CREATING ACTIVE LEARNING IN A LARGE INTRODUCTORY STATISTICS CLASS USING CLICKER TECHNOLOGY

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Over the years, various teaching strategies have been developed to energize teaching and learning specifically for large classroom enrollment. Large classes do not lend themselves to student participation or inquiry. The use of clicker technology provides one way to address a part of this problem. It is a handheld device commonly called "clickers" or "key-pads" used by students in a large classroom to transmit their answers by pressing the clicker buttons. In this study, some initial results will be discussed on how clickers are used for teaching and learning of students in a large Introductory Statistics lecture environment. As this technology will be implemented for the first time in our department, the major challenges that the faculty and students will encounter when using this technology are also explored.

INTRODUCTION

Different teaching techniques and methods have been developed to stimulate the interest and engage students in large lecture classes. One of the challenges of large classes is a strategy to create an active learning environment and to justify whether the method is successful in improving student learning. This study discussed an alternative teaching format by integrating i<clicker technology to encourage student interaction in a traditional lecture environment. The use of i-clicker technology provides one way to address a part of this problem. It is a handheld device popularly known as "Clickers" or "key-pads" or handsets used by students especially for large classrooms to transmit their answers to questions posed by the teacher in class. This classroom technology allows an instructor to present a question to the class and allow the students to enter their answers into some kind of device and instantly summarizes students' answers or feedback for the instructor in a form of a histogram. Although one early example of a clicker had a single response button (Poulis et al., 1998), modern clickers usually have a 10-digit numeric keypad and often some accessory buttons including a power switch, a send button, or function keys that permit text entry (Barber & Njus, 2007).

As this technology was implemented by the Department of Statistics for the first time, in this study, we described our experiences of using this system in a large introductory statistics lecture class last Fall, 2009 and presents some initial results on how they are used for teaching and learning of students. The different major challenges of using this technology will also be discussed.

METHOD

The study was conducted to examine and evaluate students perceptions and attitudes on the use of i>clickers in a large Introductory Statistics class. The basic idea is to explore how this technology facilitates the student interaction in a large Statistics class.

The i>clicker technology was adopted for the first time during the Fall Term 2009–2010 in the Department of Statistics of the University of Manitoba. It was integrated in the lectures of nine sections of STAT 1000 (Basic Statistical Analysis I) and two sections of STAT 2000 (Basic Statistical Analysis II) courses where each class is compose of approximately 175 students. STAT 1000 is a service course of the department, which is composed of, mostly of freshmen students while STAT 2000 is a second course composed of major students. A survey was conducted during the Fall Term 2009 -2010 where 2 sections of STAT 1000 and one section of STAT 2000 were used as random sample. A total of 290 students participated in the survey that represents approximately 87% of all students in the three sections.

A survey evaluation was administered on the last week of the lecture class. Most of the students were from different disciplines. Most students enroll in this course to fulfill their university mathematics requirement or a requirement for their major. So in other words, students are just taking the course because they must, not because they are interested in learning the subject. The survey evaluation instrument was based on the papers of Preszler et.al. (2007) and Kaleta et. al. (2007) which was modified and validated. The survey instrument is composed of two parts. Part

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A of the survey includes three items related to students' overall impression of i>clickers, three items exploring the specific benefits of the system, three items on how clicker should be used in classroom and two items deal with the different problems experienced while using i>clickers in the classroom. One more question asked deal with study preference of the students in preparing for the exam. Part B of the survey contains questions related to students' opinions of i>clicker on class engagement, participation and attention, impact on feedback, learning and influence on marks. The last part of the survey included an open ended question that ask comments regarding the implementation of i>clickers in the classroom. Items related to students' perceptions or opinions were answered in the form of a 5-point Likert scale. The obtained data was analyzed using some quantitative statistical tools such as basic descriptive statistics like mean, standard deviation and percentages to describe the data. Chi-square analysis was utilized to test if there are significant differences on the distribution of responses on the different questions across the two courses.

