**Using clickers as a tool in classroom to facilitate student learning**

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**Abstract.** Educational technology in the form of classroom response systems (clickers) have become an important tool in teaching. Clickers are used in the classroom to promote student engagement and to provide immediate formative assessment of the student’s learning. This paper reports on the ongoing research done on the use of clickers in the Extended Curriculum Programme (ECP) physics classroom as a tool to facilitate student learning, within the Physics Department at the University of the Western Cape. The current research focuses on the use of the clickers as a tool for monitoring a student’s learning, doing pre-class preparation, student conceptual understanding, engaging students in group and class discussions and their attitude towards adopting clickers. The results of the research indicate that clickers are a useful tool for the students as well as the lecturer to monitor a student’s learning. Generally, the students’ attitudes were very positive towards clickers.

**1. Introduction**

To engage students in active learning and to provide immediate formative feedback of the students learning in large classes can be challenging for the lecturer. Literature indicates that a solution may be found in educational technology in the form of classroom response systems, known as “clickers”.Clickers are an electronic voting system which consists of a computer, data projector, screen and a clicking device. A question is displayed on a screen and students submit their answers via the clickers. The students’ responses accumulate and are displayed on lecturer’s computer in the form of a bar chart. The responses can be projected on a screen where both the students and the lecturer can view and discuss responses [1]. The clickers integrated into a student-centered active learning pedagogic approach can serve as a tool to promote active student participating in their learning. Examples of these include the work of Eric Mazur, “Peer Instruction” which describes the pedagogical underpinnings on the use of clickers and also provides a set of questions that can be use in the class with clickers [2]. The class starts with a brief introduction of the topic of the lesson in the common lecture approach. Students are asked a conceptual question, given time to think and give their answer via clicker. Next they are asked to discuss their answers with their peers and finally respond the discussed answer via clicker. Their responses are displayed and the correct answer is explained during the class discussion that follows. A more recent work is that of Beatty in a physic class, “Question-driven instruction”. A class activity is developed around a question cycle which actively engages students with clickers in their learning [3].In this approach the cycle begins with a question which is posed to the class. The students are allowed a few minutes to discuss the problem in small groups. Students are then asked to individually respond with clickers. Their responses are displayed and a class discussion is prompt and volunteers are asked to explain the reasons for their answers. If answers and explanations given during the discussions show a need for clarification, the lecturer can follow up with brief lecture summarising students thinking revealed during discussions or give a related question. In both approaches, both the student and the lecturer benefit. Student actively engages in their learning and the lecturer receives immediate formative feedback on the students’ learning. In essence this tool provides productive student engagement. For the students the feedback means they can monitor their own learning. For lecturer the feedback means he/she can monitor students’ progress and immediately address difficulties with their learning.

Physics educational research suggests that teaching physics using non-traditional instruction methods, especially those where students are actively involved promotes their learning [4 and 5]. Gurthrie and Carlin pointed out that the traditional lecture-based classes are out of touch with how modern students engage. According to them modern students are primarily active learners [6]. Evidence in the literature indicates that the teaching methods employing clickers does enhance student participation, engagement and learning [7 and 8]. For, example, Crouch and Mazur found that using peer instruction improved student scores on tests and foster interactive and collaborative learning. Kay and LeDage based on their findings, links improve student engagement to students’ improved attention and focus through clickers. It has also been found that the anonymity that clickers offer increases student participation and engagement [9]. Regardless of whether the anonymity clickers’ offer is important to many students, the clickers have clear advantages over the traditional shows of hands or coded flash card responses. Clickers quickly and accurately aggregate and quantify students’ responses and display the results in a histogram giving them and their lecturer immediate feedback on their thinking about the question or problem posed. This enables the lecturer to give immediate and constructive feedback to the class that will enhance learning [3].

