

Transforming Classrooms Into Active Learning Zones

While student response systems (SRS) have been around well over a decade, it was not until recently that I began to take advantage of their pedagogical benefits. In the span of time since my first implementation of SRS-associated peer-instruction approaches (about five years ago), SRS technology has greatly evolved from hand-held clickers to Bring Your Own Device (BYOD) cloud-based classroom interaction systems. Undeniably, the evolution of cloud-based has opened the door to teaching and learning approaches that were previously impossible to implement or were limiting in nature, especially in large enrollment courses.

For example, the ability to ask students questions using varying types of formats, including short-answer questions, image quizzes, and ordering, in addition to multiple choice questions via the cloud-based system, support the efforts of educators to enhance the learning experience in diverse ways. Additionally, built-in features such as “ask an anonymous question” and the “confused flag” give students additional opportunities to communicate with their professor during class time and empower professors to build a stronger learning community by creating seamless links between students and themselves.

Most research on the benefits of using SRSs in the classroom has shown that the wise use of such systems can help assess prior knowledge, poll student attitudes, confront common misconceptions, transform the way you demonstrate, test students’ understanding and retention, test conceptual understanding, facilitate discussion and peer instruction, and increase classroom attendance. Research also shows that students become engaged and enjoy using the technology. I certainly had that experience after implementing the Echo360-ALP for the first time in my second-year large enrollment course (three sections of approximately 200 students each). Indeed, the experience has transformed my classroom into an active learning zone and continues to do so to this day.

For example, analytics provided showed that:

- The participation rate (based on the number of students submitting answers to questions I asked in class during a given class) was nearly 99 percent on a per-lecture basis.
- Approximately 70 percent of students, on a per-lecture basis, took class notes via the notetaking features of the program—350-500 words during lectures that were more traditional in nature, and fewer words on days where active engagement activities (e.g. many SRS questions were asked) were the primary mode of instruction.

- Students submitted 5-10 questions (using the “ask an anonymous question” feature) per class and indicated confusion (using the confusion flag) during problematic concepts. The questions that were submitted were answered either during class time or soon after.

Based on classroom observations, student comments, and efforts by our Teaching and Learning Support Services (TLSS) team to deploy the Echo360-ALP on our campus, factors that appear to contribute to the high rate of student engagement in my classroom include:

- Low cost: Echo360-ALP is offered to students free of charge at the University of Ottawa. Thanks to efforts by our TLSS team, this effectively takes advantage of the BYOD movement and eliminates additional costs students may have incurred had they been required to purchase access to the cloud-based system or physical clickers.
- Low-stakes participation: Approximately 15 percent of the overall grade was dedicated to participation marks. If students answered (correctly or incorrectly) 80 percent of the total questions asked throughout the term, they received full participation marks. If they participated less than 80 percent, their participation mark was calculated as a percent of the submission rate divided by 80. This approach provided flexibility by allowing for absences or malfunctioning issues related to their devices, for example. With the solution being cloud-based, some students also valued the flexibility of being able to participate from a different location. Though I did not originally intend to use the solution in that way, I must admit that they are engaged in some manner!

This technology provides many mechanisms to help educators break out of the traditional mold and establish learning communities within their classroom to fulfill their teaching and learning objectives. For me, these include actively engaging students during class periods, facilitating low-stakes testing and enabling anonymous participation, providing and receiving real-time feedback and insights based on students’ questions and answers, and questioning students using a multitude of question types.

Does Fearless Engagement Translate Into Class Performance?

To answer this question, I share below my observations of trends in class performance through the lens of final exam average scores, as well as learning gains and item analysis scores from a validated concept assessment test. Overall, these assessments are designed to measure a series of prescribed course-level learning outcomes.

The final exam average has been steadily increasing (about 68 percent to about 75 percent) compared to the years prior to introducing SRSs into my classroom (about 65 percent). Concomitantly, the proportion of students in the A and B ranges of our letter grade system increased and the proportion of students in the C and D ranges decreased. Moreover, failing rates decreased from five percent of the class to one percent.

