Using cellphones as virtual clickers in a mathematics classroom

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Abstract

A virtual clicker system is a Classroom Response System where students respond interactively to instructor questions using their cellphones or other everyday electronic devices. Response is usually provided through simple texting or via a smartphone app. As almost all students have cellphones and texting packages, virtual clicker systems provide an inexpensive alternative to physical clickers for students to engage in the classroom using popular millennial devices. While physical clickers are mostly restricted to multiple choice questions, virtual clickers allow questions in a variety of formats as well as the facility to reuse questions. In this article, we provide an overall introduction to the best practices associated with the use of virtual clickers in a mathematics classroom, an analysis of the advantages and disadvantages associated with their use as well as a round-up of the currently available virtual clickers systems. We also announce the results of a study where student perception on the use of virtual clickers in mathematics classrooms in three college campuses is measured and the results are compared with the results of a similar study for physical clickers.

1. Introduction

Would you ever consider asking your students to take *out* their cellphones during class? In today's classroom filled with millennial students, the use of cellphones (especially for non-academic texting) in the classroom has become an annoyance and a distraction to most instructors who usually ban its use during class. This action by most instructors is justified in the conclusions of [8] which showed that texting (for non-academic purposes) in the classroom not only disrupts learning but students also expect it to disrupt their learning. It was also established that such cellphone usage in class causes significant distraction to both students and instructors [3]. However, it has to be acknowledged that cellphones do remain a familiar millennial device that most students are quite fond of and are also pretty good at using, and thus it makes sense to explore and harvest its possible uses for learning. This rationale is strengthened by a study which showed that students overwhelming approve the use of cellphones in the classroom for academic purposes [13]. Through this article we would like to showcase one such use of a cellphone-based technique for classroom polling and compare student feedback to this method with that for methods using physical e-clicker type devices. In the method we use, students text in codes for the correct answers for multiple

choice or open-ended questions using their cell phones. We will explain the methodology involved and showcase its advantages as well as disadvantages. We will also present the results of a study which measured student perception for this polling method while comparing the results with a similar study where student feedback for the use of traditional e-clickers was obtained from a variety of math classes [15]. Although almost all students in our study used their cellphones to vote during class, the polling engine that we use (and almost all other such engines) will also accept votes through a website to help students who do not have cellphones. This allows students to vote using most popular millennial devices which have web access. Therefore rather than use the term "cellphone clickers" throughout this article, we shall use the term "virtual clickers" and the traditional clicker devices mentioned will be called "physical clickers."

2. Effectiveness of Classroom polling

A set of hardware or software used to invite students to respond to questions posed in the classroom is broadly called a Classroom Response System (CRS). The advantages of the use of CRS have been studied intensively, especially during the last six years which saw more and more teachers using clicker devices in their classrooms.

With an emphasis on mathematics, research by a number of scholars showed that clickers enhance student engagement, and overall help to create a more energized classroom where students enjoy learning [1, 2, 4, and 5].

A landmark article [12] showed that if the clicker questions were selected appropriately to enhance student collaboration and engagement (such as questions which appear in the Cornell Good Questions Project), then clickers can be used to significantly enhance student learning in mathematics. This article also goes on to show why clickers have become such an effective tool for mathematics learning.

2.1. Virtual Clickers vs Physical Clickers

Using physical clickers in a classroom, in spite of its high level of effectiveness, has its share of disadvantages too. Some of the main disadvantages on the use of physical clickers are the following. First and foremost, it costs a significant amount of money for students (and the department) to buy clickers which is a major constraint. Another disadvantage is that sometimes it happens that the physical clickers do not function properly. The fact that physical clickers can only be used on multiple choice and true/false questions is another major shortcoming as well as the extra time needed to set up the environment. A final disadvantage which is becoming increasingly significant in today's multi node distance education classrooms is the fact that physical clicker use is restricted to a single node campus-based classroom and does not help in engaging students in the modern distance education based classrooms in multiple locations.

