Clicker technology: The tool to promote active learning in the classroom

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Because lecturers at South African universities are used to content-based teaching, they generally find it difficult to adopt a student-centered approach to teaching. It is difficult for lecturers to identify whether students understand a specific concept during the teaching-learning process. There is a divide between traditional methods of teaching often used by lecturers and digital-orientated students. The use of personal response system, commonly known as clickers, is one of the ways to address this problem. The use of clickers in education is growing fast because of their ease to use and their contribution to an increase in students’ involvement in the learning process. The aim of this chapter is to describe the process of using clickers in the learning environment, and to identify the pitfalls and necessary precautions for the use of clickers. The sample consisted of first year Science students at a South African university. The findings showed that effectively implemented clickers promote active learning and increase student participation during class.

Keywords clickers; active learning; higher education institution

1. Introduction

Because lecturers at South African universities are used to content-based teaching, they generally find it difficult to adopt a student-centered approach to teaching. It is difficult for lecturers to identify whether students understand a specific concept during the teaching-learning process. There is a divide between traditional methods of teaching often used by lecturers and digital-orientated students. The use of personal response system, commonly known as clickers, is one of the ways to address this problem. It has been shown that clickers could tackle two fundamental challenges in teaching, namely student engagement and determining whether students understands what is taught [1]. The use of clickers in education is growing fast because of their ease to use and their contribution to an increase in students’ involvement in the learning process [2].

Despite these apparent advantages, and their overall impact on promoting active teaching and learning, clickers have not been fully utilised in the South African context. Most of the existing findings stem from international studies [3]. In the study reported on this article, the challenge was for the lecturer to understand whether students grasp basic concepts and to keep them actively involved during the learning process. Immediate feedback to students poses certain problems, but through the use of clickers, immediate feedback and the measurement students’ understanding is possible [1, 4, 5]. It is stated that active learning occurs when students learn by performing appropriate activities [6]. In the research conducted by [7], it was revealed that active learning provides an opportunity for interaction and collaboration between students and content, student and student, and students and lecturers. Therefore, with the use of clickers during class, it was found that students are no longer passive listeners, as they become active participants throughout the lecture [1].

The study was conducted among first-year students in the Sanitation Safety and Hygiene (SSH) courses in the Department of Biotechnology & food technology in the Faculty of Science, at a South African university. In order to reflect on the impact of clickers on the promotion of active learning, this study was undertaken to investigate the use of clickers in teaching and learning, to determine active learning among students and the level of student participation during class and to identify challenges encountered with the clickers. Data were collected by means of the mixed method. Qualitative and quantitative data were collected by means of a questionnaire, pictorial data and observations.

The author argues that clickers, when implemented effectively, can promote active learning and increase participation among students in class. Clickers could bridge the gap between the traditional methods of teaching and digital-orientated students. The aim of this article is to describe the process of using clickers in the learning environment, and to identify the pitfalls of using clickers and the precautions that have to be taken when implementing clickers. The article commences with the literature review with on the use of clickers in teaching and learning in higher education institutions (HEIs), the use of clickers to promote active learning, and a technology-enhanced teaching strategy.

2. What is a clicker?

[8] explains the term clicker as instructional technology that allows the instructors to collect and analyse student responses to questions during class quickly. A clicker is a handheld, wireless or mobile device used by audience members to respond to questions [5, 9, 10 & 11]. Clickers use radio frequency or infrared technology to record audience responses to multiple-choice questions or questions.
responses to questions. The aforementioned authors use different terminology to refer to clickers, such as a wireless student response system, a personal response system, an audience response system and a classroom communication system. In this article, the term clicker means educational technology, a wireless mobile device that allows the lecturers to rapidly gather and analyse student responses to questions during class. The clicker product that was used in this study is TurningPoint from Turning Technology. Figure 1 shows the TurningPoint personal response system.

