needs to use the usual resources today: Internet and Smartphones with connection to Internet.

Having strategies of active learning on mind, these tools can facilitate the cooperative learning, strategy that, several educational institutions are promoting in science education (Eurydice, 2011). It can be useful to improve the efficiency of the cooperative learning. Namely, in many occasions, the teacher has students who work in group but they all have the same knowledge. With this tool, the teacher can know what every student thinks and can form the groups in the ways which promote the dialogue, this is, joining in the same group people who have answered differently.

Before the smartphone: Clickers

Several educational institutions, like universities and high schools, are using an electronic device to know the answers of the students in real time. The devices are called in the United States "clickers" or "key-pads" and in United Kingdom "handsets" or "zappers" (d'Inverno et al., 2003; Caldwell, 2007). These devices are similar to the remote control of the television set. The teacher formulates a question, showing it to the students with the help of the projector, while they use the device to choose one of the answers. It is not flexible because the questions must be of multiple-choice type.

In addition it is necessary to invest some money to buy the devices. It is usually used during a traditional class. This use has the aim to assess the learning and opinion of the students and can facilitate the cooperative work (Caldwell, 2007).

Why do we use the smartphones or the tablets?

Manuguerra & Petocz (2011) refer to mobile learning as the new concept which has followed e-learning. The use of these tools can be useful for the teacher because he/she can control the students' learning in real time. By this way, he/she can know which doubts they have and assess his/her own educational task.

Referring to it, several applications are developing:

1. The teacher can easily design tests, which can be opinion or knowledge tests.
2. The students can answer only with the smartphone and a connection to Internet.
3. The teacher knows the results of these tests at once.
4. The results of the tests do not have to be public, they can only be known to the teacher.

Given the following applications, we are going to focus in the integration of the Smartphone in class, provided that most of the students use it to have access to Internet. The advantages are the following (Attewell, 2005; Kolb, 2011; Duncan et al., 2012):

1. Mobile learning can be used to encourage both independent and collaborative learning experiences.
2. Mobile learning helps to remove some of the formality from the learning experience and engages reluctant learners.
3. Mobile learning helps learners to remain more focused for longer periods.
4. Mobile learning helps to raise self-esteem.
5. Mobile learning helps to combat resistance to the use of ICT and can help bridge the gap between mobile phone literacy and ICT literacy.
6. Cell phones can save money.
7. Students use them very well.
8. Cell phones are very flexible, students can use them anytime, anywhere, from any source, at any pace.
9. Cell phones can empower students who are visually or hearing impaired.
10. Cell phones distract less than laptops.

About the power of mobile phone is said that "they are also particularly useful computers that fit in your pocket, are always with you, and are always on" (Prensky, 2004:3).

Sample and methodology

The students involved in this pilot research were 36 prospective teachers, studying for a degree in Primary Teaching. In this degree there are some one-semester subjects, one of them is physics teaching. They do not need previous scientific studies to access this degree. In fact, they usually avoid scientific studies in their last pre-university years. The course on physics teaching lasts a semester. The authors have design this learning sequence and the first author (in what follows "the professor") implemented it during one month.

The goal of this initial study was twofold:

1. to explore feasibility of using *Socrative* and smartphones as easy-to-have tools for increasing opportunities of active physics learning in classroom;
2. to facilitate prospective teachers' learning of mechanics.

The structure of the sessions was always the same. The physics professor introduces some questions or situations in *Socrative* in order to assess the conceptual learning of the students (Driver, Guesne, & Tiberghien, 1989; Varela, 1996; McDermott & Shaffer, 1998; McDermott, Shaffer & Constantinou, 2000). In class, the professor explains some concepts during approximately fifteen minutes. Then he guides the students in order that they become able to answer the test. The test is usually composed of four questions put in *Socrative* and the students are supposed to answer them individually (**Figure 1**). In this part the students can take ten minutes.

Figure 1. *Students answer questions in personal phase using their mobile phones.*

Later, the professor downloads the answers of the students and, after paying attention to one or two questions in which there is a major difference of opinions, he joins the students who answered different in groups of three or four members. Such approach to compose groups has the purpose of promoting the dialogue as much as possible. Sometimes it is difficult to join four students who have different answers. Nevertheless, the teacher never gathers students whose answers were the same. This process takes approximately five minutes, due to the fact that the answers should be downloaded in a spreadsheet and ordered according to the response. The students argue their answers during twenty minutes in the groups (**Figure 2**).

Figure 2. *Students argue their answers in the group phase.*

After this process, the students answer individually again the test in Socrative, but this time they had chance to change their minds because they have listened to the arguments in the groups.

Finally, the professor provides expert-like answers to the test questions and resolves the doubts that still exist.

Results

Examples of questions and answers in class

The professor asked the students four questions each class, some of them were multiple choice and some opened questions. One example of a multiple-choice question was:

I go by train at a constant speed of 70 km/h and I am going to run towards the cabin of the train.
A. I will make more effort than if the train was stopped.
B. I will make less effort than if the train was stopped.
C. I will make equal effort than if the train was stopped.
D. I will not make any effort.

