Student Response Systems as a successful tool for formative assessment: students' perceptions in a university pilot study

Student Response Systems come strumento per la valutazione formativa: la percezione degli studenti in un pilot study
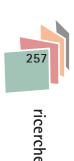
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Student Response Systems (SRS) are increasingly used in Universities and schools around the world. In Italy, they have only been in use for a few years, but are spreading rapidly thanks to the fact that they can be used as simple, free Apps on students' smartphones. SRSs have had positive feedback from both students and teachers, especially in terms of enhanced engagement and attention, peer interaction, and potential for formative assessment. The results of a pilot study in a university Educational Technology program have shown that students greatly appreciate SRSs. Above all, they would like to use SRSs as a "learning check". In particular, they stated that they have a very positive perception of the feedback provided by the teacher, which help them gain a better understanding of the most important concepts of the topics covered. This interaction process helps the teacher to develop a formative assessment process that must, however, be managed and prepared with care.

Keywords: Student Response Systems; formative assessment; teaching strategies; peer interaction; metacognition

Gli Student Response Systems sono sempre più utilizzati nelle Università e nelle scuole in tutto il mondo. In Italia sono presenti solo da pochi anni ma si stanno diffondendo velocemente anche grazie alla possibilità di utilizzarli come semplici App, senza costi sullo smartphone degli studenti. Nella letteratura di riferimento gli SRS hanno avuto dei feed-back positivi sia da parte degli studenti che degli insegnanti soprattutto in termini di engagement e miglioramento dell'attenzione, peer interaction, e la possibilità di fornire una valutazione formativa. I risultati di una ricerca esplorativa effettuata all'interno di un corso di Tecnologie Educative, hanno dimostrato che gli studenti apprezzano molto l'uso degli SRS. In particolare preferirebbero utilizzarli alla fine di ogni lezione come controllo sulla comprensione dei contenuti trattati. Dichiarano inoltre di avere una percezione molto positiva del feedback fornito dal docente che commenta le risposte perché li aiuta a capire meglio i concetti più importanti degli argomenti trattati. Questo processo di interazione stimola il docente a sviluppare un processo di valutazione formativa che va però gestito e preparato con cura.

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Introduction

Student Response Systems, also known as "clickers", are interactive remote answering devices. They enable teachers and instructors to have simple real-time feedback from students in the classroom. They have been used since the late 1990s, although simpler tools have been employed in classrooms since the 1960s. In Italy, school and university use has been growing in recent years. While most early Student Response Systems were dedicated devices built and programmed to do only this specific task, today an increasing number of teachers allow students to use smartphones with dedicated Apps.

A wide range of SRS is currently available (some free, and others for a fee), each with certain distinctive features as well as those common to the entire group. SRS are a cost-effective solution for students and for the institution; this has also provided greater flexibility in use, from the BYOD (Bring Your Own Device) perspective. SRS operation is simple: the teacher asks questions and students provide immediate feedback with their smartphones. The software then gathers the responses in real time and displays them to the entire class on the screen. It should be noted that the teacher can decide whether identify or not the student who makes each response, but the rest of the class cannot. Students thus feel that they are not alone in making mistakes, which can be as effective as anonymity in reducing anxiety.

1. Teaching Strategies with Student Response Systems

SRS use in a wide range of disciplines have received positive feedback from students at schools and universities (Habel & Stubbs, 2014; Johnson & Lillis, 2010; Aljaloud et al., 2015). Many studies have found improvements in students' examination scores (Guess, 2008; Martyn; 2007). The systems can have a number of positive impacts on learning processes, including:
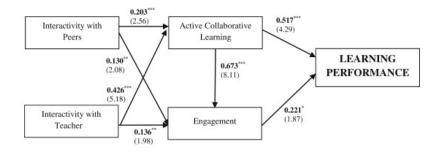
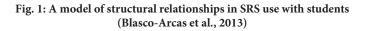– Enhanced engagement, better attention and participation,
– Peer interaction,

– Active collaboration in learning,
– Formative feedback.

During a lesson, attention drops (albeit slowly) after only 15-20 minutes (Bradbury, 2016; Farley, Risko & Kingstone, 2013), whereas a typical class or lecture lasts 50 minutes or more. To avoid student attention deficits, teachers can propose a set of questions using an SRS: many studies have reported that students employing these tools are more engaged and attentive, focusing on key points (Caldwell, 2007; Meguid & Collins, 2017; Ranieri, Bruni, and Raffaghelli, 2018). As regards active collaboration in learning, SRS can stimulate students' active participation in the learning process by enabling them to discuss questions and answers (Blasco-Arcas, Buil, Hernández-Ortega, & Sese, 2013). The latter study proposes a structural model that seems to demonstrate that interactivity between peers and teachers positively and significantly influences both collaborative learning and engagement (fig. 1), and ultimately improves student learning performance.