The cellphone-based virtual clicker technique that we will introduce gives solutions to the vast majority of these shortcomings while posing a few different constraints. One of the advantages of the technique is that it taps in to the motivation and familiarity possessed by millennial students in cellphones and texting. The relative cost effectiveness of the system is also a significant advantage. From the instructor's angle, the polling engine that we use is free to use for classes with less than forty students at the time this article was written. From the student's angle, the only cost involved is the cost of sending a few text messages. As almost all students today have texting packages, this

cost will not affect most students. The other advantages include the ease of setting up the polling engine (The instructor only needs to access a browser and open a saved question while the students simply take out their cellphones). The ability to use non-multiple questions, the ease of saving/ reusing the created polls and the ability to use images in the questions add to the strengths of this method. Another major advantage in this era of online/distant education classrooms is the fact that through cellphone-based voting, students based in different physical locations across the world can collaborate and engage actively in the classroom.

Our virtual clicker technique has some disadvantages too with the first and foremost being the dependency on cellphone signal strength. However, as the competition among cellphone providers intensifies, more cellphone signal towers are being put up and the intensity of this issue can be expected to significantly decrease with time. Although the possibility of having a student who does not own a cellphone or a texting packages exists, this probability is very low with the current US student population. Moreover, the instructor can virtually eliminate this problem by getting the students to vote in groups. We feel that it can be safely assumed that in a group setting there will be at least one member with a cellphone texting package. In the worst case scenario where an individual student or a group is without a cell phone or a texting package, the polling engine also has the facility of voting through a webpage accessible through a classroom computer or a laptop. If an instructor is planning to use cellphone polling in a classroom, it might be a good idea to find a classroom which has good signal strength for the providers covering that particular geographic region. Of course in the absence of all technology, a student can still use colored cards to vote and there is research to show that results that you get are pretty much the same as when using physical clickers [11].

3. The polling technique

We feel that in addition to explaining the study, an explanation of the techniques we use will benefit the instructors who read this article. While there are a few options for virtual clickers available (some of which we will list in a later chapter of this article), we will explain the polling method through the engine we use, which is polleverywhere.com (www.polleverywhere.com). When asking students to vote we use the “one-cycle voting” method as described in [6] which invites the students to first discuss the solution to the posed problem as a group and then vote. After the voting, a randomly selected student from the group will present a justification of the voting. There is another popular method of voting named “two-cycle voting” which requires the student to vote twice for the same question, first individually and then again after discussing with the group. We use the one-cycle method as it will allow us to do more sessions in an hour as well as reduce possible problems of an individual student being unable to vote due to signal strength or texting plan issues. A reader can see a good comparison between these two methods in [6].

The virtual clicker engine that we use (www.polleverywhere.com) which allow texting-based and browser-based live polling for multiple choice as well as non-multiple choice questions. Mathematics is a subject filled with symbols and formulae and though the site would allow various types of questions (text, images, PowerPoint slides) as input, in order to save time and conduct polls efficiently, we use a method we found to be convenient and efficient. We display the question in a favored document format (Pdf, PowerPoint, MS Word, TeX, etc.) or in a textbook page in one window and open the polling site in another window. Then we enter a generic question (which can

be saved and re-used) in the polling site. We will explain this more clearly in the following discussion.

The polling process consists of several steps.

3.1. Step 1:

In the method we are about to explain, problems with math formulae are not directly entered in to the polling engine. These problems appear in a separate window in a popular document format while a generic question is submitted in to the engine. We will explain this in more detail below. However there are at least two virtual clicker engines (Top Hat (https://tophat.com/) and Polleverywhere.com) which do support LaTeX input to different extents. In step 1, the instructor would put up the question as a pdf (or any other type of document type) on the screen complete with the most exotic math formulae. (Note that this is more convenient for math polling sessions as questions may be filled with equations and graphs. However for another discipline, the instructor may find it easier to input the question/images straight in to the input box of the poll site.) Figure 1 below shows an example of a voting question (extracted from MathQUEST: Math Questions to Engage Students). This slide is shown at the beginning of the polling session and students are asked to work in groups and decide on an answer (A, B, C or D) for three to five minutes.

Q 01: What is the domain of $f(x) = \sqrt{x+3}$?

