



2nd International Conference on Higher Education Advances, HEAd'16, 21-23 June 2016,
València, Spain

Student Perceptions to the Use of Paperless Technology in Assessments- A Case Study using Clickers

Rangith Baby Kuriakose^{a*}, Nicolaas Luwes^a

^a*Department of Electrical, Electronics and Computer Systems, Central University of Technology, Park Road 1, Bloemfontein, 9301, South Africa*

Abstract

Modern classrooms see many innovative practices in facilitation. Most facilitators prefer using presentations animated videos and multimedia to better explain their content. Campuses are Wi-Fi enabled and students use tablets, laptops and smartphones to capture the essence of a lecture. However the one area where technological innovation is still lagging behind, in an academic setup, is in assessment. This paper looks at the perception of students to the use of clicker technology as a form of paperless assessment. Clicker technology was introduced as a tool for conducting formative and summative assessments to a first year electrical engineering subject, Digital Systems 1. The paper first elaborates on the significance, types and the methods of academic assessments. It then discusses the pros and cons of assessments using clicker technology. Thirdly it sheds light on the research methodology used in acquiring data for this research. Finally the results are analyzed which among others show that that 71% students enjoyed using clickers in class for formative assessments while only 52% appreciated its use in summative assessments. One of the reasons touted for this decrease is student anxiety. The key recommendation from this research is to increase the use of these assessment techniques within a formative assessment environment so as to familiarize students to eventually use it with confidence in summative assessments.

© 2016 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Peer-review under responsibility of the organizing committee of HEAd'16

Keywords: Online assessments; student perspective; clicker technology; formative assessments; summative assessments.

* Corresponding author. Tel.: (56-2) 2820 0300
E-mail address: rengithbaby@gmail.com

1. Introduction

“Assessment is the most powerful lever teachers have to influence the way students respond to courses and behave as learners”(Graham, 1999). This is the view of Gibbs on assessment. His view is reinforced by those of Smith and Wood who go on to state that “...appropriate assessment methods are of major importance in encouraging students to adopt successful approaches to their learning. Changing teaching without due attention to assessment is not sufficient”(Smith & Wood, 2000). These are just some of the views of active researchers in the field of education on assessment.

Some of the questions this paper poses and aims to find answers to are; what is the perception of students on paperless assessment?; Can the clicker be used to bridge the gap between facilitators and students?; Using paper-less assessments are we encouraging more students to actively participate in our classrooms?; Is this going to be the way forward in assessments?

There has been similar research done in mathematics education(Engelbrecht & Harding, 2005), but very little in engineering and almost none noting the perception of electrical engineering students in South Africa to the use of innovations in assessment.

The Central University of Technology (CUT)(“Central University of Technology, 2015”) is home to approximately 13000 students. CUT offers National Diplomas and Bachelor of Technology degrees in various faculties, including the Faculty of Engineering and Information Technology. It is the Electrical Engineering department of CUT that forms the base of this research. First year students from the Digital Systems 1 course willingly participated in the research.

To facilitate the research, formative and summative assessments were done utilizing Clickers (paperless assessment technique), a responder device developed by Turning point Technologies™. The paper starts off by elaborating on academic assessments and its significance. Focus then shifts to assessments using clickers and a comparison between clicker assessments and traditional assessments is done. Next, it sheds light on the research methodology used in acquiring data for this research. Finally the results are analyzed with the help of tables and figures.

2. Significance of assessments

A good definition of assessment of student learning is provided by Barbara E. Walvoord (Walvoord, 2010). She defines assessment as “the systematic collection of information about student learning, using the time, knowledge, expertise, and resources available, in order to inform decision about how to improve learning.” The author goes on to state that a good assessment is a process that involves three steps. They are as follows;

- Establishing goals for student learning
- Gathering qualitative and quantitative evidence for how well students meet those goals
- Using the information to improve learning.

As a lecturer one of the key mistakes one can make is to consider assessment as an add-on to a course (Shepard, 2000) or even neglect its significance altogether (Surgenor, 2010). Students view assessment in a different light. The primary objective of most students is to pass the course, hence only study what is assessed (Engelbrecht & Harding, 2005).