![Fig. 1 The Turning Point personal response system](image)

2.1 The use of clickers to enhance teaching and learning

The enhancement benefit brought about by clickers is the ability to provide immediate feedback and to measure student understanding [4, 5, 12]. Clickers can be used to ensure that students understand basic concepts [5]. In agreement with [1] and [13], It has been pointed out by [5] that clickers are useful in enhancing teaching and learning experiences. The mastery of complex concepts can be monitored through clickers. Lecturers report a dramatic decrease in students’ nodding off at the back of the room, as clickers keep students involved [4].

[1] encourages the regular use of clickers to promote active learning and to observe changes among students. [3] emphasises that the use of clickers could promote active and deep learning. [3] explains how the clickers can be used. The lecturer presents the problem or question to the class, without introduction. The students are given a few minutes to discuss the question among themselves in small groups. Usually, various opinions and points of view will be stated by students within a group. The students will then each state his/her argument until one student convinces the others. If the groups are not satisfied with the answer, discussion and elaborations may follow. Students then press the clickers to enter their answers. If deep learning is encouraged in learning, guessing and memorising among students could be reduced.

Clickers can also be used with multiple-choice questions (MCQs). The lecturer ask a MCQ, the students select the answer and click a button on a small transmitter [1, 3]. A receiving unit counts all the answers and displays them on the lecturer’s computer as a histogram. A histogram or pie chart may be projected for the class to see. In this case, the clickers assist students to realise immediately whether they understand the concept that the lecturer is presenting, without waiting for the formal test [5, 9, 10, 11].

If MCQs are carefully designed and the guidelines for using MCQs are followed properly, they can facilitate deep and active learning. Different cognitive level of Revised Bloom’s taxonomy such as knowledge, comprehension, application, analysis, evaluating and creating could be established with MCQs [14]. [14] suggest that lecturers link test items to content with high cognitive levels in order for students to learn and perform accordingly.

[5] illustrates how the elements of active learning are integrated with clickers. Lecturers use clickers to keep students motivated and to engage them in what is happening in class [5]. Simultaneously, students use clickers to encourage debate and discussion, turning a passive lecture into an interactive exchange. These are the characteristics of deep learning. The findings of [5] reveal that students indicated that clickers are fun to use in learning.

2.2 Clickers as part of the teaching strategy

The incorporation of clickers into teaching and learning requires a teaching strategy. A teaching strategy is a structured plan that assists lecturers to adopt and adjust to innovative teaching to accommodate students. Activities and media are planned that can incorporate the use of clickers. In order to understand the potential of clickers, lecturers should rethink their whole teaching strategy and classroom activities [3]. [3] has developed a teaching strategy for using clickers known as question cycle effective model for classroom communication use in class. Another teaching strategy for using clickers is peer instruction, developed by Mazur [15]. In this study, Beatty’s question cycle model was adopted during the implementation of clickers. Figure 2 below represents the question cycle-effective model for CCS use in class.
2.3 Active learning

Active learning is a necessary approach in learning because it gives students an opportunity to take ownership of and responsibility for their learning. Students are enabled to identify the gaps in their learning by interacting with the learning material and they can share the knowledge and experiences among each other. With the use of clickers in class, students are no longer passive listeners, but become active participants during the lectures [1]. Students pay attention to the posed question and respond to a question. When feedback is displayed, students can evaluate their understanding. Through this engagement they become in charge of their own learning [3].

According to [16] students should be active participants in the learning process. Students should do more than listen. Students receive information from multiple sources [16]. Students then process that information in multiple ways, solve problems and deliver the output. Active learning involves the use of strategies that increase opportunities for interaction [7]. According to [6], active learning occurs when students learn by performing appropriate activities. Active learning provides an opportunity for interaction, and collaboration between students and content, student and student and students and lecturers [7].

3. Research methodology

In this study, a mixed method approach was used to collect data. The mixed method approach entails a combination of qualitative and quantitative data-collection approach and gives a clearer understanding of research problems than either approach alone [17: 9]. The question that was posed by this study was “How can clickers as a technology tool be used in teaching and learning to optimally promote active learning?”

