Clickers in the classroom

Clickers? More technically, maybe *personal response systems* (but no one will say this while telling the colleagues). More than one of you will be using them in your lectures. Do you already know what I'm talking about? No? Think of TV game shows: each participant has a sort of remote control to choose his answer, most times with a strong determination to press that little button hard and persistently. Ah, you meant that! It happens that for a long time these devices have been used in teaching, for student engagement, in guidance by the instructor, on innovation, in improvement of the catalysed learning process.

Without going into technicalities, the system consists on a set of clickers, one per user-student, either anonymous or not, that emit a signal of the kind "option B has been chosen", a receiver connected to the instructor's computer, and in this latter the software that collects, processes data and displays them on the projected screen, usually in real time. Many systems allow in fact integration of the results graph (for instance, with 4 bars showing the frequency for the 4 answers) inside the presentation (PowerPoint or similar) that the instructor was using and where the question was presented, so avoiding the need to switch between programs. It is also possible to store all answers for a later analysis.

The main idea when using clickers in the classroom is to explore the students learning on the fly. You may use them as a rapid assessment, although there are other, more profitable, approaches, as we will soon describe.

In the simplest strategy, the clicker is a way to ask something to the group of students and get a panoramic view of their answers. We may think of posing questions in the traditional way, i.e. verbally and with answers by a show of hands. However, part of the students may not answer due to shyness or fear of publicly exposing their errors. The clicker provides anonymity that may considerably reduce this hindrance. On the other hand, it is more practical to get the results of several alternative answers in one go, without counting the hands several times.

The use of clickers involves the students, which is positive to increase their engagement in the lecture, reinforce attention and avoid their mind drifting away. Often times, both the voting process and the immediate display of results trigger some amusement; in my opinion, a little fun –well channelled by the instructor– will do no harm, will fight routine in the class and keep attention and interest.

Upon looking at the answers, one student will possibly pose a question, ask for an explanation, verbalise a doubt or misconception that was there although unnoticed. We have, hence, a route for formative assessment and corrective action in the learning process.

The biggest utility –and the method recommended by experts– goes through using the system to reorient the lecture: by detecting what the students have or have not understood, we can concentrate time in the classroom on the aspects that are in need of attention. This means, for instance, to present a question before having explained that part of the lesson. If the majority of students answer correctly, and those who don't can quickly accept the correct answer when the graph of results is displayed, there is no need to devote more time to explain that part. If, on the contrary, answers indicate a lack of knowledge or a conceptual error, it is the moment to develop that part thoroughly, to strengthen the teaching in that point. It is, so, a question of optimising in-class time as well as its efficiency.

Taking the strategy one step further, if we manage to get the students used to work on the lesson before coming to the classroom (yes, that utopia, but there are places where it works), a quick series of questions will let us devote the class to solve real learning problems, rather than to fill in the contents that the student may assimilate without much difficulty. This methodology has been dubbed *flipped teaching*,

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meaning to invert the lecture process: first the student works, then the teacher acts where there is more need. With some groups we may not achieve “100% flipping”, but at least we can partially get closer to the strategy of guiding the lecture by probing the students knowledge.

Many of you will be thinking of objections: *yes, that’s very interesting, but in my case unworkable*. There are indeed considerable practical limitations. First, the budget, specially tied to the number of students in the group. Second, infrastructure: we need to be assured that both hardware and software will be operational every day in that classroom. We can maybe add another component: training the lecturer to use the system. Finally, and far from negligible, the logistics problem: who and how manages the delivery and collecting of clickers at the beginning and the end of the class, what to do if one of them breaks down or *gets lost*, etc. There is no doubt that in some environments all this has been solved (a quick internet search is enough to see how many centres have clickers as an everyday method), but that mainly requires a clear position and compromise on the part of the institution. Well, so what happens if your environment and situation do not allow you to implement it? You should not throw in the towel, I will present a simple and cheap alternative –very cheap. Actually, to tell you about this experience is what prompted choosing the topic of this article.

If you can have the *true* system, enough clickers for all your students, an efficient logistics, a powerful software with features for analysis of results… congratulations! Go ahead with it. If you do not benefit from all those requirements, you can still work quite successfully and without complexity using an alternative. The requirements: internet connection in the computer that the instructor uses in the lecture hall or classroom. A clicker for each student… they already have it on the desk, in their pocket, or hidden under the desk: their laptop, tablet or smartphone. Internet connection for each student: who lacks it? It’s in the very same “clicker”! Indeed, times have changed, let’s just take profit. To end, the software to manage the answers… for free, on the web. Nothing to install. The instructor signs up to open an account in the server; students don’t need one. The result: what I call *clickers without the clickers*.