The above stated view of students to assessment should highlight the significance of assessments and that it should not be seen merely as a tool that can be used allocate grades or degrees to students. It should play an important role in focusing student attention (Surgenor, 2010) and drive their learning (Sainsbury & Walker, 2008). Good assessment technique (Gibbs, Simpson, & Macdonald, 2003) has six main functions. They are;

- Capturing student time and attention
- Generating appropriate student learning activity
- Providing timely feedback which students pay attention to
- Helping students to internalize the discipline’s standards and notions of equality
- Generating marks or grades which distinguish between students or enable pass/fail decisions to be made

Providing evidence for other outside the course to enable them to judge the appropriateness of standards on the course

Some other rationale for conducting assessments include (Brown, 2004);

- Fulfilling student expectations
- Motivating students
- Providing feedback
- Performance indicator for students, staff and institution
- Provide opportunity to remedy mistakes

3. Assessment using clickers

One of the earliest record of faculty actively using clickers or audience response systems (ARS) is by the University of Wisconsin-Madison (“Classroom ‘clickers’ catching on as instant assessment tool,” 2005). Faculties including psychology, pharmacy and mechanical engineering made use of the clickers in one way or the other with some measure of success. More faculties (Caldwell, 2007) have since moved on to using clickers in either formative, summative or both forms of assessments.

The main reason stated by one (“Nanyang Technological University,” 2015) of the faculties for introducing clickers into the curriculum is that that the traditional passive learning paradigm of information delivery by the lecturer to his students is no longer adequate for adept functioning in a knowledge-based economy (Laxman, 2011). The author goes on to state that “Technological advancements have produced a new generation of student learners who are savvy in using technology to meet their needs. In fully harnessing and optimizing the talents of this new cohort of students a paradigmatic shift to active learning supported by cutting edge technologies is needed – an educational approach that focuses on self-directed learning with emphasis on active inquiry, application and synthesis of information and autonomous learning.”

As mentioned in the introduction, Clickers used at the Central University of Technology are developed by Turning point Technologies™ (“Turning point Technologies,” 2012). These clickers leverage upon three technological affordances to allow for adaptive and flexible learning. The first is that clickers are wireless handsets with each unit possessing a unique signal to enable responses from each individual student to be identified and recorded (Caldwell, 2007). The next key component embedded in clicker technology is the linking to data manipulation and a projection display. Questions can be relayed to the students on a question paper or through Microsoft office presentations. Responses from students can be displayed on the projection screen instantly as bar charts or in other appropriate formats like Microsoft office excel.

The ability to compute and display the data to the entire class is an important feature. This provision of immediate display of results enables the lecturer to easily assess students’ understanding of material covered in class and offer remedial instructions to correct student misunderstandings, if any. Students also obtain immediate feedback on how well they are learning. The third and final component is a personal computer loaded with the software from Turning point Technologies™ that facilitates the collection, processing, display and storage of response data.

The advantage of using Digital Systems 1 for this study was that although it is an engineering subject, the focus is mainly on mathematics and especially number systems. A lot of calculations provide numeric responses or even short answers. It also helped that the subject is an entry level subject and the focus is on the lower cognitive levels of the Blooms taxonomy. A comparison between the use of clicker assessments and traditional assessments is shown in Table 1.

Table 1. Comparison between clickers and traditional assessments

Parameters	Clicker assessments	Traditional assessments
Initial investment	Very high	Comparatively much lower
Time to setup questions	Very high-especially to design high end questions	Comparatively much lower
Quality of questions	Might be compromised if enough time is not spend in design	Not a factor
Grading time	Instantaneous and independent of class size	Depends on class size
Grade tabulation	Automatically generates results in Microsoft Excel	Needs to be done manually
Feedback to student	Immediate	Depends on class size and grading time

The comparison clearly shows that both forms of assessments have their pros and cons. As to which form of assessment a facilitator chooses for their subject depends to a large extent on the parameters mentioned in Table 1. If the subject can be easily adapted to clicker assessment format and it has a large class size, like Digital Systems 1, then clickers can be used. It has the distinct advantage of providing immediate feedback, and provision for instigating remedial measures. The initial capital investment and time taken to setup questions could be seen as a drawback to using the clickers.