A. $(-\infty, \infty)$
B. $[0, \infty)$
C. $(-3, \infty)$
D. $[-3, \infty)$

Figure 1: *a sample poll question from college algebra class*

3.2. Step 2

The polling site is opened in a new window and a new poll is created by writing a generic question into the site's question box and the polling slide is generated (or one can open a previously created and saved poll, which may save time in the classroom). The polling site we used has the facility to enter questions in a comma separated format. So typing "The answer to Q 01 is? A,B,C,D" and pressing return while inside the question box will ensure the creation of a multiple choice polling question "The answer to Q 01 is ?" with the answers A,B,C, and D. The instructor can create the poll at this point and the students will see the voting slide which will provide a code for each of the answers and a number to text the correct code to (A good way to create a quick poll would be to keep a generic question "The answer to the question (question number) is? A, B, C, D," saved and create a poll by simply opening it and filling the question number). This method should save a lot of time and effort for math instructors.

3.3. Step 3

In this step, student groups will text in the code associated with their choice using their cellphones (to a common number given in the slide). The voting slide will then fill up "live". Sometimes the students would like to see the question again and it might be a good idea to keep the question minimized on the screen and toggle between the question window and the voting window. It is important to mention that during our study we found that keeping the screen on display while the

voting is going on can have an effect in two ways. On the positive aspect, the spectacle of live votes coming in increases the fun atmosphere in the classroom. On the flip side, a student group who is not so sure of the correct answer can watch how the other groups vote and simply vote for the most popular answer. Figure 2 below shows the filled up voting slide for a particular question. This particular step has undergone a slight change from the time the study was done and when this article is written. At the time this article is written, students are first required to text in a code to enter a session and once they enter, they can text in the actual answer number (A, B, C, D or E) instead of a code to each answer.

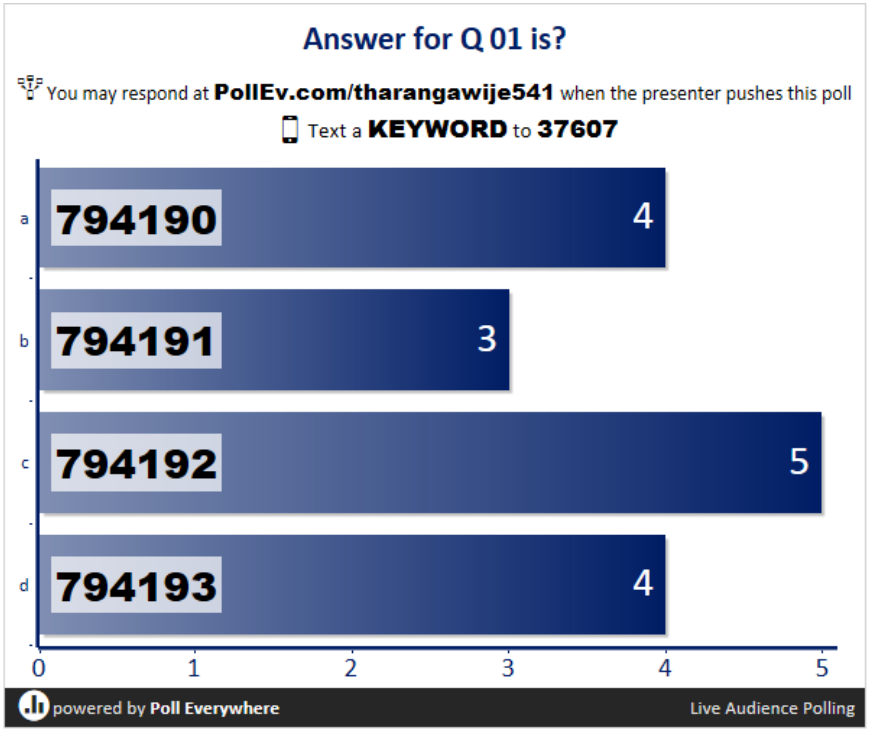

Figure 2: *a voting slide*

3.4. Step 4

This is the step in which we ask student groups for their justification for the answer. It might be a good idea to ask a randomly selected person for the answer as this will help the group dynamics and engagement during step 1 when the group plans the answer. The random selection of the student usually motivates everyone in the group be ready to explain the reasoning behind the group's vote. The instructor would neither agree nor disagree with a group's explanation and would try to keep a poker face as groups explain. When all the groups have finished explaining, the instructor can summarize the explanations and explain more if deemed necessary. During this step it sometimes happens that student groups who voted incorrectly would discuss among themselves after the voting session and would state this during their explanation. This is still OK and the instructor could ask such a group to explain what lead to the incorrect answer in the first place.