DISCUSSION OF RESULTS

The data was analyzed quantitatively. In general, the responses of the students in both Introductory Statistics courses for the three items relating the overall value of using i>clickers in a large introductory statistics class were found to be favourable. Table 1 reported that across the two courses, averagely 61.04% of the students found i>clickers to be a good addition to the class lecture whereas 17.93% considered it a distraction from the class. For both courses, 42.41% of the students would recommend a clicker class to a friend while only 15% would not recommend an i>clicker class. For the item which asked whether i>clicker worth the price, 61.72% reported yes or probably whereas 38% answered negatively.

For each survey question in Part A, chi-square analyses were used to determine and compare the distribution of students' responses for both courses. The chi-square test was conducted and the test (Overall value, ($\chi^2 = 6.56,\ df = 2,\ p < 0.061;$) recommendation to a friend,($\chi^2 = 3.6,\ df = 2,\ p < 0.051;$)cost of i>clicker, ($\chi^2 = 5.89,\ df = 3,\ p < 0.387;$) has shown that the distribution of students responses with respect to the three items on the general value of i>clicker was not significantly different between the two courses. When the students were asked on the specific advantages of clickers, majority (74.83%) of them felt that using i>clickers in their respective course improve their interest in their course while only 18% of the students responded no to the statement that clickers improved their interest in the course. In terms of class attendance, it was reported that 71.73% agreed or strongly agreed that clickers improved their attendance and only 6% answered that clickers did not motivate their attendance in class. The responses of the students ($\chi^2 = 5.86,\ df = 2,\ p < 0.071;$) did not reveal significant differences for both courses. The results from Table 1.0 revealed that 51.72% of the students agreed or strongly agreed that using clickers improved their understanding and have been beneficial to their learning. The responses of the students for both courses did not show any differences as reported by the chi square analysis ($\chi^2 = 7.82,\ df = 3,\ p < 0.453;$)

In terms of the management of clickers, it was shown that 59.31% of the students for both courses recommended one or two clicker questions per class session while 20.00% prefer five or six clicker questions per class lecture. We have seen that there is no variation in terms of the responses of the students for both courses on the number of i>clicker questions used per class lecture. Actually, Table 1.0 shows on the average 61.07% of the students for both courses felt that the number of clicker points earned is just right and 22.09 % of the respondents said that it is too low. It was also reported that 50.59% of the students prefer to answer clicker questions after discussion with their classmates and 36.47% preferred to answer the clicker questions first by himself, and then again, after discussion with classmates. Only 13% of the students choose to answer the clicker questions without discussion with their classmates. It is interesting to know that almost 89% of the students for both courses did not encounter any problem with the registration of their clickers. As reported, only 6% had trouble following the detail e-instructions and 5.52% experiences trouble using the electronic instruction website. This maybe explained by the fact during the first day of class orientation, the instructor distributed to all his students a hard copy of the information on how to register their i>clickers.

Table 1. Distribution of student responses for combined STAT 1000 and STAT 2000 Courses