4. Research methodology

An exploratory study is employed along with descriptive statistics involving quantitative analysis of the collected data. An exploratory design may set the stage for future research and usually involves only a single group of respondents (Jara & Mellar, 2010). Descriptive statistics are used as the results are interpreted with regard to specific freshman electrical engineering students enrolled at CUT. Quantitative analysis is important as it brings a methodical approach to the decision-making process, given that qualitative factors such as “gut feel” may make decisions biased and less than rational (Reddy, Higgins & Wakefield, 2014).

The target population was restricted to freshman electrical engineering students enrolled for Digital Systems I during the second semester of 2014. The class size was 73, but only 66 actively participated in the survey hence $n = 66$. The clickers were used in a classroom environment to obtain student perspectives on nine specific questions relating to the use of clickers in formative and summative assessments during the semester. Closed-ended questions, featuring Likert scales, were used based on previous research which focused on student perceptions of practical work done in a laboratory (A. J. Swart, 2014; A. Swart, 2012). Using these clickers in class ensured a high response rate, while the closed-ended questions did not require the participants to express lengthy views, as this is rather cumbersome with the use of clickers.

5. Results and discussion

The results of the survey are shown in Table 2. Before discussing the results of the study, it is important to establish the reliability and validity of the survey that was done using the Likert scales. Research has shown that for sample sizes up to one hundred (Yurdugul, 2008), a Cronbach alpha technique is a good measure of internal consistency for reliability. Since the sample size in this study was $n=66$, the Cronbach alpha technique was administered on the specific set of the survey questions and produced $\alpha = 0.78$. This value of alpha translates to a good internal consistency and therefore the study done in this paper can be one that is reliable and valid for the purpose of gaining student perceptions to the use of clicker technology in assessments.

The results of the survey are divided into two sections. This is primarily done to make for easier explanations. The first section focusses on the perceptions of the students to the use of clickers in assessments. This is described in Table 2. The second section focusses more on the recommendations by the students. These recommendations will help in improving the service given to the students in future. This is shown Figure 1.

Table 2. Perceptions of students to the use of clickers in assessments

No	Questions	Answer options	Frequency	Percentage
1	Is there a need to practice more using the CLICKER	Strongly agree	3	4.62%
		Agree	14	21.54%
		Neither	14	21.54%
		Disagree	10	15.38%
		Strongly disagree	24	36.92%
2	Was using the CLICKER user friendly	Strongly agree	13	19.70%
		Agree	31	46.97%
		Neither	13	19.70%
		Disagree	3	4.55%
		Strongly disagree	6	9.09%
3	Did you enjoy using the clickers in classroom for formative assessments	Strongly agree	24	36.92%
		Agree	22	33.85%
		Neither	8	12.31%
		Disagree	4	6.15%
		Strongly disagree	7	10.77%
4	Did you enjoy using the clickers in classroom for summative assessments	Strongly agree	13	20.31%
		Agree	21	32.81%
		Neither	14	21.88%
		Disagree	5	7.81%
		Strongly disagree	11	17.89%

The result of the first and second question of the survey shown that more than 70% of the class used the clicker at least three times or more before the summative assessments and 67% of the class either agreed or strongly agreed that the clickers were user friendly. This showed that the students had access to the clickers and did not find the clicker technology overwhelming.

Questions three and four tested the response of students to the use of clickers for formative and summative assessments. 71% enjoyed using the clickers in the classroom (formative assessments) while the number decreased to 53% in test or exams (summative assessments). The fact that summative assessments are high stakes as compared to formative assessments might be a reason for this decrease, but a follow up question was asked probing this decrease. This will be dealt in the recommendation section of the results.

