Technology-enhanced Engagement: Impact of an In-class Engagement Activity on Out-of-class Engagement in Learning

Meral Demirbağ Büyükkurt, Danielle Morin, Ying Li, Dale Doreen
Concordia University, Canada

Introduction

At the core of the challenges faced by higher education today, such as large class sizes, distinctly different learning needs of the millennium student population, and mandatory courses that do not appeal to non-major students, is a lack of student engagement. Given the well-established relationship between student engagement and various desired educational outcomes (Kuh, Cruce, Shoup, Kinzie, & Gonyea, 2008; Pascarella & Terenzini, 2005), engagement has increasingly become a separate subject of research study beyond being investigated as a mediating variable (Krause & Coates, 2008).

As the case with many educational constructs, there is no universally agreed-upon definition of engagement. One of the widely cited definition is provided by Hu and Kuh (2002, p555) who define engagement as 'the quality of effort students themselves devote to educationally purposeful activities that contribute directly to desired outcomes'. While relatable to our intuitive understanding of the engagement concept, this definition is too general to guide and direct research efforts on engagement. For the purpose of this study, we adopt a more nuanced conceptualization of engagement put forward by Fredricks, Blumenfeld, and Paris (2004). Based on extensive review of the relevant literature, the authors suggest engagement be studied as a multidimensional construct, including behavioral, emotional and cognitive engagement. Behavioral engagement is associated with participation and involvement in curricula as well as extracurricular activities; emotional engagement refers to student reactions to various components in the learning context, such as teacher, peers, school; cognitive engagement involves investment of mental efforts in grasping complex ideas and developing tough skills.

The current study examines the impact of a technology-mediated instructional activity on student engagement in an Introduction to Business Statistics course at a Canadian university. The technology used was Student Response Systems, commonly known as clickers. Clickers are basically a polling tool, allowing students to vote with a handheld input device and the instructor to display the aggregated results as a histogram on a projection screen. During the activity, the instructor displays a multiple-choice question and asks the students to respond with their remotes. The question usually targets concepts students would normally find difficult and will, as a result, yield uneven distribution of responses. After seeing such results, the instructor will call on small group discussions followed by a second vote. Then a whole class discussion may ensue to make sure misconceptions are completely dispelled. The pedagogy used in this activity is called Peer Instruction (Crouch & Mazur, 2001). In the sections involved in the present study that used clickers, three to five Peer Instruction activities were conducted in a typical class of 75 minutes, breaking up the lecture into smaller chunks.

Taking advantage of the powerful affordances of the technology, clicker-based Peer Instruction has great potential to increase student engagement in all three dimensions of engagement mentioned above. Research has found that the use of clickers boosts in-class participation (Freeman, Blayney, & Ginns, 2006; Stowell & Nelson, 2007). The increased participation can be seen as an improvement in behavioral engagement. In addition, as students are encouraged to contribute their input and interact with peers, they develop positive attitude towards the learning environment (Sprague, & Dahl, 2010), resulting in higher emotional engagement. After students commit to an answer through electronic voting, they have made an emotional investment in finding out if their answer is the correct one (Wit, 2003). This, along with the fact that students can see from the histogram that they are not the only one struggling, may lead to increased self-efficacy and goal-directed efforts, hence heightened cognitive engagement.

While a large number of studies have investigated and shown the impact of clicker-based pedagogies on student engagement (e.g. Addison, Wright, & Milner, 2009; King & Robinson, 2009), little has been done to examine if student engagement in the clicker activity will carry over to out-of-class engagement with the course and if students' perceived level of engagement correlate with objective measures of engagement. Such is the interest of the current study.

Method

Sixty-one students in four sections of the Introduction to Business Statistics course in the undergraduate program participated in the study. Two sections used clicker-based Peer Instruction and two sections used traditional lecturing. Perceived learning engagement was measured using the Student Course Engagement Questionnaire (SCEQ) developed by Handelsman, Briggs, Sullivan and Towler's (2005). Compatible with Fredricks et al.'s (2004) multifaceted view of engagement, this instrument measures four dimensions of college student engagement, namely skills engagement, participation engagement, emotional engagement and performance engagement with a total of 23 items. Students' participation and performance in online self-quizzes that they could take on a voluntary basis to check their knowledge of the material was used as a surrogate objective measure of out-of-class learning engagement. These online self-quizzes provide immediate feedback to the students and allow repeated opportunities to answer a question until the correct answer is given. Due to this feature, both participation and performance data from these quizzes can be seen as indicators of engagement.

Data collected on these perceived and objective measures of learning engagement was analysed to answer the following research questions:

1. Is there a difference between students in clicker and those in non-clicker classes in terms of average perceived engagement?
2. Is there a correlation between the perceived and objective measures of engagement?
3. Is there a difference between students in clicker classes and those in non-clicker classes in terms of participation and performance in online self-quizzes (out-of-class engagement)?
4. Among the classes that do use clickers, are the students' participation and performance in using clickers (in-class learning activity) correlated with their participation and performance in online self-quizzes?

Data Analysis and Results

With regard to research question 1, test of significance between clicker and non-clicker sections in terms of SCEQ average score (total score/23) was conducted. Results show no significant difference between the average perceived engagement scores of students in sections using clickers and those in sections not using clickers.

To answer research question 2, correlation analysis between SCEQ average scores and the participation and performance in online self-quizzes was carried out for all four sections, combining as a group, students who used clickers and another group of students who did not use clickers. The correlation between the perceived measure of engagement (average engagement score) and objective measures of engagement (self-quiz participation and performance) are presented in Table 1 below.