As mentioned earlier the questions are not restricted to multiple choice questions, and it is possible to collect short answers for some of the mathematics problems. Due to the limited capability of entering completed mathematical symbols into a text message, not every kind of open-ended

answer can be collected through a text message. The following figure describes a set of open-ended responses of students from a linear algebra section.

In the above case, the system will generate a single code mapped for the particular problem and students can text their answer along with the code. There are several ways of arranging student responses (Text Wall, Word Cloud, or Cluster) and in this instance the responses were displayed in the cluster mode.

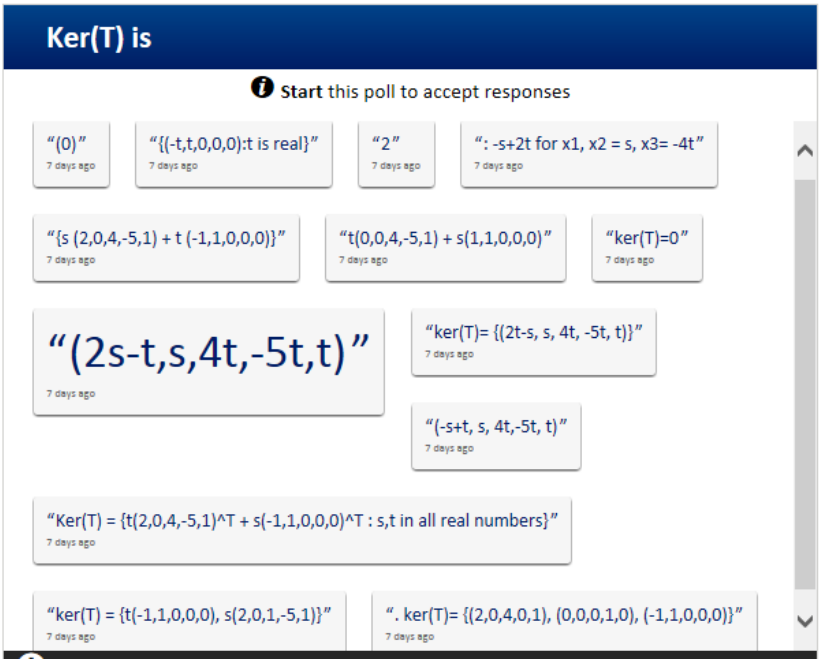

Figure 3: *student responses in cluster mode*

4. The study

Our study involves measuring the student perception of using a virtual clicker system for mathematics at three small liberal arts colleges in the Midwestern and Southwestern regions of the United States. In all, 83 students took part in the study which covered one section in Trigonometry, a section in linear algebra, a section in college algebra and two sections in Calculus II.

In 2006, a study where student perception to classroom polling using physical clickers was measured through a survey [15]. We use the same survey questions in our study to measure the student perception in using virtual clickers and compared the feedback between the two methods.

4.1 The survey

The following ten question survey, which was borrowed from the study presented in [15], was given to students of all three sections at the end of the semester.

Q1. Does the voting make the class more fun?
Q2. Does the voting help you engage in the material?
Q3. Would you be better prepared for the homework and exams if the instructor did more examples on the board and less voting? Yes/No

Q4. Does the classroom voting help you learn? Yes/No
Q5. How do you think that the amount of voting used in this class should change? Increased/decreased/remain the same
Q6. Do you feel comfortable being called on to explain your vote to the rest of the class? Yes/No
Q7. Would you learn better if the teacher just explained what the correct answer was, instead of spending time with discussions after each vote? Yes/No
Q8. Suppose that two sections of a math class were offered and one would have classroom voting, while the other would not. Which would you chose? Voting/Non-Voting
Q9. What do you like best or least about classroom voting?
Q10. How could we make classroom voting better? If we wanted to improve the process, what could we do?

5. The results and the analysis

As far as the statistical analysis, we consider each question separately and conduct a chi squared test with continuity correction. The size of the p value and the 95% confidence level of the ratios are looked at to decide whether the student feedback was significantly more positive for the use of virtual clickers.

First let us look at the questions where the percentage of positive responses is significantly higher for the virtual clickers than physical clickers. Questions Q2, Q3, Q5, Q7 and Q8 fall in to this category.