Table 3. Recommendations of students to the use of clickers

No	Questions	Answer options	Frequency	Percentage
1	Is there a need to practice more using the CLICKER	Strongly agree	24	36.92%
		Agree	19	29.23%
		Neither	9	13.85%
		Disagree	3	4.62%
		Strongly disagree	10	15.38%
2	Was using the CLICKER user friendly	Strongly agree	13	20.31%
		Agree	20	31.25%
		Neither	18	28.13%
		Disagree	8	12.50%
		Strongly disagree	5	7.81%

As seen from Table 3, 66% of the students either agreed or strongly agreed that they need more practice using the clicker. This might also be taken as one of the pointers that students were indeed getting used to the clicker technology and might back up the reasoning provided to the answers of questions five and six on the survey.

The second question that was asked of the students was if they felt the use of clickers bridged the gap between students and facilitators. The results shown that, 51% of the students either agreed or strongly agreed that the facilitator got a better idea of what the students understand and do not understand. While 51% is not an overwhelming “yes”, the converse of the result state that only 21% either disagreed or strongly disagreed that the clicker bridged the academic gap between the students and the facilitator.

The last question that was posed to the students was what some of their fears when using the clickers. This question could give an answer as to why fewer students were open to the idea of using clicker in the summative assessments as compared to formative assessments. The results are shown in Figure 1.

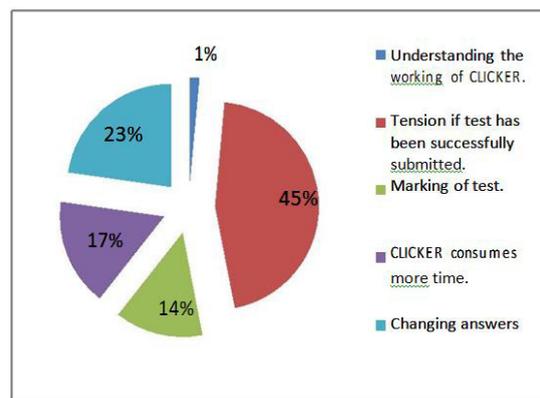


Fig. 1. Response to question “What was your biggest fear when answering questions on clicker”

The responses shown in figure 1 show the following; 45% of the students were worried if the tests were submitted successfully. 23% were fearful that their changed answer was not recorded by the clicker. 17% of the class also felt that the clickers took longer than traditional assessments. 14% echoed their fears in the marking of the test by the clickers. These answers clearly show the reason why there was decrease in takers when it came to the summative assessments. They also go on to emphasize the need for more practice using the clicker.

5. Conclusions

The primary focus of this paper was to get the perceptions of students regarding paperless assessments with the clickers as a case study. Some of the other questions posed in this research were; can the clicker be used to bridge the gap between facilitators and students?; using this technology are we encouraging more students to actively participate in formative assessments?; is this going to be the way forward in assessments?

The research was done with the students of Digital Systems 1 at the Central University of Technology, Free state. The general perception of the students to the use of clickers in assessments is dependent on the type of assessment. 71% of the students state that they enjoy using the clickers in formative assessment. While only 53% of the students enjoyed using clicker in summative assessments. This is shown in Table 2 question number three. This proves that they accept the clicker as a tool in formative assessment but need more convincing when it comes to their use in summative assessments.

With regards to the use of clickers in bridging the gap between students and facilitators, question two in Table 3 shows that the results are inconclusive (51% agreed or strongly agreed) but progressing in the right direction. As a facilitator for the course, the formative assessments done using the clicker almost immediately showed which concepts were grasped by the students and which were not. This meant that one could re-visit a section in the same class or earmark it for revision at a later stage. This was not possible earlier without the clickers.

The final question to which answer was needed was on if this assessment technique is indeed the way forward. Students were apprehensive to the use of clickers in summative assessments. Only 53% enjoyed using it in the summative assessments. This was owing to various anxieties among the students with regards to the use of clickers, the main one being; not knowing if their tests were submitted correctly. Readers need to take note at this point that the clicker registers an answer as soon as the respondent moves to the next question and affords the respondent an opportunity to correct their answer when reverting back to the same question.