Table 1: Correlation between Perceived and Objective Measures of Engagement

CORRELATION		Objective measure of engagement	
		Self-Quiz Performance	Self-Quiz Participation
Perceived Engagement	All sections	0.375	0.343
	Clicker Sections	0.563	0.535
	Non-Clicker Sections	0.212	0.179

We can see that the perceived and objective measures of engagement are more strongly correlated in the classes where the clicker technology was used. This could be explained by the fact that when students are given the opportunity to engage more in the in-class learning (using clickers), they tend to get more engaged in other engagement options of the course.

For research question 3, we ran a test for significance between clicker and non-clicker sections in participation and performance in online self-quizzes. Results are displayed in Table 2 below.

Table 2: Test of Significance between Clicker and Non-clicker Sections

Online Self-quizzes				
Average Score	Clickers		Significance	
	Yes	No	One-tail	Two-tail
Participation	0.474	0.280	8.5E-05	1.7E-04

Performance	0.440	0.245	3.8E-05	7.7E-05

We can conclude that students in classes using clickers show average performance and average participation in an out-of-class engagement activity very significantly higher than students in classes where clickers were not used. This could be explained again by the more hands-on approach to learning promoted in the clicker group.

To answer the last research question, we performed a correlation analysis between participation and performance in clicker use and participation and performance in online self-quizzes. See Table 3 for the results.

Table 3: Correlation between Clicker and Self-quiz Participations and Performances

CORRELATIONS		*Self-quiz*		*Clickers*	
		Performance	Participation	Performance	Participation
Self-quiz	Performance	1			
	Participation	0.991	1		
Clickers	Performance	0.442	0.445	1	
	Participation	0.295	0.314	0.415	1

We note that the correlation between the self-quiz performance and clicker performance is 0.442, while the correlation between the corresponding participations is 0.314. This could be explained again by the more hands on approach to learning promoted in the clicker group leading students to become more engaged outside the classroom as assessed by the self-quiz activity.

Implications and Conclusions

Our findings raise some interesting questions at the same time as they answer some important pedagogical questions. Firstly, the lack of significant difference between the perceived engagement scores of students in classes using clickers and those in classes not using clickers is noteworthy. Is this a case of social desirability bias where respondents tend to show themselves in a favorable light? Or is it because some students lack metacognitive awareness of their own state of engagement or both? Secondly, the stronger correlation between perceived and objective measures of engagement in classes that use clickers than those that do not use clickers can be an indication of heightened awareness of learning engagement among students who are provided with an environment encouraging engagement. Students in classes using clickers clearly demonstrated their engagement in the class by having heated discussions during peer instruction, attentively observing the immediate feedback provided and by cheering when they got the correct answer, while those in classes not using clickers did not have such an in-class engaging opportunity. Thirdly, the very significantly high performance and participation in out-of-class learning activity among the students in classes using clickers than those in classes not using clickers strongly support the benefits of engaging the Millennium generation students in a large class of a required course in class. While this is reported as a major challenge, the technology available such as clickers and the accompanying pedagogy such as Peer Instruction can provide a solution.

References

Addison, S., Wright, A., & Milner, R. (2009). Using clickers to improve student engagement and performance in an introductory biochemistry class. *Biochemistry and Molecular Biology Education*, *37*(2), 84-91.

Coates, H. (2005). The value of student engagement for higher education quality assurance. *Quality in Higher Education*, *11*(1), 25-36.

Crouch, C. H., & Mazur, E. (2001). Peer instruction: Ten years of experience and results. *American Journal of Physics, 69*(9), 970-977.

Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concept, state of the evidence. *Review of educational research*, *74*(1), 59-109.

Freeman, M., Blayney, P., & Ginns, P. (2006). Anonymity and in class learning: The case for electronic response systems. *Australasian Journal of Educational Technology*, *22*(4), 568-580.

Handelsman, M. M., Briggs, W. L., Sullivan, N., & Towler, A. (2005). A measure of college student course engagement. *The Journal of Educational Research*, *98*(3), 184-192.

Hu, S., & Kuh, G. D. (2002). Being (dis) engaged in educationally purposeful activities: The influences of student and institutional characteristics. *Research in Higher Education*, *43*(5), 555-575.

King, S. O., & Robinson, C. L. (2009). 'Pretty Lights' and Maths! Increasing student engagement and enhancing learning through the use of electronic voting systems. *Computers & Education*, *53*(1), 189-199.

Krause, K. L., & Coates, H. (2008). Students' engagement in first-year university. Assessment & Evaluation in Higher Education, 33(5).

Kuh, G. D. (2003). What we're learning about student engagement from NSSE: Benchmarks for effective educational practices. *Change: The Magazine of Higher Learning*, *35*(2), 24-32.

Kuh, G. D., Cruce, T. M., Shoup, R., Kinzie, J., & Gonyea, R. M. (2008). Unmasking the effects of student engagement on first-year college grades and persistence. *The Journal of Higher Education*, *79*(5), 540-563.

Pascarella, E. T., & Terenzini, P. T. (2005). *How College Affects Students: A Third Decade of Research*. San Francisco: Jossey-Bass.

Sprague, E. W., & Dahl, D. W. (2010). Learning to Click An Evaluation of the Personal Response System Clicker Technology in Introductory Marketing Courses. *Journal of Marketing Education*, *32*(1), 93-103.

Stowell, J. R., & Nelson, J. M. (2007). Benefits of electronic audience response systems on student participation, learning, and emotion. *Teaching of Psychology, 34,* 253-258.

Wit, E. (2003). Who wants to be… The use of a personal response system in statistics teaching. *MSOR Connections*, *3*(2), 14-20.