Table 1: *Comparison of responses to survey questions across the studies*

Question	Mean % voting "Yes" in the present study using virtual clickers	Mean % voting "Yes" in the Zullo et al. study using physical clickers	95% Confidence Interval for the difference of the ratios	p value
Q2. Does the voting help you engage in the material?	97.6%	89.3%	(0.03363053, 0.13260165)	0.0287
Q3. Would you be better prepared for the homework and exams if the instructor did more examples on the board and less voting? Yes/No	29%	50.2%	(0.1000673 0.3274674) (For the no answer)	0.0004646 (For the no answer)
Q5. How do you think that the amount of voting used in this class should change? Increased/decreased/remain the same.	97.6%	73.8%	(0.1854233, 0.3004970)	0.000002402

(Yes=increased or remain the same)				
Q7. Would you learn better if the teacher just explained what the correct answer was, instead of spending time with discussions after each vote? Yes/No	13.6%	23.8%	(0.01656739, 0.19400589) (For the no answer)	0.04601 (For the no answer)
Q8. Suppose that two sections of a math class were offered and one would have classroom voting, while the other would not. Which would you chose? Voting/Non-Voting	90.4%	74.4%	(0.07811903, 0.23983114)	0.002385

It is difficult to say for each and every one of these questions separately why the feedback for the virtual clicker method is significantly more positive than the physical clicker method. However we feel that we can safely say that certain aspects did contribute. One such factor is the fact that students really didn't have to pay anything extra for the device or the method. This would help in their significantly higher positive response to questions such as Q8 ("Suppose that two sections of a math class were offered and one would have classroom voting, while the other would not. Which would you chose?"). Another aspect which might contribute to the preference for virtual clickers over physical clickers is that fact that while students would regard a physical clicker as a device purely used in education, they would regard the cellphone as a device used for entertainment and communication. This perception would make the cellphone a more likable device to be used in the classroom. As a matter of fact, a study showed that 19% of college students spend more than three hours a day on their cellphone while 31% say that use it at least once in a classroom [3] (these numbers may be even higher in 2015 when this article is written). The ability to use this "cool" device in the classroom would contributed significantly to their enthusiasm and therefore provide greater positive responses questions such as Q2 ("Does the voting help you engage in the material", Q3 ("Would you be better prepared for the homework and exams if the instructor did more examples on the board and less voting? Yes/No") and Q5 ("How do you think that the amount of voting used in this class should change? Increased/decreased/remain the same. (Yes=increased or remain the same)").

There is considerable evidence to show that students contribute a very high level of engagement to the process of texting [8, 14] (both academic and non-academic) and this could be a factor which makes the student feedback to Q2, the question on engagement, significantly greater for virtual clickers than physical clickers. The ease of use could also play a role in the positive feedback. Millennial students send text messages all the time and this is a very natural action to them, and the fact that the virtual clickers only require them to perform that simple action would contribute to

their positive feedback. This also leads to the fact that when using virtual clickers, the students are using a very familiar device. This will possibly help students to recover from a device failure situation with the cellphone faster than from a failure of the relatively unfamiliar physical clicker device. In addition to that, certain aspects which have very little to do with the technology would also contribute positively. Once such aspect is the fact that for our sessions, we selected optimized multiple choice problems from some of the best question banks available such as the MathQUEST: Math Questions to Engage Students (2006-2009), the Cornell University Good Questions project, and Purdue University's past exam archives. Questions which have the correct amount of challenge contribute positively to engagement, and this could very well contribute to the feedback of the student engagement question.

The following table shows the questions for which the percentage of positive answers for the virtual clicker method is NOT significantly higher than the method using physical clickers.