Because exam questions and difficulty may differ from year to year along with group abilities, and despite all the good intentions to formulate thoughtful and useful questions to assess student learning, final exam scores may not necessarily serve as good indicators of class success. An alternative way to assess classroom performance is through the use of pre-validated concept inventories. Concept inventories are tools designed to help educators evaluate students' understanding of a specific set of concepts and identify misconceptions. Unlike typical multiple choice question tests, both questions and response choices are the subject of extensive research designed to determine what a range of people think a particular question is asking and what the most common answers are. In its final form, the concept questions present correct answers and distractors that are based on commonly held misconceptions. If valid and reliable, concept inventory data can be used to measure student learning over the duration of the course and provide educators data that can be used to evaluate the effectiveness of classroom interventions and, thus, learning.

As matter of habit to assess teaching and learning, a genetic concept inventory (Smith et al., 2008), which comprises a set of 25 multiple-choice questions designed to measure the aforementioned course learning outcomes is administered at the beginning (pre-assessment) to get a baseline level of student understanding and again at the end of the course (post-assessment). Analyses of the results of the student performance on the concept assessment test administered to my classes prior and after my use of SRSs revealed the following:

- Students do better on almost all the questions in the post-assessment phase when compared to years where SRSs were not used.
- Learning gains have progressively increased (yr1=48%, yr2=53%, yr3=60%, yr4=60%) compared to 30-36% prior to using SRS-linked peer instruction methods.

Here, I make no claim that the data provide convincing arguments for a causal relationship between student engagement and success in the classroom. Using evidence-based student focused activities in my classroom, the data presented above are consistent with investigations that demonstrate that educational conditions and practices that foster student engagement contribute to student success. So, does leveraging the features of the Echo360-ALP translate into classroom success? I will let you be the judge of that.

Strategic Uses of Echo360 Classroom Solutions to Enhance Teaching and Learning Effectiveness in the Classroom

Through my use of this tool, I am consistently finding new ways to leverage its features to maximise

the student learning experience—and let's not forget the educator's teaching experience! Insofar as concept inventory data are concerned, they cannot only be used to evaluate the effectiveness of classroom interventions, but also can be used to identify student misconceptions and problematic concepts, allowing for pedagogical approaches to be designed to address them. In my genetics course, student difficulties that are often identified are typically related to misconceptions and application of analytical thinking to formulate hypotheses to solve problems. Indeed, data from the item analysis of student answers on the concept assessment test not only serve as a catalyst for reflection and designing approaches to address the difficulties, but also to evaluate their effectiveness.

Implementing approaches to address problematic concepts and misconceptions is not a trivial task, especially in large enrollment courses. In this respect, Echo360-ALP features, such as the different ways to ask your class a question, have paved the way for facilitating the integration of teaching and learning approaches to mitigate difficult concepts and misconceptions. With the identification of the common misconceptions and the concepts that are most difficult to the students, the Echo360-ALP facilitates active learning and formative assessment opportunities to improve student performance by offering a diversity of approaches to set-up instruction and reflections on prior knowledge (to provoke thinking, stimulate discussions, and induce cognitive conflicts); to develop knowledge (tackle misconceptions, exercise skills, and conceptual understanding, judging, etc.); communicate (asking questions, answer questions); and assess learning (exit polls, probe limits of understanding, demonstrate success, and review). Indeed, while the Echo360-ALP offers educators endless ways to engage students' intellectual domains, I find it also offers diverse opportunities to reach out to their affective domain and metacognition.

So, this brings us back full circle to student engagement. Does student engagement translate into successful learning? I believe the Echo360 classroom solution offers educators opportunities to engage students in fearless reflection, interactivity, collaboration, community, discovery, and exchange—hallmarks of academes—regardless of class size!

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