Items	Frequency (n)	Percentage (%)
A. Overall Importance		
1. Overall, I found the clickers to be:		
a) A great addition to the class.	50	17.24
b) An OK addition to the class.	177	61.04
c) A distraction from the class	52	17.93
d) Very detrimental to my learning in this class.	11	3.79
Total	n=290	100.00
2. I would recommend a clicker class to a friend.		
a) Yes, absolutely	123	42.41
b) I don't think it matters if clickers are used	96	33.10
c) No, I would tell them to avoid clickers.	71	24.49
	n=290	100.00
3. The cost of purchasing and registering the clicker was worth it.		
a) Yes	56	19.31
b) Probably	123	42.41
c) No	111	38.28
Total	n=290	100.00
B. Specific Advantages of Clickers		
4. The clicker kept me more interested during the lecture.		
a) Strongly agree	89	30.69
b) Agree	128	44.14
c) Neutral	52	17.93
d) Disagree	21	7.24
Total	n=290	100.00
5. The clickers made it more likely that I would attend and participate in class.		
a) Strongly agree	53	18.28
b) Agree	155	53.45
c) No, I would have come anyways.	65	22.41
d) No, they did not motivate me to attend in class.	17	5.86
Total	n=290	100.00
6. The clickers helped me understand and/or learn the material better.		
a) Strongly agree	26	8.96
b) Agree	124	42.76
c) Neutral	68	23.45
d) Disagree	72	24.83
Total	n=290	100.00
C. Management of Clickers in Classroom		
7. How many clicker questions do you recommend per class section?		
a) None	60	20.69
b) One or two	172	59.31
c) Five or six	58	20.00
Total	n= 290	100.00
8. The number of clicker points to be earned is:		
a) Too high	46	15.86
b) About right	180	62.07
c) Too low	64	22.07
Total	n= 170	100.00
9. I prefer to answer clicker questions:		
a) Without discussion with classmates	39	12.94
b) After discussion with classmates	151	50.59
c) First by myself, then again, after discussion with classmates.	100	36.47
Total	n= 290	100.00
D. Concerns with Classroom Clicker Use		
10. Did you have nay problem registering your clicker?		
a) Yes, I had trouble using the e-instruction website.	16	5.52
b) Yes, I had trouble following the detail e-instructions.	17	5.86
c) No problem with registration of my clicker	257	88.62
Total	n=290	100.00
11. Did you have problems getting your clicker to work in class?		
a) No, it worked every time.	213	73.45
b) I had problem 1 or 2 days.	60	20.69
c) I had problem 3 to 5 days.	3	1.03
d) I had problems on more than 5 days.	14	4.83
Total	n=290	100.00

Students Perceptions on Classroom Engagement and Participation

It was shown in Table 2 that the mean perception rating $\overline{X} = 4.38$, that is 65.5% of the students for both courses agreed or strongly agreed that the use of i>clicker system increases the student engagement during class. This was supported by the study that shown that there were twice as likely to work on problem presented during class if answers were submitted by clicker than by show of hands and even more if credit for answering (Cutts et.al., 2004). Only 10% of the students disagree with the statement that clickers led them to become engage in class. A chi-square test did show any significant difference in terms of the distribution of responses of students for both courses. The chi-square test reported ($\chi^2 = 5.61,\ df = 2\ \ p < 0.453;$) did not show significant differences on the responses of the students for both courses on this item.

It was shown from Table 2 the mean perception rating of $\overline{X} = 4.01$, that is 71% of the students for both courses agreed or strongly agreed that i-clickers increased their frequency of class participation in the course. The students are given wider interaction by allowing them to respond to all the questions asked by the instructor. It was reported that i>clickers allowed them to participate freely in class discussion without any reservation or fear of embarrassment for incorrect answers. In the open-ended question of the survey, some students' comments include " I liked how the clickers started discussions, especially if the question was especially difficult. The use i>clicker in class made more active in class…" It was shown from Table 2 that there is a significant difference in terms of the distribution of responses of students in STAT 1000 and STAT 2000. This was validated from the chi-square analysis ($(\chi^2 = 7.89,\ df = 3\ \ p < 0.001)$) where p-value is very small.

Moreover, the report had shown that the mean perception rating is $\overline{X} = 4.21$, that is 68% of the students agreed or strongly agreed that using i>clickers helped them to be more attention in class and only 15% disagreed on this item. Chi-square test ($\chi^2 = 6.82,\ df = 3\ \ p < 0.2290$) did not show any significant difference on the distribution of responses for both courses.