There are several servers offering this system at no cost; I will not go here into a comparative review. A quick search and a few minutes reading took me to try one (socrative.com) last September, and here I want to tell you the key points of my experience, rather than analysing in detail the software. In summary: a very reasonable response time, it never crashed or stalled my class waiting for results; cost: none; ease of use: high, thanks to the simplicity of design.

Free services do have their limitations, obviously. You might need to go for a superior, paid, service, in order to access more features. Maybe next year that particular server has vanished, in a typical tech bubble. In my experience, behaviour has been fluid at all times and has allowed me enough profit with this technique which was unreachable in the traditional format. Learning the system was simple and quick, so the investment in time is not burdensome in the case I should need to switch to another.

Let’s move on to the important part: how to benefit in the classroom. Among the various question formats offered by the software, I found advantage in two.

The simplest option, called “*Multiple Choice*”, works in this way: 1) The instructor accesses internet and logs into his account on the server. 2) Students connect to the general page (which is public, without passwords), either in their web browser or using a specific app installed in their phone, and they type the number of the “room” they want to connect to, a number assigned to the instructor account which does not change. 3) The instructor poses a question on the blackboard or in the projected screen, with several answer choices. 4) The instructor opens in the server a call for answers. 5) Each student sees in her device 4 or 5 buttons labelled A, B, C… (fig. 1) and clicks or taps on one, according to the choice of answer. 6) The instructor’s computer screen displays, in real time, the number of connected students, number of votes received and the bar graph with the votes. Sometimes it is good to hide this screen so that students who have not yet voted are not biased. 7) A discussion is promoted.

Another useful format, called “*Start Quiz*”, requires that one or several questions have been prepared in advance, with their candidate answer options (one or more correct) and an

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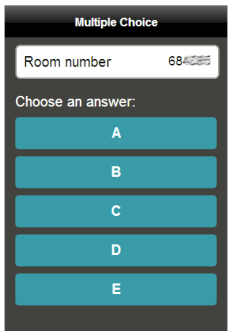
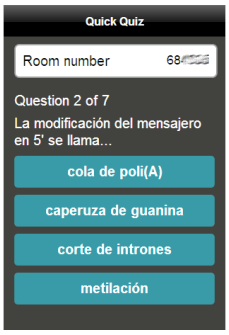
Figure 1. Student interface for an impromptu question.





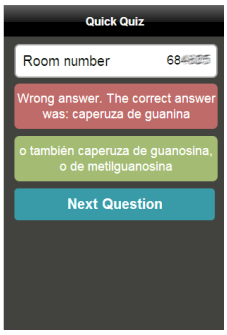


Figure 2. Student interface for pre-made questions.

optional explanation for feedback. Questions are stored in the server and may be reused later. An example of the process would be: 1) Both the teacher and the students access their respective space in the web. 2) The instructor selects out of her collection a question set, and opens the call for answers. 3) Students choose the answers for the whole set of questions, one at a time, at their own pace (fig. 2). 4) On the teacher's screen, the number of connected students is displayed, along with the number of answers each one has completed (but not the actual option chosen). 5) When a student has finished, the phone may be passed to a fellow student so they can also take the quiz (in the case of unavailable personal device). 6) When all have finished, or the instructor decides to end the test, she closes the voting, downloads the results and opens them in a spreadsheet. There, responses from each student are displayed in a row, for each question (column), coloured for correctness (fig. 3). A quick analysis shows which were the most conflictive questions, which the most frequent incorrect answers, those that everybody knew how to answer, and so leads you to comment, explain and guide the learning.

This second modality allows even more flexibility. Questions with open-ended answer are possible, even though this format does not lend itself to a quick analysis while in the classroom. You can choose if the students must answer each question under instructor's control, or else they can follow their own pace, if the student will see or not which is the correct option after answering each one, if a feedback phrase will or not be displayed. The order of answer options may be made random. Closed-time quizzes may be launched. Results may be downloaded or received by email. The first question in each set may request the student name, or let the test be anonymous.

In summary: a tool that, without complexity or a long time investment, lets the instructor explore this teaching methodology, the usefulness of which is widely documented and acknowledged. I can assure you the experience is positive and, in addition, good fun.