The sample consisted of the lecturer and 95 first year students registered for SSH course in one of the universities in South Africa. Of the total sample 75% were female and 25% were male. Due to the nature of the course, more women register for it than men. The age group of the participants ranged from 18 to 30 years largely because it is a first-year course. Approximately 76% of the participants were between 18 and 20 of age, 20% were between 20 and 25 years and 4% were between 26 and 30. Convenience sampling was used to form a sample. Participants were selected based on their interest and availability [18: 156]. [19: 175] state that convenience sampling entails a group of subjects selected on the basis of being accessible and may represent specific types of characteristics. [17: 119] advise researchers to select the same participants for the qualitative and quantitative samples. These participants were selected because the lecturer had an interest in the subject and wanted to explore the use of technology in teaching and learning.

According to [17: 116], qualitative and quantitative data are collected at approximately the same time in concurrent data collections. [17: 116, 20] argue that the two forms of data, namely, qualitative and quantitative data are independent from each other when collected concurrently. Qualitative and quantitative data were collected by means of, questionnaires, pictorial data and observation. Two questionnaires were distributed to the participants. The first questionnaire was developed and designed in TurningPoint. Students used clickers to respond to a questionnaire through which quantitative results were obtained. Qualitative data were obtained from the questionnaire that was uploaded in the electronic course. Pictorial data were obtained by taking photos of the students during the learning process with and without clickers. I did the observation since this was the first class in which the lecturer integrated clickers into the teaching and learning environment. I kept the research diary in which I recorded the observations.

Data analysis in mixed method research requires the analysis of qualitative data using qualitative methods and the analysis of quantitative data using quantitative methods [17:128, 20]. Data analysis in qualitative research refers to reasoned argumentation that is not based on statistical relations between variables [21: 127]. Qualitative data were analysed manually, and were reduced to certain codes and categories, and then interpreted by using diagrams and...
connecting figures. Qualitative data were analysed from data gathered from the questionnaire, pictorial data and observations. Quantitative data were analysed using the TurningPoint report system.

4. Findings and discussions

4.1 The effective use of clickers in teaching and learning

The findings revealed that in order to integrate clickers as a technology tool in teaching and learning, a teaching strategy needs to be in place. In order to really understand the potential of the clickers, lecturers should rethink their whole teaching strategy and classroom activities [3]. The teaching strategy that was incorporated into this study was adapted from Beatty’s model question cycle-effective model for classroom communication system use in class.

The clickers were used in SSH class for learning by integrating assessment questions such as MCQs into the presentation. Assessment for learning assists lecturers to check learning in order to decide what to do next. The appropriate assessment objectives were used to assess student learning at different stages. Formative assessment was used during the presentation of the lecture to measure the following:

- How well the student understood the concepts
- Whether they were able to link the concepts or ideas to the previous one
- Whether they were able to apply these concepts
- How is thinking varied

4.1.1 The process of using clickers in the class presentation

MCQs were designed to assess different cognitive levels as defined by Bloom’s taxonomy. Most of the questions asked were on the knowledge, comprehension and application level of Bloom’s taxonomy. According to my observation, the lecturer managed to incorporate some assessment questions into the presentation following Bloom’s taxonomy. The lecturer presented the lesson by using PowerPoint. The lecturer presented for 15 minutes and then posed the questions. Students used their clickers to respond to questions. The questions were linked to the information that was presented in class. After the students responded the graph was displayed on the screen for them to see their responses. The lecturer observed the graph and checked the percentages to determine whether students managed to grasp the concept taught. The lecturer then moved on to the next question. If the lecturer saw from the graph that most of the students did not get the answer right, she reset the slide and explained that concept again. The lecturer then posed the question again. In some instances where students did not manage to get the answers right, the lecturer asked them to discuss it with their neighbours in order to come up with the answer. She reset the slide and intervened to lead the discussions. The students were then given a chance to respond again to the same question.