The literature indicates that rich teacher-student interaction and feedback from teachers are good strategies for monitoring and improving learning processes (Yates and Hattie, 2013). It is necessary to distinguish between two forms of interactivity: one among students and the teacher, and the other between students. Each form is important in the learning process: in the first case, if a sizable number of students has difficulty in answering one or more questions, the teacher can make "on the fly" decisions and ask the students what they do not understand. The teacher can then choose a different teaching strategy or cover a specific topic more extensively.

Note: Standardized beta coefficients are in bold; t-value in brackets.
Levels of significance: ***p<.01; **p<.05; *p<.1

**Fig. 1: A model of structural relationships in SRS use with students
(Blasco-Arcas et al., 2013)**

In the second case – interactivity between students – teachers can use a more advanced learning strategy to stimulate students to start a peer discussion for each "critical" answer choice.

Peer Instruction is regarded as a good instructional strategy: several studies have found that about 80% of teachers consider peer instruction engagement to be effective in terms of learning gains (Balta, Michinov, Balyimez, & Ayaz, 2017; Fagen, Crouch and Mazur, 2002; Vickrey, Rosploch, Rahmanian, Pilarz, & Stains, 2015). Another interesting finding is that memory retention over the days after the use of an SRS tool increases (Lantz & Stawiski, 2014), but this gain seems related mostly to the teaching strategy used by teachers as feedback (Han & Finkelstein, 2013). In this sense, SRS effectiveness can be influenced by the teachers' lecture preparation (Nielsen, Hansen, & Stav, 2013; Shieh & Chang, 2013). Infact, SRS questions take more time and effort to set up than other test questions (Habel & Stubbs, 2014), partly because the teacher must prepare several sets of SRS questions for every lecture: the literature confirms that the more learning trials completed, the better the achievement (Heward, Gardner, Cavanaugh, Courson, Grossi, & Barbetta, 1996).

2. Are SRS an effective way to assess?

As we have seen, SRS can provide a real-time check for students and teachers: teachers can use the results to adapt the lecture to students' needs, and students can verify their comprehension of specific topics. Although SRS can be used as a traditional summative assessment for assigning grades to students (Premkumar, 2016), a more effective way of using them seems to be for formative assessment (Cubric & Jefferies; 2015; Polly, et al. 2015). For such purposes, however, teachers must learn how to use SRSs correctly (Williams & Kingham, 2003): in fact, it is important to distinguish between technology and pedagogy.

As the *Technological Pedagogical and Content Knowledge* (TPACK) framework suggests, technological tools are more effective when supported by appropriate pedagogical approaches to meeting learner's needs. From this standpoint, SRS can be an interesting tool for stimulating alternative teaching strategies, such as peer instruction or students' discussion of critical topics revealed by the answers given to the questions. Practicing formative assessment is not simple in these learning contexts: for example, it calls for understanding students' questions and responding to them promptly to clarify misconceptions "on the fly". Not all teachers are comfortable in such situations.

3. Students' perceptions of using SRS: a pilot study in a university course

In 2018, we ran a small-scale preliminary study to investigate student perceptions of SRS use in a single university course in order to evaluate the feasibility of a future project to introduce Student Response Systems throughout our university . The pilot study was held during an Educational Technology course for the Masters' degree program in Educational Management. Kahoot! was chosen as one of the simpler freely available SRSs and because it incorporates several game-based features (Wang, 2015) that are useful for holding students' attention.

An online survey was administered at the end of the three-month course to explore students' perceptions about the teaching/learning process during the lectures. Twenty-four students (all present more than 75% of lectures) participated in the survey, and had a mean age of 23 years (M=3, F=22). The survey consisted of 14 questions scored on a 5-point Likert scale. The research questions probed the following dimensions of SRS use:

1) overall user satisfaction,
2) anonymity,
3) effects on metacognition and reflection processes,
4) teacher feedback,
5) public visualization of answers,
6) peer interaction, and
7) preferences for SRS use (before, during or after the lecture).

The SRS was used during and after each lecture. Most SRS questions were multiple-choice with four options. A first significant finding of the survey was that all students strongly agree (83%) or agree (17%) that using SRSs during lectures was a positive experience, and would like to use them more often (fig. 2).