The answers were:

Table 1. *Answers of the students in one of Socrative's classes to one of the questions about the Newton laws, individual phase and group phase*

Answers	Individual phase	Group phase
A	3%	3%
B	56%	38%
C	35%	41%
D	6%	18%

The professor was trying to form groups with the aim to have in all groups' students who had different answers. In this case, he looked for that there was someone in every group who had answered "b" and other one who had chosen another response. After the group phase, there is a change but it was not very dramatic.

Another example was:
I move two toy cars in a track without friction, first one at 20 km/h (constant speed) and the second one at 30 km/h (constant speed). In which case do I do more force?
A. The first one.
B. The second one.
C. In both cases I do a force and it is the same.
D. I do not make any force.

The answers were:

Table 2. *Answers of the students in one of Socrative's classes to one question about the Newton laws, individual phase and group phase.*

Answers	Individual phase	Group phase
A	9%	0%
B	52%	56%
C	12%	0%
D	24%	41%

The teacher tried in this case that there was someone in every group who had answered "b" and other one who had chosen another response. The students' reasons were very different. 52%

says "the second one" because it is faster than the first one. 24% says that the cars go at constant speed and there is no friction, therefore there is no force in any of the cases. 12% states that one will make the same force because the two cars go at constant speed. 9% says that the first one because, if the car run slower it will be more difficult to move it.

After the group phase, there was a change. The percentage of correct answers was much higher.

Opinions of the students

When the experience with the *Socrative* in class finished, the students were asked to give their opinion in a brief survey (Crossgrove and Curran, 2008). There were seven Likert-type questions and four open questions. Out of 36 prospective teachers, 33 answered the survey.

The answers of the Likert-type questions, related to their experiences with using *Socrative*, were the following ones:

Table 3. *Answers of the students to the first six questions of the survey*

Questions	strongly agree	Agree	neutral	disagree	strongly disagree
They have made me be more involved.	3%	67%	18%	6%	6%
They have helped me to pay more attention to my way of thinking.	3%	64%	24%	9%	0%
They have allowed me better understanding.	6%	48%	36%	6%	3%
They have allowed me to improve the practice of the procedures.	12%	42%	27%	18%	0%
They have stimulated my interaction with my partners.	30%	64%	6%	0%	0%
They helped me realize of what I knew.	15%	76%	9%	0%	0%

The students stated that these experiences have helped them to be more involved in the classes, know their way of thinking, work at group and be aware of their knowledge. The students considered that it was not so useful for them to understand the concepts and to improve in the practice of the procedures.

The question regarding the optimal frequency of use was:

What frequency would you recommend the professor to use the Socrative?

The answers are given the **Figure 3**:

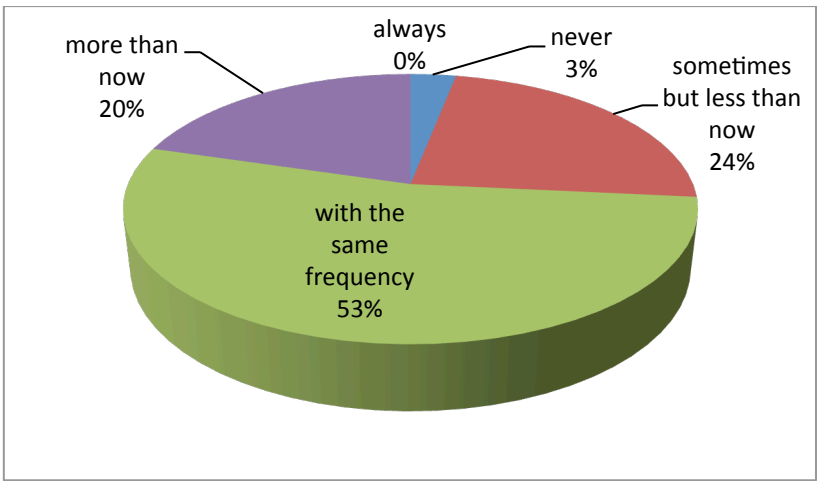

Figure 3. *Answers of the question of the survey: What frequency would you recommend the professor to use the socrative?*

The negative reasons of the students were that "the professor should explain more about theory" and "he should use other methodologies, too". As for the positive comments, they emphasize that "it was funny", "it helped to argue", "it facilitated to understand" and "it facilitated the interaction with the classmates".

The question related to positive experiences with the *Socrative* was:
What do you like more about your experience using Socrative in class?

45% of the students said that it was the work in-group. In addition, other answers (with approximately 10 % of students choosing each one) were that "it helped me to be motivated", "it is interesting to do the tests in the mobile" and "it facilitated to think seriously".

The question, which explored the obstacles with Socrative, was:
Which were the obstacles that you had using Socrative in class?

