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Clickers Adoption in a Small Class Setting

by Bih-Ru Lea, Missouri University of Science and Technology

Teaching involves both the process of conveying/transferring knowledge and the process of knowledge retention. As an educator, we hope students to leave our class with knowledge and/or skills they did not have when they began the class. Months later, we hope those same students retain what they have learned, apply it to new situations, build upon that learning to develop new perspectives, and continue the learning process. Many of us believe that the most effective way to achieve this level of learning is through a balanced combination of traditional lecture and active learning activities (activity-based experience), as suggested by Dale's Learning Pyramid shown in Exhibit 1.

Technology not only revolutionizes the way we live, think, and do things, it also changes the way we learn and teach. The new student generations are often characterized as fast-paced multi-tasking technology savvy Net Generation (or N-Geners) who seek immediate gratification (Tapscott, 1998). Although traditional lecture techniques (e.g., lecture, reading assignments, audio/visual and demonstration) are effective in conveying foundation concepts and knowledge to students and in providing background knowledge, they are often passive in nature and lack the excitement the new generations are looking for. Active learning techniques (e.g., discussion group, practice by doing, teach others/immediate application) could be effective in improving knowledge retention rate, but we often found it a challenge to break the ice to bring discussions to the level we hoped for. How do we keep the fast-paced, multi-tasking generation engaged to learn and master the knowledge we teach in their learning process,

whether it is during the passive or the active stage?

Technology once again provides several potential solutions including smart boards, interactive classroom management systems, computer simulation, and clickers, to name a few. Application of clickers will be examined in this issue while others will be investigated in the next few issues. Clickers, a radio frequency device that allows students to respond and interact via small handheld remote keypads (Student Response System (SRS) or Personal Response System (PRS)), provide exciting options to engage students in a timely manner to keep new N-Geners focused and excited in their learning process. Although there is no consistent results on whether the use of clicks improves student learning outcomes, professors have reported that attendance and class participation are up, and students appreciate the quick feedback in large classes where attendance and participation are difficult to maintain. Clickers are also effective to provide pre-assessment to measure what students know before lectures, to ensure students have done their assigned reading, or to get students to confront common misconceptions; to facilitate testing of conceptual understanding of a lecture to confirm student's knowledge retention; to facilitate discussion and peer instruction; or to reduce grading and assessment efforts.

As most clicker adoptions reported are in a large class setting, this report will examine the impact of clicker applications in a small class environment. A Managerial Accounting class, an upper division (senior) level required core course, in a business administration department is used in this report. The class is compu-



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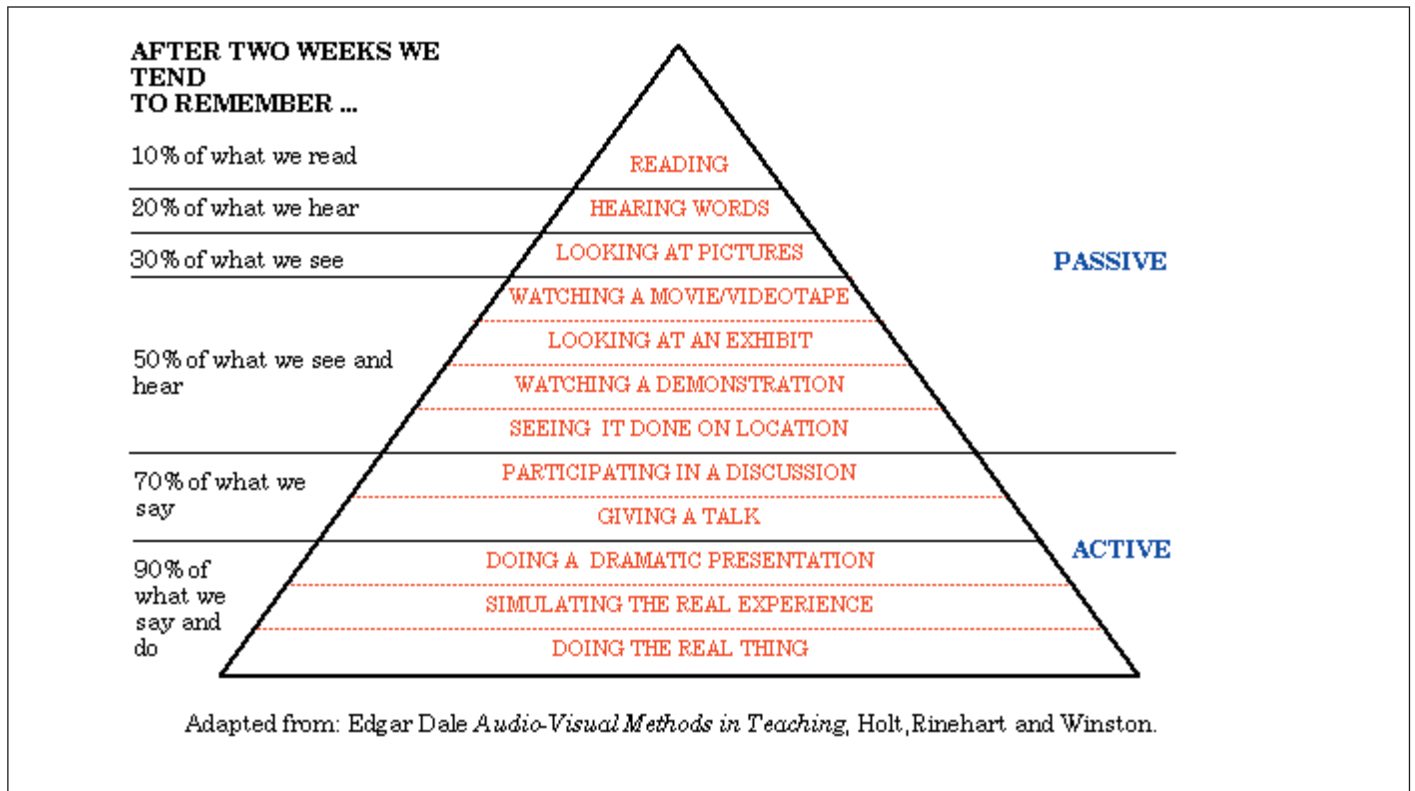