In South African clickers’ usage in the classroom is still a very new concept. Especially in the teaching of large first year physics students at university with very little research published in this field. It is important that South African undergraduate physics teaching and learning approaches are aligned with current global developments in physics education. Since the clickers’ technology has been shown to enhance pedagogic active student learning, there is a need to assess how the clickers’ technology can be of use in the undergraduate physics classroom at South African universities. This paper reports on the ongoing research done on the use of clickers in the ECP Physics classroom as a tool to facilitate student learning, within the Physics Department at the University of the Western Cape. The current research focus on the use of clickers as a tool for assessing, pre-class preparation and students’ conceptual understanding and a tool to engaging students in group or class discussions. The attitudes of students towards clickers in the classroom were also investigated. The results of the research indicated that clickers may be a useful tool for the first year physics lecturer as well as for the students in monitoring students learning. Overall the students’ attitudes towards clickers were positive. The results of the research also reveal that students at a South African university experiences the use of clickers as a tool integrated to a pedagogic which promotes active learning similar to students in other parts of the world. In South Africa the undergraduate physics student throughput and retention are low. Using clickers as a tool to promote active learning may be away to increase the throughput and retention.

**2. The ECP Physics teaching method and the clickers**

The ECP Physics was developed to give students of diverse academic backgrounds access to the study of the Physical Sciences, particularly physics and improving their success with physics and retention in physics. Sociocultural perspectives on learning in the sciences and best practice in Physics Education have guided the development of the course pedagogic which underpinned active learning and the monitoring of it. All class activities are structured to encourage students to take responsibility for their own learning. Students get the opportunity to engage with the work themselves. Learning outcomes, class activities and assessment of activities are all aligned to achieving this goal. The lecturers’ role is to facilitate the students learning by encouraging active student interaction and engagement (pre-class activities, group activities, class discussion, peer-marking, and self-assessment) and to provide immediate formative feedback on their learning in class. The potential for the use of the clickers in the ECP Physics pedagogic was immediately evident. It was decided to integrate the clickers in our pedagogic by adapting Mazur’s “Peer Instruction” and Beatty’s “Question-driven instruction” approaches.

**3. The research**

A total of 60 students from the ECP Physics 151 group 1 class participated. Each one of the students in the class was allocated a clicker. The investigations were carried out in the second term of the first semester 2011.

The following research factors were investigated:

* 1. Clickers as an assessing tool for pre-class task. Students were given pre-class reading or homework to prepare for class. This was assessed via the clickers at the start of class, posing carefully designed questions directing and raising awareness of main ideas/concepts in reading or homework. Followed by an entire class discussion facilitated by the lecturer.
	2. Clickers as a tool to for assessing students’ conceptual understanding. Students were given carefully designed question, stimulating cognitive processes. Students were asked to work through a question posed on their own. They were allocated time to do it and were asked to respond via clicker. Their responses were displayed on a screen. They were allocated time to discuss their answers with each other in their groups and were asked again to respond individually via clicker. Followed by an entire class discussion facilitated by the lecturer.
	3. Clickers as a tool to engage students in group and class discussions.
	4. Students’ attitudes towards the use of clickers as a classroom instruction tool.

Both qualitative and quantitative data were collected. Qualitative data were collected during the running of the investigations which includes observations and informal group discussions. In the last week before the term ended students were asked to complete a survey of their experiences of the use of clickers in classroom based on the factors investigated.

**4. Findings**

4.1 Assessing pre-class task

It was observed that students were excited to see whether they were correct or incorrect. From the group discussions it became clear that many students felt that it was exciting to see the results and the results of their classmates immediately. For students to see how they compared with the rest of the class were encouraging to them to do better. Hence, students said they will definitely prepare better for class. They also felt that the class discussions that followed clear up many concepts they did not comprehend while doing the pre-tasks which came up in the class discussions. The results from the survey show that approximately87% of the students felt that the use of the clickers in class discussion allows for immediate feedback on their understanding. Approximately 75% of students said it made their understanding of the work content known to lecturer through class discussions using the clickers. The lecturer felt the immediate feedback enables one to measure students’ understanding of the work content and how to proceed with the lecture. These findings indicate that the use of clicker enhances students’ learning from pre-class tasks.

4.2 Assessing students’ conceptual understanding

It was observed that during these activities students were eager to engage with each other, correct responses increased after each group discussion and students were more willing to participate in class discussion. From the group interviews, it became clear that students felt by exchanging ideas with their group members they learn more. Some said when they explained their answers to their group members they realised the mistakes in their answers while others changed their answers because they were convinced by the explanations of their group. The results for the survey show that approximately 73% of the students’ believe taking part in class discussion with clickers improved their understanding of the work content. Approximately 91% of students reported that they used the clickers in class discussion to monitor their understanding. The lecturer reported that students’ interaction and responses during the class discussion enabled him to do the necessary scaffolding to make the work clear. Hence, the findings seem to be in agreement with that of Mazur that the use of clickers integrated in teaching approach which promotes active learning does enhance student conceptual gain.

