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Clicker Technology – An Alternative Pedagogical Tool for Physics Lessons

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Abstract

The study investigates how clickers would support the teaching and learning in Maltese secondary schools. The research focussed on how clickers were used by teachers and students during physics lessons. For this study, classroom observations were used to probe into the teachers' and students' interactions, their experiences and the challenges they encountered when using clickers. Two schools, three teachers and four classes participated in the study.
Following the lesson observations, the three participating teachers took part in an interview. During the interviews, the teachers expressed their views about the use of clickers as a classroom resource. Furthermore, six students from each of the four participating classes took part in focus groups. These students shared their experiences about the usefulness of clickers to learn physics.
The research findings indicate that clickers are useful as they help the teacher to gauge students' understanding and promote classroom discussion. The teachers had reservations about introducing clickers on a regular basis as they feel that this might negatively affect students' engagement. They also stated that they felt uncomfortable when using new technologies as they were aware that the time constraints involved when teaching a content loaded curriculum and the lack of proper training were an issue. Students stated that they believed that clickers encourage engagement and can therefore support learning.

1. Introduction

The Maltese National Curriculum Framework [NCF] promotes digital literacy as a cross curricular theme [6]. Tackling digital literacy across a multitude of themes will allow the students to acquire skills such as a critical use of technology for communication, work and leisure. Furthermore, the use of ICT in science teaching brings closer the science taught in schools and what students experience on a daily basis in today's digital world.

1.1 Clickers as teaching resources

'Clickers' is the term which refers to student response systems used in the classroom. When using these resources, the teacher creates a set of True-False [T-F] statements or multiple choice questions [MCQs] and submits them through the software provided for on-screen display in class. Students then provide feedback to the statements or questions by keying in their answers. Such response systems offer the possibility of real-time feedback from the teacher and allows her/him the possibility of assessing students' understanding [7]. Furthermore, the system offers the teacher the opportunity to carry out a discussion to evaluate the various choices submitted by the students.

1.2 Clickers and conceptual understanding

The following advantages are listed as being most commonly observed when clickers are used in the classroom. Clickers: [i]enhance interactivity, [ii] are fun to use, [iii] allow students to vote anonymously, [iv] are easy to use and [v] evaluate the students' level of understanding [8]. All this supports the understanding of the science content taught [3]. Submitted answers allow teachers immediate access to student responses and the analysis of these responses can reveal "student conceptual difficulties, common mistakes, and misconceptions, as well as help the instructor gauge the quality of student learning and consequently the quality of his/her own teaching" [5].

2. Research Methodology

In this study, data was generated by three methods. The methods used were: [i] classroom observations of eight lessons, [ii] interviews with the three participating teachers and [iii] focus group with students from each participating class.

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Four Form 4 classes from two schools took part in the research. Observing all the lessons allowed one the opportunity to infer insights related to the use of clickers as an alternative teaching tool. After the observations, individual interviews were carried out with the participating teachers. Finally, students' focus groups were also held in order to obtain a more complete understanding of the teaching and learning scenario resulting in this particular classroom setting.

3. Results and discussion

The research involved the participation of four classes and a total of 59 students, from two different schools. Two classes were from a boys' church school and two from a girls' church school. These students were taught by three teachers. One teacher taught both classes in the girls' school while two teachers taught the classes in the boys' school. A set of eight lessons were observed in this study.

Table 1: Student distribution

Form 4 [Boys' School]		Form 4 [Girl's School]	
Physics topic - Motion		Physics topic - Optics	
Class 1	Class 2	Class 1	Class 2
Teacher A [TA]	Teacher B [TB]	Teacher C [TC]	Teacher C [TC]
13	16	16	14

3.1 Teachers' feedback on the use of clickers

The classroom observations and teachers' interviews brought out a number of considerations related to the use of clickers when teaching physics. These considerations provide useful ideas about how a clicker pedagogy can be put to use in practice.

3.1.1 Teachers' lesson preparation

Prior to the actual lessons, the researcher discussed the lesson plan and the resources with the teachers. The teachers' preparation for clicker aided lessons was observed to be quite different. The two boys' school teachers were observed to follow closely to the lesson plan provided. It was observed that these teachers needed to stop at numerous intervals to have a look at the lesson plan in order to take note of what was the next step in the lesson. The teacher in the girls' school was observed to have given the lesson plan more attention and her preparation to the lesson was more in-depth than that of the other two teachers. During the lessons, she was observed to have been able to introduce the voting system in her lessons with ease. It seems that one crucial aspect of the introduction of such innovative pedagogies is lesson preparation.

3.1.2 Clicker frequency of use

Speaking about the frequency of use of the clickers in their physics lessons the teachers had different opinions on when to use the clickers as well as how often the tool would be included as part of the lesson plan. A boys' school teacher spoke of the fact that having used the clickers and observed the student level of engagement; he would substantially limit the use of clickers in lessons. The reason for doing this would be that he would keep the tool as an 'exciting addition' and would not like the clickers to lose their effectiveness. The girls' school teacher stated that she would consider using the clickers in order to introduce a new topic, to gauge understanding or as a method of formative assessment towards the end of a topic. The employment of such technologies during lessons seems to be significantly teacher dependent as views about frequency and purpose of use does tend to vary.

3.1.3 Clickers as informal formative assessment tools

During the observations made and the interviews it was noted that teachers appreciated being able to track students' progress as well as highlight any students' misconceptions before moving on to another T-F statement. One of the properties the clickers have which is beneficial for the teachers is the instantaneous feedback of the submitted answers. The boys' school teachers stated that the clickers could be used in an informal manner to assess the students' understanding in class. Teachers spoke positively of noting the outcome of student responses as they considered this as an alternative

form of assessment. Such tools made introducing formative methods of assessment simple yet effective.