Exhibit 1: Dale's Learning Pyramid.

tation intensive, topics build upon each other, and discussions are essential to the understanding of materials (i.e., there is no absolute correct or incorrect answer as model selections require reasoning in many cases). The class size was 20 for fall 2006 and 13 for spring 2007. Clickers were used in fall 2006 and spring 2007. No student had prior clicker experience in fall 2006 while 23 percent of students in spring 2007 had used a clicker in a prior class. A typical class structure is provided in Table 1. Clickers were used in quiz, lecture-exercise cycles, and a group discussion and problem solving period in fall 2006 and spring 2007.

A review question set, lecture slides, and a problem-solving worksheet set were provided to the students when a new chapter/topic was assigned. I started the class with general announcements and agenda to provide an overview to the class, so students knew what to expect from that class. A question-and-answer period was then followed. Students were encouraged to ask questions from read-

ings, review questions sets, and materials covered from previous class period. Once a question was asked, I would ask a few volunteers to give his/her answer with rational/explanations and then divided the class into small groups (three to four students a group) to discuss all possible answers presented for a few minutes. In many cases, students were able to answer those questions asked by themselves without intervention from the instructor.

Students often became engaged after the question-and-answer period and that provided a good atmosphere to give a five-minute quiz based on their reading assignments or to introduce new materials. The quizzes were designed to create incentive for students to complete the reading assignments before class, be rewarded for doing so, to stimulate discussion at the beginning of class, and give the instructor a chance to revise the lecture plan to respond to student's needs. The quiz carried sufficient weights (around 12 percent of a student's semes-

ter grade) so that students took them seriously but not so much that they would feel anxious about them. Quizzes were in paper format and students would receive their quiz result at the beginning of next class before the use of clickers. Quizzes were given via clickers for fall 2006 and spring 2007, and students received immediate feedback. Furthermore, I was able to use quiz results to adjust my lecture plan immediately when clickers were used. I explained the most missed questions and then re-tested students with a similar question to ensure that they fully understood the materials before moving on to the next topic. It was observed that students were more focused and would ask questions if they didn't understand them because they knew that I always had a re-test question planned afterward.

Researchers have shown that students have an effective attention span of 10 to 15 minutes, so I designed my lecture and problem-solving exercises in several "lecture-exercise" cycles to

Activities	Time allocation
1. Class announcement and agenda	3- 5 min.
2. Questions and answers period	Varied (5-15)
3. Possible Quiz	5-10 min.
4. Structured "lecture - exercises" cycles	20-40 min.
5. Group discussion and problem solving	10-15 min.
6. Review, assignment, and plan for next class	3-5 min

Table 1: Typical Managerial Accounting class structure.

keep students focused. The lecture slides have blanks that students need to fill during the lecture, so students could write down important concepts using their own words to improve their knowledge retention. With clicker quizzes, I was able to confirm that students have become acquainted with basic terminologies and definitions in their preparation for class, so I gave a three- to five-minute short lecture focusing on one concept that would be difficult for students to learn on their own or was needed for the problem-solving exercise. The exercise problem worksheets were carefully designed so they could be divided into several subsections to correlate with the short-lecture designs (and lecture slides). During the "lecture-exercise" cycle, students followed a step-by-step problem-solving process led by the instructor. Clicker questions were used to confirm students' understanding after each "lecture-exercise" cycle in fall 2006 and spring 2007.