The students were asked to respond in the Likert scale of strongly agree, agree, strongly disagree and disagree on to the following: questions asked in class help me to understand the content better. Thirty four percent of the students strongly agreed with the statement and 50% agreed. Only 9% strongly disagreed and 2% disagreed. The results further indicate that 84% of the students observed the use of clickers as a tool that assisted them to grasp the content and were able to apply it in a practical situation. When the students were asked whether the use of clickers improves their understanding of concepts, 25% strongly agreed, 54% agreed, 13% strongly disagreed and 8% disagreed. The [1] and [5] agree on the use of clickers to enhance the teaching and learning experience and they state that clickers can be used to ensure that students understand basic concepts. According to my observation, I may argue that in this class, students were more attentive, concentrated more and listened to the lecture. Their eyes were on the screen and some of them asked for clarification of concepts while the lecturer presented the class.

4.2 Active learning in this study

The students indicated that using clickers in teaching and learning allowed them to be active participants in class and engage with learning. During the lectures, I observed the interaction between the students and lecturer and also among the students themselves. Discussions took place among the students to get to the conclusion of the question. They took full control of the learning. When the participants were asked whether they felt involved in the class presentation and whether the use of clickers improved their learning, the results showed that 37% strongly agreed, 46% agreed, 10% strongly disagreed and 7% disagreed. This implies that 83% of the participants felt actively involved in the lesson. One of the participants indicated the following: “With the use of clickers everyone took part in the learning process because we saw how many were taking part and how many were not”. Another participant indicated: “Everyone participated in class” and another said “Active learning was promoted by giving us clickers”. Participants were awake and listening the
whole time while the lecturer presented the lesson. During the observation of the class, none of the students withdrew from the lecture and the majority of the students took notes.

4.3 Student participation during class

The participants indicated that the use of clickers in class assisted them to be attentive in class. They listened carefully to the lecturer. They also asked questions for the clarification of concepts. The participants focused on the lesson because they knew that they will be asked questions. This is indicated by the results, where 84% of the participants state that the use of clickers in the teaching and learning process helped them to pay attention in class. The majority of the participants (86%) also indicated that clickers increased their participation in class. Comments by the participants that supported the quantitative evidence included the following: “Clickers promote participation of students in class”; “Because clickers assess you after every section we are doing”; “The whole class gets a chance to interact with the subject”; and “It also helps in attaining statistics of the class’s overall performance”.

According to [13], clickers increase student engagement and improve their learning. This is observed when students are encouraged to debate answers with other students before answering the questions in class. Students were interested in the tool because it made them participate during class. The participants indicated that they “Get to understand the concepts taught in the class and to process that information according to their own understanding” and that they were “engaged in the learning process by responding to the questions asked as well as discussions”. One participant indicated that the students “were engaged by answering every question that has been asked”. One participant said “I was asked questions to answer”. Another participant revealed that she “was engaged in a paradigm way which can benefit myself as a student in the learning process”, and another student said “there was more participation in the class”. This feedback supported the statement that the use of clickers in class enhances students’ learning as well as their participation in class.

4.4 Feedback provided by clickers

The benefits of clickers are its ability to provide immediate feedback and to measure student understanding [4, 5, 12]. Students indicated that with the immediate feedback provided by the system they could have discussions with each other as well as with the lecturer to clarify some concepts and to enable them to link the content with the real life situations. Their relationship with the lecturer improved. The lecturer began to involve the student in the teaching process. The lecturer centred approach that was used in this class before the integration of clickers was supplemented by the student to student approach as well as the student teacher approach. The lecturer was able to measure the students’ grasping and understanding of the content through the immediate feedback provided by the system.

On the statement whether instant feedback provided by clickers helped the students to know how much they know and what they did not know 36% strongly agreed, 44% agreed, 10% strongly disagreed, and 7% disagreed. From these results evidence is provided that 80% of the students managed to measure themselves during the learning process and their acquisition of knowledge and content through instant feedback in the form of graphs.

On the questionnaire delivered by TurningPoint participants were asked about their understanding the learning material. Seventy-nine percent of the participants indicated that feedback on clickers in class helped them to understand the learning material. One of the participants indicated: “With clicker feedback you can see your mistake if you get the question wrong”. From the graph the lecturer was able to see whether the students understood the lecture content. The lecturer was also able to evaluate herself, and ask more questions when she realised that the students did not select the correct answer.