Table 2. Mean and Chi-square analysis of students' perceptions across the two courses

Items	Average response (STAT 1000 /2000)	SD	Chi-square Statistic
A. Students' Perceptions on Classroom Engagement and Participation			
1. Clickers led me to become engage in class.	4.48/ 4.27	1.04/1.12	$\chi^2 = 5.61,\ df = 2,\ p < 0.453$
2. Clickers increased the frequency of participation in the course.	4.10/ 3.92	0.74/0.93	$\chi^2 = 7.89,\ df = 3,\ p < 0.001$
3. Using clickers helped me to pay attention in class.	4.28/4.13	0.99/1.07	$\chi^2 = 6.82,\ df = 3\ \ p < 0.229$
B. Students Perceptions on about Feedback, Learning and Marks			
1. Clickers helped me get instant feedback on what I knew and didn't know.	4.31/4.37	0.76/1.11	$\chi^2 = 2.01,\ df = 3,\ p < 0.92$
2. Clickers have been beneficial to my learning.	3.88/3.91	0.68/0.76	$\chi^2 = 7.82,\ df = 3,\ p < 0.453$
3. Using the clickers helped me get a better mark in homework and tests.	3.32/4.08	0.93/0.98	$\chi^2 = 17.6,\ df = 3,\ p < 0.023$

Students Perceptions on Feedback and Learning

It was shown from Table 2 that the mean rating response registered $\overline{X} = 4.34$, that is 77% of the students for both courses agreed or strongly agreed that i>clickers helped them get immediate feedback on what they knew and didn't know and only 8% disagreed on this question. This allows them to gauge their mastery of the topic lectured by the instructor during the class period. The chi-square analysis as shown from the table ($\chi^2 = 2.01,\ df = 3\ \ p < 0.920;$) did not give significant variation on the responses of the students for both courses. Clickers are useful in sustaining attention and breaking up lectures. It has been demonstrated that the most well-recalled portion of a lecture is the first five minutes (Burns, 1985), so using clickers emphasize an important concept at the beginning of class may make good use of this phenomenon, as well as helping students to focus and settle down at the start of class (Elliot, 2003). A majority of the students that is 55% agreed or strongly agreed that i> clickers have been beneficial and valuable to their learning. The mean rating for this item is $\overline{X} = 3.90$. Lastly, the study reported a mean rating of $\overline{X} = 3.70$, that 52% of the students strongly agreed that i>clickers helped them earned a better grade in the course since i>clicker

questions are very good practice for tests. This might be attributed to the fact that most of the i>clicker questions used in class are questions derived from past midterm tests and final examinations. The Chi-square test ($\chi^2 = 17.06,\ df = 3\ \ p < 0.023;$) reported that there is a significant difference in the distribution of responses of students on this item.

Challenges in Using i>clicker

In spite of the positive reaction of students to the use of i>clickers in the classroom, there were some challenges that they encountered. One issue with instructor new to i>clickers is the time factor. Integration of i>clicker in the class lecture required a greater amount of time than many instructors anticipated. i>clicker activities consumed a considerable amount of time especially if it is discussions were linked to the questions. Each i>clicker question requires around 1 to 2 minutes from students to complete and after that discussion of question will take again 1 to 2 minutes. This was done to make the students engage and learn more with the lecture materials.

Another challenge is the technical help or support since this technology was just implemented for the fist time different students' i>clicker problems such as lost, defective, or incorrectly registered clicker have been experienced. Students usually asked their instructor whenever they had clicker problems since they expect problem-free technology and they want clickers that are easy to use and to register. However since the Department of Statistics has its own Information Technologist who assists with the students' technical problems hence some of these problems have been minimized.

The results of this survey seem to demonstrate that students enjoyed using the i>clickers in large introductory statistics classes. It reported few problems in technology. Although, the i>clicker technology was just implemented for the first time, it gives a positive impact on student attendance, and most of all, it increased student engagement in the large class lecture environment. The results of the study have shown that in general, i>clickers are great and flexible tool for teaching which can be incorporated into a large lecture class to increase interaction between students and instructor. However, these results may not be not be so conclusive since it was just the first time that was used in our large lecture classes. Some follow up researchers remain to be done in the future to justify the effectiveness of the use of i>clickers.

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