A few similar questions/problems to the in-class exercises were assigned to students to solve after the completion of the instructor-led exercises. If time allowed, students were called to the board to solve the assigned problems individually or as a team. Otherwise, students were asked to solve the problem after class and discuss their answers in next class period. Once students had their initial answers, these review problems were also presented as clicker questions for team competition in fall 2006 and spring 2007. The last five minutes of class time was used to provide students with a brief review of concepts covered that

day and to give an assignment and plan for the next class.

Students were asked to provide feedback on clicker usage in a mid-semester survey one week after the first test (during the fifth week of the semester) and in an end-semester survey one week before the end of the semester (during the 14th or 15th week). Both surveys used a 5-point opinion Likert scale with 1 representing "strongly disagree" and 5 representing "strongly agree." The survey questions, mean responses of both surveys, and p values of the two-group mean tests are presented in columns 1 to 4 of Table 2, respectively. One of the reasons to conduct the same survey at two different times was to investigate whether student's perceptions changed over time. As I used clickers in almost every class, it was important to know whether it is effective throughout the entire semester as the new N-Geners constantly seek new thrills, whether it is from technology or other means. Based on results from the 2-group mean test, it was observed that student perceptions shift to a more positive direction, although they are not statistically significant.

It is also important to investigate whether the effectiveness of clicker usage would change as more classes adopted clickers. Clickers were first used in my fall 2006 class and no students had prior clicker usage experience at that time, while about 23 percent of students had prior clicker usage experiences in my spring 2007 class. It was interesting to learn that student perceptions toward the use of clickers did not change with

more exposure to the device, as shown in columns (4) and (7) of Table 3. However, it is also interesting to point out that more students perceived that clickers made learning fun in fall 2006 while the opposite was observed in spring 2007, although the difference was not statistically significant, as shown in row (i) of Table 3. It is likely that more experienced students realized that clickers were not just a gaming device, but also a tool to improve their learning experience. This observation was more evident as there was no difference in all other factors between the two types of students. As observed from p-values shown in columns (4) and (7) of Table 3, both types of students felt that the use of clickers motivated them to attend, prepare for, and stay focus during a class; promoted active learning and higher interactivity; enabled the instructor to determine whether a topic needed more in-depth discussion or coverage; helped them to confirm their learning in a timely manner; and consequently helped them to learn better in the class.

As educators, we know that reading class materials (chapters or articles) before class is beneficial to student's learning outcome, and regular attendance is important for classes so that topics build upon each other. It is interesting to learn that the use of clickers creates interest and motivation for the new N-Geners to attend, prepare for, and stay alert and focus during a class because that has been a challenge for many instructors like me. Discussions and peer instructions have been proven to be effective active learn-

(1) Survey Questions	(2) survey 1 Mean (μ_i)	(3) survey 2 Mean (μ_j)	(4) $\mu_i = \mu_j$ p value
(a) The use of clicker quizzes creates interests and motivation to attend the class	3.484	3.531	0.8648
(b) The use of clicker quizzes motivates me to prepare for the class	3.290	3.313	0.9314
(c) The use of clicker quizzes motivates me to stay alert and focus during a class	3.581	3.500	0.7686
(d) The use of clicker quizzes promote active learning (peer discussion and instruction)	3.742	3.750	0.9752
(e) The use of clicker quizzes creates higher interactivity in the classroom	3.839	3.781	0.8014
(f) The use of clicker quizzes provides faster feedback	4.065	4.188	0.4944
(g) The use of clicker quizzes helps me to identify and confirm my understanding of materials	3.387	3.656	0.3033
(h) The instructor uses clicker quizzes to determine what topics to cover more in depth	3.516	3.469	0.8324
(i) The use of clicker quizzes makes learning fun	3.065	3.063	0.9938
(j) The use of clicker quizzes helps me to learn better in this class	3.097	3.226	0.6194

Table 2: Survey results.