4.3 Engaging students in group and class discussions

Overall, it was observed that all students where actively involved in their learning. When students were asked about this in the group discussions they believed it is due to the fact that there is help available and because they could see in the displayed responses that their classmates have similar problems. The results of the clickers made students feel more comfortable to come forward with their problems. In the survey results 90% of the students felt that the use of clickers in class discussion increased their interaction with lecturer while 75% students felt clickers increase their interaction with other students in class discussion. Approximately 93% students said that the clickers in the classroom promote class discussion while 88% students felt the use of the clickers increase they feeling part of the class. These findings support the finding in the literature that clickers do enhance students’ interaction and participation in the class.

4.4 Attitudes to the use of clickers as a classroom instruction tool

It was observed that the students were pleased using the clickers. From the group discussions it became clear that the students felt very excited using the clicker technology which most of them only see on television. They did not feel intimidated by the clicker because it was easy to use and they enjoyed the interactive nature of the clickers. Some also said that the anonymity which the clickers provide made it easier for them to take part in class discussion. In the survey 91% of the students said that they enjoyed taking part in class discussion with clickers while 87% of the students said that they would highly recommend clickers in class discussion. Overall the students’ attitudes towards clickers were very positive.

**5. Discussion**

The findings from this research support the view in literature that clickers integrated into a pedagogic promotes active learning, enhance student participation, engagement and learning. The findings from this research seem to suggest that the reasons for these might be due to the fact that clickers create an environment where students feel at ease to express themselves and immediate formative feedback is provided on a student’s work in non-judgmental way. The “at ease feeling” is the result of seeing all students’ responses and talking to one’s classmates makes one realise that everyone in the class have the same problem and can be resolved by sharing ideas. When the immediate feedback is given, it points out to everyone in the class and not to an individual. The solution of the question or problem is facilitated by the lecturer as a class effort. However, further research needs to be done to investigate the explanations of findings.

**6. Conclusion**

This research set out to investigate the integration of the clicker with the ECP Physics pedagogic which promotes active learning. In particular, research focused on the use of the clickers as a tool for monitoring students learning, doing pre-class preparation, students conceptual understanding, engaging students in group and class discussions as well as their attitude towards adopting clickers. The findings of the results show that clickers enhance students engagement and learning doing
pre-class preparation, students conceptual understanding, engaging students in group and class discussions. Overall, the students’ attitudes towards the clickers were very positive. They enjoyed the interactive nature of the clickers. These findings are in good agreement with that reported in the literature. However, in spite of the good agreement achieved between this research and that in the literature a more detailed and quantitative investigation is planned to assess by how much the clicker as a tool integrated into a pedagogic which promotes active learning increase student learning.

**7. References**

[1] Beatty I 2004. *Transforming Student Learning with Classroom Communication Systems.*

 *R*esearch Bulletin No. ERB0403, Educare Centre for Applied Research,

[2] Mazur E 1997. *Peer instruction: a user’s manual* N.J: Prentice Hall.

[3] Beatty I, Gerace W, Leonard W and Dufresne R 2006. *Designing effective questions for classroom response system teaching*. American Journal of Physics, **74** (1), 31-39.

[4] Wieman C and Perkins K 2005. *Transforming Physics Education.* Physics Today, **58,** 26-41.

[5] Etkina E and van Heuvelen A 2007. *Investigative Science Learning Enevironment – A science process approach to learning physics.* In Redish E and Clooney P (Eds), Research-based reform of university physics. American Association of Physics Teachers.

[6] Gurthrie R and Calin A 2004, *Waking the dead: using interactive technology to engage passive listeners in the classroom.* Proceedings of the Tenth Americas Conference on Information Systems, New York.

[7] Crouch C and Mazur E 2001. *Peer instruction: ten years of experience and results*. American Journal of Physics. **7(2)**, 970-977.

[8] Kay R and LeSage A 2009. *Examing the benefits and challenges of using audience response systems: A review of literature.* Computers and Education, **53**, 819-827.

[9] Patterson B, Kilpatrick J and Woebkenberg E 2010. *Evidence for teaching practice: The impact of clickers in a large classroom environment.* Nurse Education Today, **30(7),** 603-607