4.5 Formative assessment results

To motivate the students to attend class and participate in class, marks were allocated for the formative assessment. The participants took the clicker work seriously, because they knew that the marks obtained from the clicker assessment will contribute 10% to their predicate mark. During the first test 25% of the total test mark was allocated to MCQs which were used by clickers. The participants appreciated the inclusion of the clicker questions to the test. One participant indicated that she “could easily remember what I answered in the presentations”. Another participant said, “The class presentations had a lot of information that came out in the test”. The results from the Likert scale support the participants’ views on the preparation for the test in class as 25% strongly agreed, 51% agreed, 15% strongly disagreed and 9% disagreed. Ninety-five students took the test using clickers, of which the results are given in Figure 3 below.
4.6 Challenges encountered with clickers

Though positive results were observed from this study, there were problems that were encountered during the implementation of the clickers in this class. The challenges that were encountered during class were clicker loan system, logistics and management, and technical problems.

4.6.1 Clicker loan system

The challenge that we encountered during the implementation of clickers was that students did not own clickers. Clickers were used via a loan system from the Directorate of Teaching and Learning with Technology. Lecturers have to book clickers every time they needed to use them. This demoralised, and demotivated the lecturer to use clickers. The lecturer indicated that she enjoys using clickers during the teaching process, but travelling to acquire clickers a day before the class was strenuous and time consuming.

4.6.2 Logistics and management

The management of clickers during tests or class was also a problem. Handing out clickers to students was another challenge, as it took up 20 minutes of lecture time at the beginning and again at the end of the lecture. Students had to sign in when taking the clickers and sign on the return of the clickers after class. The students indicated that they like to use clickers, but that they were irritated and annoyed by the process of handing out the clickers.

The lecturer had to bring a laptop, a data projector and the clickers to class, which was heavy load. Logistically, the institution was not ready for this type of technology, although I did note that the classroom had a mounted data projector that was broken and never been fixed.

4.6.3 Technical problems

In this study, the technical problems that were encountered during the class presentation were that some of the clickers did not connect to the system. Extra clickers were available for any technical problem that might arise during class and were registered on the system. According to my observation during the class test, there were 88 students in this class. Only 86 were registered on the clicker system. Two of the students, who were repeating the course, attended the class for the first time in class and they were not allocated clickers. The students were then registered. Extra clickers were registered for the following reasons: clicker connection failure to the system; easy exchange of clickers before the test or class starts; and to provide for students coming late during the test or class.

5. Conclusions

The main argument that was posed in this article is that clickers, when implemented effectively, can promote active learning and increase participation among students in class. The article described the process of using clickers in the learning environment during a lecture, and identified the pitfalls of using clickers and the precautions that have to be taken when implementing clickers. If lecturers desire to use a student-centred approach, identify students’ understanding of concepts and promote active learning, activities and media can be planned that incorporate the use of clickers. The following recommendations are made:

- There should be discussions among lecturers in HEIs about how they might integrate clickers into the teaching and learning environment, what precautions should be taken and how to ensure that the required facilities are in place.
- In order to understand the potential of using clickers, HEIs should rethink their whole teaching strategy and classroom activities.
- Learning activities that encourage a student-centred approach and participation in class should be promoted by incorporating clickers.
- A teaching strategy should be developed for using clickers in teaching and learning to accommodate different student learning styles and students’ different approaches to learning.
- For the successful implementation of clicker technology and infrastructure information and communication technology departments in HEIs should be involved and have a five minute solution of the technologies in class.

In conclusion, the above discussion provides an indication that clickers when implemented effectively, promote active learning and increase student participation during class. Despite the positive results from this study, problems were encountered such as clicker loan system, logistics and management, and technical problems. However, these problems did not hinder the successful implementation of clickers. HEIs in South Africa should take advantage of clickers and their impact on the promotion of active teaching and learning.
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References