(1)	Survey 1			Survey 2		
	(2) fall 2006 Mean (μ_i)	(3) spring 2007 mean(μ_j)	(4) $\mu_i = \mu_j$ p value	(5) fall 2006(μ_k)	(6) spring 2007(μ_l)	(7) $\mu_k = \mu_l$ p value
(a) Attend class*	3.444	3.538	0.812	3.474	3.615	0.735
(b) Prepare for class	3.278	3.308	0.937	3.158	3.538	0.312
(c) Stay focus	3.611	3.538	0.845	3.526	3.462	0.880
(d) Active learning	3.667	3.846	0.604	3.842	3.615	0.578
(e) Interactivity	3.722	4.000	0.423	3.684	3.923	0.455
(f) Faster Feedback	4.167	3.923	0.333	4.316	4.000	0.241
(g) Confirm Learning	3.556	3.154	0.367	3.632	3.692	0.842
(h) In depth coverage	3.389	3.692	0.312	3.316	3.692	0.278
(i) Fun	3.333	2.692	0.077	3.158	2.923	0.541
(j) Improve Learning	3.167	3.000	0.669	3.263	3.231	0.929

*Refer to column (1) of Table 1 for complete survey questions.

Table 3: Survey results' comparison between semesters.

ing methodologies and are important for subjects/classes where model sections or answers rely heavily on reasoning. I found that the use of clickers was very effective in breaking the initial ice, or silent period, to bring as many different viewpoints from as many students as possible. When discussions were needed in fall 2006 and spring 2007, I often made up a clicker question that had several possible answers and one open answer, "others" or "none of the above." As there was no clear correct or incorrect answers, student responses were often diversified and that created a good starting point for group discussions and debates. Once each group presented group results, students were given a second chance to respond to the same clicker question and answers; multiple answers based on different assumptions and reasoning in many cases would then be revealed. I noticed that students, especially those who were often quiet and normally would not express their opinions, were significantly more involved in discussion when clickers were used than classes without clickers. My observations are also supported by data shown in rows (d) and (e) of Table 2.

It is equally important for both instructors and students to know that students have learned knowledge and/or skills they did not have when they began the class. Although there are different means (paper quiz, online quiz, verbal description, etc.) to confirm students' understanding of materials, I found that the use of clickers was more effective than other means, especially for the new N-Geners students, as it provides immediate feedback in a game-playing setting. Like many other instructors, I often have to guess whether students understood the topic by looking at their facial expressions during a class period. I find that the clicker's instant feedback feature is invaluable as it allows me to verify whether students grasped the concepts and to adjust my lecture plan accordingly to ensure students have mastered the topic before moving on to the next one. However, as an educator, it

is most rewarding to know that students perceived the use of clickers as a means to help them confirm their understanding of materials in a timely manner and has helped them to learn better in my class instead of just adding another technology thrill to their learning process.

Conclusion

Contrary to common application in classes with large enrollment, this report presented several interesting observations of clicker applications in a small business class setting. It is observed that students are motivated to attend, prepare for, and stay focus during the class. Students also felt that the use of clickers creates higher interactivity and active learning environment, helps them to confirm their understanding of materials, and consequently help them to learn better. It is valuable to compare student academic performance with sound experiment design. It would also be invaluable to have more investigations and cases to address the effectiveness and applicability of clickers in different subject areas.

Reference

Tapscott, D. (1998). *Growing up digital—The rise of the Net generation*. New York: McGraw-Hill. ■

Call for opinions and comments

"The Classroom" column wishes to publish your comments and opinions on selected articles to facilitate more in-depth pedagogical discussion in the issue following the article's publication. The "Clickers Adoption in a Small Class Setting" is the first "call for opinions and comments" article. To ensure your comments are considered and included in the October issue, please send your comments, opinions, and/or experiences on this article to Dr. Bih-Ru Lea at leabi@mst.edu by September 19, 2008.

INTERNATIONAL, from page 6

Western universities. An obvious and yet important impediment to Taiwan's progress is its current practice of teaching graduate courses in the Chinese language, while yet still encouraging students to publish in English journals. A stronger effort needs to be made to imbue students with the ability to communicate in English, which should begin throughout their entire secondary school system. In order to both retain and attract quality faculty, especially in the research institutions, salaries need to be increased to near Western standards, much as they are in Hong Kong and Singapore. This would also have the benefit of creating a more talented pool of applicants to the doctoral programs. While these kinds of policy changes are often difficult and take a long time to achieve, Taiwan citizens have shown their desire to improve the economy of their country by electing a new government, which now has the authority and mandate from its constituents to improve higher education and thus advance the quality of education for all Taiwanese citizens. ■

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