Literature considers the feedback clickers provide an aid for teachers to focus on difficult concepts and to facilitate teacher–student interactions [5]. The participating teachers made good use of the immediate feedback the clickers provided. It gave them an indication of any misconceptions that may have developed as the lesson progressed. The feedback obtained not only gave teachers a picture of students' understanding but it helped them make sure that all the students were participating in the teaching process.

3.1.4 Clicker use and time constraints

The participating teachers were concerned that the time needed for planning and executing lessons that include the use of clickers was significant. The teachers stated that due to the extensive curriculum, time on task is a limiting factor. Literature supports this notion and states that "the factor time in classroom and curriculum pressure are overwhelmingly the most prevalent" at hindering proper implementation of the clickers [4].

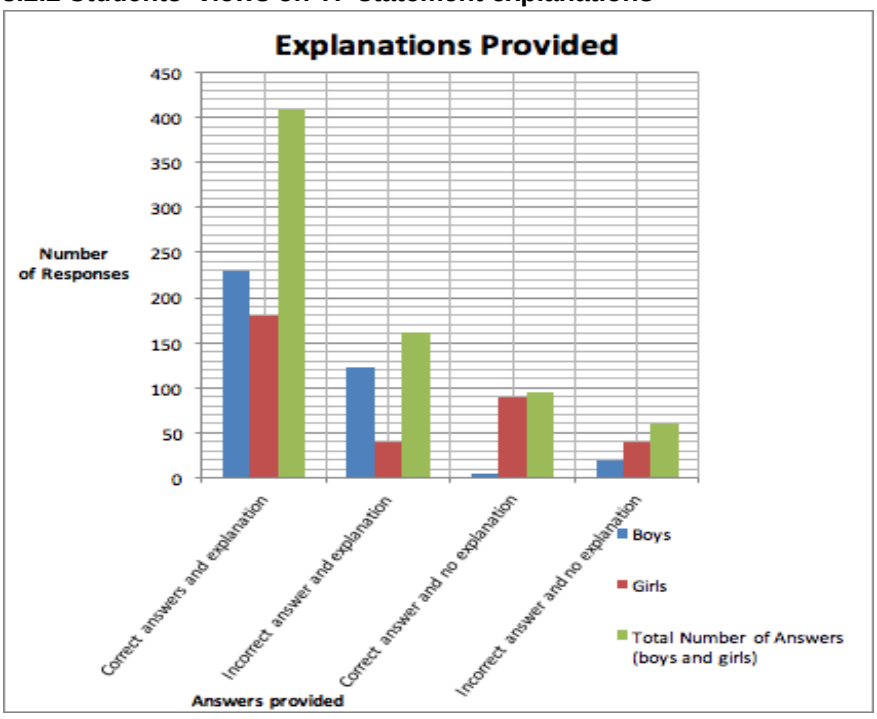
3.2 Students' feedback on the use of clickers

On being provided with clickers, students were observed to be very enthusiastic and excited even before actually using them. The following section reviews the students' views on clickers as learning tools.

3.2.1 Student participation, motivation and engagement when using clickers

Students considered clickers to be useful to the learning experience. This feedback was stated by the students during the focus group sessions. When asked about how they thought the clickers compared to other teaching approaches some agreed that they felt more at ease when participating using the clickers. Voting gave students a sense of security as they were now not afraid of getting caught out if their answer was wrong. The anonymity the clickers provided encouraged student engagement in the classroom. It seems that anonymity "provided by clickers helps students feel more comfortable answering questions, closer to their instructor in terms of communication and more open to learning" (p. 128) [1]. Students also highlighted this fact as one of the advantages attributed to using the clickers during the lessons. Furthermore, it was also observed that when the number of correct/incorrect voters was equally divided, students were more comfortable at sharing that they had answered incorrectly. During the focus groups students shared how voting anonymously helped them to increase the classroom participation and involve themselves more in the lesson. The learning benefits of clickers include the "increase in quality and quantity of classroom discussions (especially in a peer discussion format where initial votes are followed by discussion and re-voting)" [9].

3.2.2 Students' views on TF statement explanations



In addition to stating whether they thought the statement in question was true or false, students were required to provide an explanation to support their choice. Fig 1 indicates that 155 out of a total of 725 statements [around 21%] were completed without providing an explanation. The students participating in the study felt somewhat frustrated that even though they knew the explanation, they did not have the ability to formulate their own understanding into words.

Fig 1: Clickers responses

3.2.3 Resubmitting clicker responses – students' perceptions

Prior to the start of the lesson, the option which allowed the student to rethink and change their answer was de-activated. During the classroom observations it was noted that the students did not approve of the fact that they could not re-submit their answer. On numerous occasions the boys commented that upon realizing that their initial answer was incorrect they would have liked to recast their vote for a second time. The issue of re-submission was not a focus of this study and needs to be explored further.

4.0 Conclusion

The inferences made in this work were taken from a relatively small sample of participants hence these findings cannot be used to make generalizations. However, despite being unable to generalise, one may still envisage that in case studies similar to this research one may expect teachers' and students' views on the use of clickers in teaching and learning to converge.

The use of clickers allows one to realise that as the educational setting is being gradually transformed teachers must keep in mind that the development of higher order thinking skills is crucial. This research acknowledges the potential clickers have to bring out students' higher order thinking skills to enhance their learning experience.

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