Perceptions of the other dimensions were generally positive. Three-quarters of the students appreciated anonymity, 16% were neutral and only 8% were unimpressed. For the questions about metacognitive processes, high scores were reported for SRSs' ability to aid concentration (92% agree or strongly agree) and reflection on learning difficulties (84%), as well as one's own learning strategies (55% agree or strongly agree; 17% neutral or disagree).
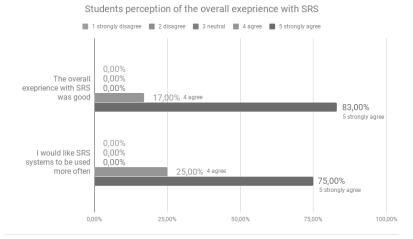
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Fig. 2: Students' perception of the overall experience with Student Response Systems

The perception of SRSs' influence on one's ability to reflect on one's own mistakes (i.e., self-assessment) is more evenly distributed (54% agree or strongly agree; 46% neutral or disagree). Responses about the importance of teacher feedback were very interesting: 95% agree or strongly agree (SD=0.55).

Question items	1 strongly disagree	2 disagree	3 neu-tral	4 agree	5 strongly agree	Mean
Overall perception						
The overall experience with SRSs was good.	0%	0%	0%	17%	83%	**4.83**
I would like SRS systems to be used more often.	0%	0%	0%	25%	75%	**4.75**
Anonymity						
I appreciated the anonymity in answering.	0%	8%	17%	25%	50%	**4.17**
Concentration and reflection						
Using SRS made me think about my concentration during the lecture.	0%	4%	4%	42%	50%	**4.38**
Questions helped me to think about how well I was learning the subject matter.	0%	0%	17%	21%	63%	
Displaying the answers made me think about my learning difficulties.	0%	4%	13%	25%	33%	**3.71**

Motivation to reflect on errors						
Displaying the answers motivated me to think about where I was wrong.	0%	13%	33%	33%	21%	**3.63**
Question items	**1** strongly disagree	**2** disagree	**3 neutral**	**4** agree	**5** strongly agree	**Mean**
Teacher feedback						
Feedback from the teacher helped me to understand the topics better.	0%	0%	5%	62%	33%	**4.29**
Public answer display						
Displaying the answers made me feel unprepared.	0%	38%	21%	0%	0%	**1.79**
I appreciated the fact that answers were displayed to the whole class.	0%	4%	25%	42%	29%	**3.96**
Peer interaction						
Viewing results led me to comment on them with another student.	0%	4%	25%	42%	29%	**3.95**
When do students prefer to use SRSs?						
I'd like SRSs to be used * before * the lesson to review prior knowledge.	0%	4%	13%	25%	58%	**4.38**
I'd like SRSs to be used * during* the lesson to check if I understand each concept.	0%	8%	17%	25%	50%	**4.17**
I'd like SRS to be used * after * the lesson as a summary check of key concepts.	0%	0%	0%	33%	67%	**4.66**

Tab. 1: Question items and answers grouped in eight dimensions

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Displaying answers to the entire class was appreciated by more than 70% of the students, while 54% (strongly agree or agree) thought that it can motivate them to understand where they were wrong. For 71% of the students, peer interaction was an important side-effect of using SRSs during lectures. Lastly, more students prefer that SRS be used *after* the lecture (100% strongly agree or agree, SD=0.48) than *before* (83% strongly agree or agree, SD=0.88) or *during* the lecture (75%, SD=1.01) (see fig. 3).
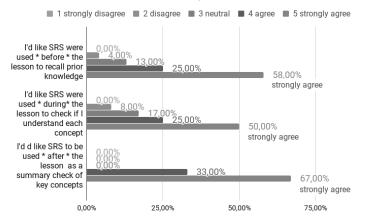
Fig. 3: Students' preferences for the sequence of SRS use in lectures

4. Conclusion

The pilot study's findings were very encouraging and will certainly lead to extending pilot study to a larger number of students. Since the interaction between students, teachers and student response systems is a complex process to manage, teachers will receive training in order to improve their teaching strategies, thinking of effective questions, preparing course materials designed for a step-by-step presentation, and being ready to give on-the-fly feedback to students.

As we have seen, in fact, the efficacy of SRSs can be significantly affected by the teachers' instructional strategies during the lecture. For example, strategies can range from simple approaches where the teacher follows each a round of questions with immediate feedback to clarify any misunderstandings, to more complex strategies such as peer-interaction, stimulating students to start a discussion about certain critical answers and afterwards voting again to check student comprehension. Future research will also try to understand whether using SRS is more effective before the start, during or after the class (or a combination of these), and will consider teachers' perceptions as well as those of students.

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