In conclusion, this survey among freshman electrical engineering students gave a go ahead for the use of clickers in formative assessments, but held reservations to its use in summative assessments. The reasons put forward by the students suggest that there is a need for more time spent using the clicker. This is a key recommendation that this paper advocates and adheres to by using clickers during supplementary instructional (SI) classes in the first semester of 2015. It is believed that more frequent use of the clicker will dispel some of the fears and make the students more accepting to the use of clickers in summative assessments.

References

- Brown, S. (2004). Assessment for learning. *Learning and Teaching in Higher Education*, (1), 81–89. <http://doi.org/10.1187/cbe.11-03-0025>
- Caldwell E, J. (2007). Clickers in the Large Classroom: Current Research and Best-Practice Tips. *CBE Life Science Education Journal*, 6(1), 9–20. <http://doi.org/10.1187/cbe.06-12-0205>
- Central University of Technology. (n.d.). Retrieved May 1, 2015, from <http://www.cut.ac.za/>
- Classroom “clickers” catching on as instant assessment tool. (2005). Retrieved from <http://www.news.wisc.edu/11142>
- Engelbrecht, J., & Harding, A. (2005). Teaching undergraduate mathematics on the internet. *Educational Studies in Mathematics*, 58(2), 253–276. <http://doi.org/10.1007/s10649-005-6457-2>
- Gibbs, G., Simpson, C., & Macdonald, R. (2003). Improving student learning through changing assessment – a conceptual and practical framework. In *EARLI conference* (pp. 1–10). Retrieved from <https://www.open.ac.uk/fast/pdfs/Earli-2003.pdf>
- Graham, G. (1999). Assessment Matters in Higher Education.
- Jara, M., & Mellar, H. (2010). Quality enhancement for e-learning courses: The role of student feedback. *Computers and Education*, 54(3), 709–714. <http://doi.org/10.1016/j.compedu.2009.10.016>
- Laxman, K. (2011). A study on the adoption of clickers in higher education. *Australasian Journal of Educational Technology*, 27(8), 1291–1303.
- Nanyang Technological University. (2015). Retrieved May 1, 2015, from <http://www.ntu.edu.sg/Pages/home.aspx>

- Reddy, W, Higgins, D, Wakefield, R. (2014). An investigation of property-related decision practice of Australian fund managers. *Journal of Property Investment & Finance*, 32, 282–305.
- Sainsbury, E. J., & Walker, R. a. (2008). Assessment as a vehicle for learning: extending collaboration into testing. *Assessment & Evaluation in Higher Education*, 33(2), 103–117. <http://doi.org/10.1080/02602930601127844>
- Shepard, L. a. (2000). The role of classroom assessment in teaching and learning. *Assessment*, 95064(310), 1–12. <http://doi.org/10.1007/s11104-008-9783-1>
- Smith, G., & Wood, L. (2000). Assessment of learning in university mathematics. *International Journal of Mathematical Education in Science and Technology*, 31(1), 125–132. <http://doi.org/10.1080/002073900287444>
- Surgenor, P. W. G. (2010). Teaching Toolkit. <http://doi.org/10.1038/nmeth.1215>. Do-it-yourself
- Swart, A. (2012). Enhancing students' perception of single-sideband suppressed-carrier principles by using cooperative and computer-based learning. *CAEE, Computer Applications in Engineering Education*, 20, 332–338.
- Swart, A. J. (2014). Using Problem-Based Learning to Stimulate Entrepreneurial Awareness Among Senior African Undergraduate Students. *EURASIA Journal of Mathematics, Science & Technology Education*, 10(2), 125–134. <http://doi.org/10.12973/eurasia.2014.1023a>
- Turning point Technologies. (2012). Retrieved April 1, 2015, from <https://www.turningtechnologies.com/>
- Walvoord, B. E. (2010). *Assessment Clear and Simple: A Practical Guide for Institutions, Departments, and General Education*. (Jossey-Bass, Ed.) (2nd ed.). Wiley and Sons.
- Yurdugul, H. (2008). Minimum Sample Size for Cronbach's Coefficient Alpha: A Monte-Carlo Study. *Hacettepe University Journal of Education*, (35), 397–405.