Angel Herráez
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Libro5 | Quiz Report Madurac-RNA 27oct13.xls

	A	B	C	D	E	F	G	H	I
1	**Maduración del mRNA**		Wed, Oct 2 07:06 AM		Room: 684885				
2	La maduración postranscripcional del RNA mensajero en eucariotas tiene lugar…	La modificación del mensajero en 5' se llama…	La modificación del mensajero en 3' se llama…	Los intrones son…	Las regiones no codificantes del mensajero situadas en los extremos se	Las regiones no codificantes del mensajero	El proceso de eliminación de los intrones y empalme de los exones está catalizado por…	Number of correct answers	Total Score (0-100)
3	todas las anteriores	caperuza de guanina	cola de poli(A)	la parte codificante del me	caperuza y cola	intrones	endonucleasas y ligasas	4	57
4	en su interior	caperuza de guanina	cola de poli(A)	la parte no codificante del	UTR	intrones	endonucleasas y ligasas	5	71
5	todas las anteriores	caperuza de guanina	cola de poli(A)	la parte no codificante del	UTR	intrones	endonucleasas y ligasas	6	86
6	todas las anteriores	caperuza de guanina	cola de poli(A)	la parte no codificante del	UTR	intrones	endonucleasas y ligasas	6	86
7	todas las anteriores	caperuza de guanina	cola de poli(A)	la parte no codificante del	UTR	intrones		6	86
8	todas las anteriores	cola de poli(A)	cola de poli(A)	la parte no codificante del	caperuza y cola	intrones	endonucleasas y ligasas	4	57
9	todas las anteriores	metilación	cola de poli(A)	la parte no codificante del	caperuza y cola	intrones	exonucleasas y ligasas	4	57
10	todas las anteriores	cola de poli(A)	cola de poli(A)	la parte no codificante del	UTR	intrones	endonucleasas y ligasas	5	71
11	todas las anteriores	caperuza de guanina	cola de poli(A)	la parte no codificante del	UTR	intrones	ninguna de las anteriores	7	100
12	todas las anteriores	cola de poli(A)	cola de poli(A)	la parte no codificante del	UTR	intrones	endonucleasas y ligasas	5	71
13	en su extremo 5'	corte de intrones	cola de poli(A)	la parte no codificante del	caperuza y cola	intrones		3	43
14	en su extremo 5'	cola de poli(A)	cola de poli(A)	la parte no codificante del	exones	intrones	endonucleasas y ligasas	3	43
15	todas las anteriores	cola de poli(A)	cola de poli(A)	la parte no codificante del	UTR	intrones	endonucleasas y ligasas	5	71
16	todas las anteriores	caperuza de guanina	cola de poli(A)	la parte codificante del me	exones	intrones	endonucleasas y ligasas	4	57
17	en su extremo 5'	caperuza de guanina	cola de poli(A)	la parte no codificante del	caperuza y cola	intrones	ninguna de las anteriores	5	71
18	todas las anteriores	cola de poli(A)	cola de poli(A)	la parte no codificante del	caperuza y cola	UTR	endonucleasas y ligasas	3	43
19	todas las anteriores	caperuza de guanina	cola de poli(A)	la parte no codificante del	UTR	intrones	endonucleasas y ligasas	6	86
20	todas las anteriores	cola de poli(A)	cola de poli(A)	la parte no codificante del	UTR	UTR	ninguna de las anteriores	5	71
21	todas las anteriores	caperuza de guanina	cola de poli(A)	la parte no codificante del	caperuza y cola	intrones	endonucleasas y ligasas	5	71
22	todas las anteriores	caperuza de guanina	cola de poli(A)	la parte no codificante del	UTR	intrones	endonucleasas y ligasas	6	86
23	todas las anteriores	cola de poli(A)	cola de poli(A)	la parte no codificante del	caperuza y cola	intrones	ninguna de las anteriores	5	71
24	todas las anteriores	caperuza de guanina	cola de poli(A)	la parte no codificante del	UTR	intrones	exonucleasas y ligasas	6	86
25	todas las anteriores	caperuza de guanina	cola de poli(A)	la parte no codificante del	UTR	intrones	endonucleasas y ligasas	6	86
26	todas las anteriores	caperuza de guanina	cola de poli(A)	la parte no codificante del	UTR	exones		5	71
27									

Figure 3. Analysis of answers.

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