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Authors	Lucey, Siobhán;McElroy, Brendan;McInally, Lauren
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Teaching in the 21st century – engaging students in active learning using student response systems

Dr. Siobhán Lucey, Dr. Brendan McElroy
Department of Economics
UCC

Dr. Lauren McInally
Department of Economics
University of Strathclyde

Introduction

The prevalence of student response systems (hereafter SRS) in higher education has grown significantly in the last few years. Student classroom participation and student's assessment of performance particularly in larger classes, has often been regarded as problematic in pedagogical research (Fies and Marshall, 2006), however, the growth in technology, coupled with popularity of handheld devices has led to the development in SRS with the intention of increasing classroom participation and engaging students in the lecture setting (Denker, 2013). A number of studies identify benefits to students participating in the classroom using SRS including increased student involvement and attendance, learning, engagement and emotion (Stowell and Nelson, 2007, Van Daele, Frijns and Lievens, 2017). This research seeks to examine the effects of a SRS on student participation and engagement in large undergraduate economics modules at both an Irish and UK university during the academic year of 2018/19. We compare a control period (no SRS in place) with a trial period (SRS in place). The results show that the use of the SRS significantly increased student's interaction with the lecturer and their ability to perform self-assessment in absolute terms and relative to their peers.

Method

Students were exposed to the usual mechanisms for student engagement by the lecturers for the first half of the semester and were then surveyed on their level of engagement. Following Heaslip et al. (2014) we employed a number of criteria to measure student engagement, which consisted of a degree of agreement with statements on a 5-point scale. An SRS app was introduced in the second half of the semester and it was employed for approximately 10-15 minutes or so in each of the lectures. At the end of the semester, students were polled again on their level of engagement using the same survey instrument. Data on the respondent's module (to control for clustering at the module level) and the number of lectures attended (proxy measure for student interest in and application to the subject, both of which may affect overall engagement) was also collected. The results for response rates are presented in Table 1.

Table 1 Response rates to base-line and follow-up surveys

	Module 1[1]	Module 2[2]	Module 3[2]	Module 4[3]	Module 5[4]	Pooled
N	391	238	148	109	108	994
Baseline	75	100	58	43	52	328
Follow-up	36	52	60	28	16	192
Both	27	38	36	12	9	122

Note 1: University of Strathclyde, Scotland
Note 2: University College Cork, Ireland

Using the standard assumption of a continuous latent response variable, a t-test is used to test the difference in means of all criteria at the module level. This method does not allow for clustering at the module level, nor for respondent heterogeneity. Thus we specify an econometric model at the level of the student. Since each student is surveyed twice, the data form a natural 2-period panel structure. The model can be specified as follows:

$$y_{it} = \beta x_{it} + v_i + \varepsilon_{it} \quad (1)$$

where y is the 5-category criterion being modelled, x is the matrix of covariates and β is a vector of parameter estimates; i is the respondent and t is the period; v_i is time-invariant respondent heterogeneity which is assumed to vary randomly and ε_{it} is the idiosyncratic error term.

Findings

Table 2 describes the average responses for each criterion pre- and post-introduction of the SRS at module level.

Table 2 Comparison of Means by Criteria at Module Level

Criterion	Abbrev.	Pre	Post	Sig
I interact with the lecturer in class	Interactivity	2.45	2.95	***
I am involved in learning during class	Involvement	3.58	3.77	*
I am engaged in class	Engaged	3.71	3.77	
I am attentive in class	Attentiveness	3.73	3.82	
I participate in classroom discussion	Participate	2.49	2.59	
I provide my opinion to questions from the lecturer during class	My opinion	2.12	2.43	***
I receive feedback on my understanding of lecture content in class	Feedback	2.74	2.98	**
I can gauge whether I am following lecture content during class	Gauge	3.66	3.89	***
I can assess my understanding of lecture content relative to other students during class	Peer Assessment	3.28	3.60	***

Note: ***= 1% level; ** = 5% and *=10% level of significance for the difference between the two means using a t-test.

Taking the variables that were significant at the 5% level, the difference between the pre- and post-introduction of the SRS was greatest for, in rank order, Interactivity at 0.5, Peer Assessment at 0.32,

followed by My opinion, Gauge, Feedback. Involvement was significant at the 10% level while the difference between pre- and post-surveys were not significantly different from zero for Engaged, Attentiveness and Participate.

As described in the methods, the above t-tests do not allow for clustering of responses at the module level, so an individual level model was specified. The results of this random effects ordered logit model for all criteria are presented in Table 3. Rather than report the results of the full models (including control variables and model diagnostics) for each criterion, Table 3 focuses on the results of the effect of SRS for each criterion. The full model results for all criteria are available in an online appendix. The odds ratios are interpreted as the chances that a student's response will be one category higher than the reference group for any given variable. The effect of using SRS was statistically significant in the case of 5 criteria, and statistically insignificant in the case of the other 4. A respondent was 2.7 times more likely to report a higher level of Interactivity with SRS than without. The odds ratios for Involvement, My opinion, Gauge, Peer Assessment were 1.67, 1.91, 2.55 and 2.36 respectively. All five were statistically significant at the 5% level. The remaining 4 criteria had lower odds ratio and were statistically insignificant

Table 3 Odds Ratios of Effect of SRS

Criterion	Odds Ratio	P>z
Interactivity	2.70	0.033
Involvement	1.67	0.005
Engaged	1.20	0.256
Attentiveness	1.38	0.393
Participate	1.33	0.171
My opinion	1.91	0.000
Feedback	1.54	0.204
Gauge	2.55	0.000
Peer Assessment	2.36	0.002

Conclusions

Non-response issues aside (as discussed below), the results indicate that students reacted positively to the SRS. All odds ratios for each criterion exceeded one, quite considerably so for some criteria. There were high effects of the app on Interactivity, Gauge, Peer-Assessment, My Opinion and Involvement compared to Participate, Feedback, Engaged and Attentiveness. Additionally, the first group of criteria are statistically significant, the second group are not. Given the high effects of student interactivity, involvement, and ability to express their own opinion, one would have thought that this would relate to higher effects on engagement and attentiveness. This was not the case however. Perhaps the underlying concepts measured by these criteria were very similar, such that the engagement and attentiveness effects were captured by the interaction and involvement criteria. In large classes, it can

be difficult for students to assess their performance. Consequently, the result that student could assess themselves against their peers and in absolute terms was a positive finding. It suggests such that the app facilitated the quick development of formative assessment.

When responding to the survey, students were given ample class time. Absentees from class completed it by email. Students were also informed in class and by email that the results of the study would inform university policy on the use of SRS. The poor response rate suggests that non-respondents believed that the opportunity cost of their time spent answering the two surveys wasn't worth the perceived benefit. This indicates that either the students chose to free-ride on the responses of classmates, didn't believe that their response was likely to make a difference to the outcome, or that the outcome of the study would not alter university policy. The SRS costs €7 per student, so it can be quite costly for a Department, School or University to roll-out. Students found it beneficial. Whether the benefit exceeds the cost is a decision for university decision-makers. As our study finds evidence of positive perceived effects and acceptability by both the lecturers and the students, future research could examine its role in formal module assessment.

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