Apart from the logistic and technical obstacle, this is, that some of the students did not have mobile and that the Wi-Fi sometimes did not work good, they said that the questions were difficult. They suggested that the class should be better organized and that "I did not understand any concepts".

And, the final question of the survey was:
What characteristic of Socrative classes would you improve?

30% of the students said that "the classes were really good". 10% said that "the professor should explain more about theory". Another 10% affirmed that all the students should have the technical means. Some of the students asked more time to answer or to receive the answers corrected by mail.

Conclusion

Given the new technological advances and the applications that are arising in Internet, educators should try to integrate them in the classroom. *Socrative* is a very useful tool because it makes possible that the teacher knows the learning of all the students in real time. In addition, provided that the majority of the students have Smartphones, it is unnecessary any additional material and an extra economic expense as it was the case previously with the clickers. "Many teachers are discovering that a basic cell phone can be the Swiss army knife of digital learning tools" (Kolb, 2011: 43)

The results of this initial study show that *Socrative* and smartphones are feasible tools that can facilitate active physics learning in classroom. Using these tools, teachers can know in real time initial answers of the students in real time and can organize groups in such a way that the dialogue is productive for students' further learning.

The students, who were involved in the reported research, think that *Socrative* is a useful tool, as it supports the learning and increases the motivation. In addition, it helped them to be aware of their knowledge and their way of thinking. The *Socrative* stimulates the cooperative work and the students enjoy the discussion and learn to argue their answers and opinions.

Limitations of this study were poor previous mechanics knowledge of involved prospective teachers and short time for instructional time. Taken together, they made difficult to get better results in conceptual learning of mechanics. So, in future studies the Socrative and smartphones should be used with students who would be better prepared for a potentially larger conceptual gain.

Finally, as today most of the students have a smartphones and access to Internet, *Socrative* is a no-cost tool, which makes feasible implementation of those tasks which foster basic personal, and group processes of active physics learning in classroom.

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Bibliography

Attewell, J, (2005). *Mobile Technologies and Learning: a technology update and m-learning project summary*. Learning and Skills Development Agency.

Caldwell, J. E. (2007) Clickers in the large classroom: Current research and best-practice tips. *Life sciences education*, 6, 9-20.

Crossgrove, K. & Curran, K.L. (2008). Using clickers in nonmajors- and majors-level biology courses: student opinion, learning, and long-term retention of course material. *Life sciences education*, 7, 146-154.

Duncan, D.K.; Hoekstra, A.R. & Wilcox, B.R. (2012) Digital devices, distraction, and student performance: Does in-class cell phone use reduce learning? *Astronomy education review*, 11, 010108-1, 10.3847.

d'Inverno, R., Davis, H., and White, S. (2003). Using a personal response system for promoting student interaction. *Teach. Math. Appl.*, 22(4), 163–169.

Driver, R., Guesne, E. y Tiberghien, A. (1989). *Ideas científicas en la infancia y la adolescencia*. Madrid: Morata.

Eisele-Dyrli, K. (2011). Mobile Goes Mainstream. *District Administration*, 47(2), 46-55.

Eurydice (2011). *Science Education in Europe: Common Challenges and National Policies*. EACEA: Brussels.

Kolb, L. (2011). Adventures with cell phones. *Educational Leadership,* 68(5), 39-43.

Manuguerra, M. & Petocz, P. (2011) Promoting student engagement by integrating new technology into tertiary education: The role of the iPad. *Asian Social Science*, 7(11) 61-65.

Matthew, Anne F. (2012) Managing distraction and attention in diverse cohorts : 21st century challenges to law student engagement. *Queensland University of Technology Law and Justice Journal*, 12(1), pp. 45-65.

McDermott, L. C., & Shaffer, P. S. (1998). *Tutorials in introductory physics*. Upper Saddle River, NJ.

McDermott, L.C.; Shaffer, P.S. & Constantinou, C.P. (2000) Preparing teachers to teach physics and physical science by inquiry. *Physics Education*, 35, 411–416.

Melhuish, K., & Falloon, G. (2010). Looking to the future: M-learning with the iPad. *Computers in New Zealand Schools: Learning, Leading, Technology*, 22(3), 1-16.

Meltzer, D. E., & Thornton, R. K. (2012). Resource Letter ALIP–1: Active-Learning Instruction in Physics. *American Journal of Physics*, 80 (6), 478 - 496.

Prensky, M. (2004) *What can you learn from a cell phone? Almost anything!* Retrieved from http://www.marcprensky.com/writing/, accessed 13 October 2012.

Project Tomorrow. (2010). *Creating our future: Students speak up about their vision for 21st century learning*. Retrieved from
http://www.tomorrow.org/speakup/pdfs/SU09NationalFindingsStudents&Parents.pdf, accessed 13 October 2012.

Varela, P. (1996). Las ideas del alumnado de física. *Alambique,* 7, 45-57.

http://www.socrative.com/

http://gosoapbox.com/

http://www.polleverywhere.com/