Table 2: *Survey question responses which are not statistically significant across the studies*

Question	Mean % voting Yes in the present study	Mean % voting Yes in the (Zullo et al) study	95% Confidence Interval for the difference of the ratios	*p* value
Q1. Does the voting make the class more fun?	94%	92.5%	(-0.04914553 0.07681175)	0.8233
Q4. Does the classroom voting help you learn? Yes/No	90.4%	84%	(-0.01450944 0.14142646)	0.1826
Q6. Do you feel comfortable being called on to explain your vote to the rest of the class? Yes/No	74.8%	74.5%	(-0.1008522 0.1055494)	1

Though there isn't a significant difference in the student response for Q1 among the two methods, students using both methods seem to overwhelmingly agree that using clickers (virtual or physical) is fun. While having fun certainly is not the same as learning, it shows that instructors can safely use clickers as a way to liven up the classroom. These results support conclusions which showed that students believe that the general mobile phone use for academic purpose in the classroom increased the enjoyment factor [13]. This was further supported by the conclusions which showed that students found a virtual clicker activity to be enjoyable [14]. While student surveys are not the best way to gauge the amount of learning, the high positive feedback to Q4 ("Does the classroom voting help you learn? Yes/No") is encouraging. Q6 ("Do you feel comfortable being called on to

explain your vote to the rest of the class? Yes/No “) does not depend on the polling technology as the student explanations occur after the polling. The relatively somewhat low percentage of positive feedback (regardless of the method) to this question is probably due to the fact these explanation sessions could make some students feel that they have been put on the spot. In spite of this, the approval score in the 70 percent range is encouraging especially since these discussions, which go on for several minutes, allow students to correct an incorrect answer themselves [15].

Overall, the positive nature of the feedback to all the questions does not reduce significantly from the same for physical clickers. This further supports the work of a study done using an Australia based virtual clicker system (VotApedia) which showed that using virtual clickers retained the pedagogical advantages of physical clickers [7].

5.1. Student Comments

In student comments to the ninth question: “What do you like best or least about classroom voting?”, quite a few students seem to like the discussion and the group work aspects the best and appreciated the opportunity to stay engaged and learn from mistakes and from others. Some students state that they would rather not see the votes of other students. Others mention that using cell phone clickers for a small class would be somewhat of an “over kill” and a regular Q&A session might be better. There are also suggestions to mix up the groups and some students appreciate the engaged discussion that arises when different groups vote for different answers. Some students state that the anonymity nature of their responses help them to participate without worrying about being embarrassed in front of fellow classmates. A few students mention that knowing how the class is doing as a whole help to reduce their anxiety. In response to the tenth question, (“How could we make classroom voting better? If we wanted to improve the process, what could we do?”), certain students suggest smaller groups and larger amounts of incoming votes. Some suggest having a dedicated set of e-clickers for this purpose while others suggest that it is better if the instructor explains the correct answer soon after a group answers correct. Quite a few students suggest using clickers more often in future classes.

5.2. Other alternatives to physical clickers.

Although we conducted our study exclusively using polleverywhere.com as our virtual clicker technology, at the time this article is written there are many other options available as alternatives for physical clickers. Socrative (http://www.socrative.com/), Mentimeter (http://mentimeter.com/), Piazza (https://piazza.com/), WiFli Response (with Google Drive, https://sites.google.com/site/wifliresponse/home), TopHat (https://tophat.com/), SMSPOLL (http://www.smspoll.net), and Gosoapbox (http://gosoapbox.com/) are some of the popular options. Online survey tools such as Addpoll, Surveymonkey, and Polldaddy can also be used to collect student responses but may require a computer or a web browser. In addition to these, the TI-Navigator system allows students to wirelessly submit answers to the teacher’s computer directly from their calculators. Some of these virtual clicker options have some additional useful features for teachers and students. Two such examples include the attendance tool offered by TopHat where a student can text a code (displayed only on the classroom projector) to record attendance and the “Space Race” game offered by Socrative where student teams compete to finish a quiz.

6. Instructor and Student Preparation for Virtual Clickers

In this paragraph we hope to explain how instructors and students may approach the use of virtual clickers. As far as the technical expertise required by instructors, most virtual clicker systems simply require instructors to input text or images into a web browser. There may be some instructors who are not that familiar with the practice of texting, but this is an easy skill to learn. Knowledge of texting can be useful when using some engines where the instructor can also participate in the discussions or when helping a student to send a text. In reality, instructors can face more complex technical issues when using physical clickers when somewhat unfamiliar electronic equipment is used; being unfamiliar with equipment may make it difficult to implement [10] and increases the possibility of it failing during a polling session. Almost all of the major virtual clicker engines have a very high level of robustness and barring any breakdowns in the more familiar classroom computer or the school internet, a reasonably computer savvy instructor should not face any significant technical problems during a virtual clicker session. At the same time there is hardly any implementation needed as the engines run on a web browser. In addition, today's virtual clicker engines are accompanied by plenty of user friendly video guides which will help the instructor to set up sessions.

The instructor, however, should be prepared to embrace a new type of assessment and feedback. Traditionally, instructors would assess students after a few lessons through a quiz or a test, but here instructors get instant feedback as to how learning has occurred in the class. In order to optimize this feedback however, instructors should take care in the design of the questions. A comprehensive set of guidelines as to how to design a good clicker question in mathematics is described in [12] where a set of optimized calculus clicker questions was created and used in a study (using physical clickers). The study showed a significant enhancement in student learning. The question bank used in this project (which is known as the "GoodQuestions Project") is available at (http://www.math.cornell.edu/~GoodQuestions/).

The project identifies several characteristics of a good clicker question. A good clicker question "stimulates students' interest and curiosity in mathematics, helps students monitor their understanding, offers students frequent opportunities to make conjectures and argue about their validity, draws on students' prior knowledge, understanding, and/or misunderstanding, provides instructors a tool for frequent formative assessments of what their students are learning and supports instructors' efforts to foster an active learning environment" [12]. Posing a good clicker question should increase the level of engagement in student groups and enhance learning. In order to achieve this however, care must be taken to avoid possible distraction and assessment integrity issues which can be caused by millennial devices.

A question that is often asked by colleagues during presentations on this topic is whether allowing the use of cellphones in the classroom can cause distraction and other consequences which are detrimental to learning. One way to avoid such distractions is to have a strict ground rule that cellphones can be switched on in the classroom only when prompted by the instructor. Another issue that can also effect a virtual clicker session is the availability of apps such as Wolfram Alpha (www.wolframalpha.com) on student cellphones which can give some students an unfair advantage while answering questions and can therefore affect the integrity of the assessment. The instructor can if needed, specifically ban the use of such apps or avoid questions which cannot be simply answered by using technology (such as "Integrate $x \sin(x)$") but offer a good question [12] such as

"True or False: You were once exactly π feet tall" which requires more discussion and deeper thinking. The considerations on integrity should be weighed carefully if instructors plan on using virtual clickers on unit exams and finals. Unlike in the case of physical clickers, cellphones have the extended ability to access the internet and send text messages and such facilities can be used to compromise the integrity of an exam. To reduce this risk, instructors can think about using some of the strategies that are used in online assessment such as using a secure browser. The Respondus Lockdown Browser (www.respondus.com/products/lockdown-browser/) has a cellphone version available. It must be stated, however, that we have not used virtual clickers for summative assessment and are not aware of any resources that recommends a collection of best practices for such use. On the topic of using clickers (physical or virtual) for summative assessment, another question which is often raised is why we should use them in the first place, as clickers are almost always used as a way of enhancing students engagement in a "live" classroom session. In defense of clicker use in summative assessment are aspects such as the opportunity for students to get instant feedback, the ease of grading and the reduction of paper waste caused by printed exams.

So how does a virtual clicker session change students' preparation? During a class where virtual clickers are used, students can expect a clicker question anytime during the class and should be ready to answer it individually or by participating in a group discussion. When physical clickers are used, the physical equipment in the class can give a hint to the student that a clicker session will happen that day. With virtual clickers however, whenever an instructor feels that the learning of a certain concept or skill needs to be reinforced by a clicker question, a student can expect the "Class, take your cellphones out" directive from the instructor without prior warning. These impromptu question sessions require the student to be reasonably current with the content taught in the classroom. As most clicker sessions are accompanied by probing questions which may require discussion, the student will also get an opportunity to engage actively in group work. A virtual clicker session will also give instant feedback to students [9] on areas which may need extra reviewing before they leave the classroom. This will be quite valuable to students who can then strengthen these areas before the next quiz or test.

7. Conclusions

Our study using virtual clickers shows that the overall student perception on using virtual clickers for mathematics classes is overwhelmingly positive. In certain aspects such as the level of classroom engagement, the amount of polling, the amount of student discussions/explanations and in the choice of sections, student responses are significantly more positive for virtual clickers than for physical clickers. The main reason for this could likely be that students using virtual clickers probably have an inexpensive opportunity to use a familiar millennial device that they like, but one which is traditionally banned in the classroom.

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