

Luddites and Learning Theories: Lessons from a flawed clicker project

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Abstract

Audience Response Systems, or clickers, are increasingly used to address difficulties associated with student engagement in large classes in higher education. Many studies extol their benefits and evidence of their success prompts many academics to adopt the technology regarded as a panacea to the staid, didactic methods representative of large group teaching. This study reflects on a project in which clickers were introduced to a class of 500 undergraduate students where none of the expected benefits were fulfilled. It considers the reasons for this lack of success, the pre-requisite and frequently overlooked role of learning theories, and suggests several small changes based on student-centred theories of teaching and learning that may encourage student engagement without the use of clickers.

Keywords

Clickers; technology; pedagogy; learning theory

1. Background

Growing class sizes have resulted in decreased student-tutor interaction (Caldwell, 2007) and a reliance on large group teaching methods that involve delivering information to a silent and passive student body (Mayer et al., 2009). To redress this lack of interaction academics are increasingly embracing Audience Response Systems (clickers), in the hope of stimulating interest and engagement (Burnstein & Lederman, 2001). Difficulties arise because, contrary to Draper's (1998) warning, it is frequently assumed that introducing this technology will automatically overcome existing fundamental problems with design or delivery. In the current study clickers were introduced to a module involving 500 students to combat low levels of attendance and student engagement. The lack of discernible benefits and lower than expected lecturer buy-in resulted in an early termination for the project. This study examines the reasons for the unfulfilled benefits of this flawed project and suggests several issues to consider before introducing a clicker programme.

2. Method

This study draws on the reflective practices that Schön (1983) suggested were key to professional practice and continuous learning. A process of 'reflecting on action' (Eraut, 2004) was pursued to make sense of the project after its conclusion to learn from the experience. Biggs & Tang (2007) advocate reflecting on a critical incident, allowing 'transformative learning' (Mezirow, 1990) through identifying a problem and its causes, possible remedies, and implementing changes. Based on Kolb's (1984) model of experiential learning, therefore, this study employs the first stages of the model to reflect on observations on the unsuccessful project and the latter stages to use these reflections to benefit those considering introducing clickers in large groups in higher education.

3. The project

The project was implemented to improve attendance and engagement in a large introductory module delivered to 500 first year students. Both lecturers involved in the module had heard of clickers but never used them and were attracted by the idea. They received support from an educational developer, another lecturer in their

discipline, and three IT consultants. As well as information and advice on designing classes for clickers they also received a review of recent research in the area and tips on writing effective questions. By the end of the semester, however, many students still had not collected a clicker and the lack of discernible improvement in attendance or in student interaction was such that it was requested that the project be terminated. The lecturers involved felt that although it had provided a break from the norm and that students were generally positive, they did not feel inclined to revise their established large group teaching methods to fully realise the clickers' potential.

4. Anticipated benefits of clickers

Literature is replete with examples of how clickers have been successfully used in a range of settings and disciplines. The eight benefits anticipated in the project study are listed in Table 1, none of which were actually observed. Possible reasons for the lack of success for each are posited below.

<i>Area</i>	<i>Benefit</i>	<i>Evidence</i>
Attendance	Clickers maintain or increase levels of student attendance	Burnstein & Lederman, 2001; Greer & Heaney, 2004; Homme, Asay, & Morgenstern, 2004; Jackson and Trees, 2003; Robin & LeSage, 2009
Enjoyment	Students enjoy class more and perceive the lecturer more favourably when using clickers	Hoekstra, 2008; Knight and Wood, 2005; Nichol and Boyle, 2003
Attention	Frequent use of clickers helps to maintain student attention for the duration of the class	Bergtrom, 2006; Caldwell, 2007; d'Inverno et al., 2003; Draper & Brown, 2004; Horowitz, 2006; Jackson et al., 2005; Latessa & Mouw, 2005; Siau et al., 2006; Slain, Abate, Hidges, Stamatakis, & Wolak, 2004
Engagement	Students are more engaged when material is presented and discussed using clickers	Hinde & Hunt, 2006; Roschelle et al., 2004; Simpson & Oliver, 2007
Interaction	Clickers result in more frequent and articulate student-tutor interactions	Banks, 2006; Freeman, Bell, Comerton-Forder, Pickering, & Blayney, 2007; Hoekstra, 2008; Homme, Asay, and Morgenstern 2004; Kennedy, Cutts, & Draper, 2006
Peer Discussion	Clickers promote greater levels of peer interaction and discussion	Bergtrom, 2006; Brewer, 2004; Bullock et al., 2002; Draper & Brown, 2004; Nichol & Boyle, 2003; Pelton & Pelton, 2006
Contingent teaching	Opportunity to adapt teaching immediate based on student feedback making class more dynamic and interactive	Brewer, 2004; Cutts, 2006; Elliott, 2003; Greer & Heaney, 2004; Hinde & Hunt, 2006; Kenwright, 2009; Stuart, Brown, and Draper, 2004
Clarity	Clickers provide an accurate and instant insight into misconceptions and common difficulties	Caldwell, 2007; Wood, 2004

Table 1: Anticipated benefits of clicker project

Attendance

The link between clickers and improved attendance is well researched and is due, according to Caldwell (2007), to an increased sense of responsibility and accountability on the part of the student. However, Robin and LeSage (2009) commented that in these studies increased attendance is contingent upon receiving credit that contributes to their final grade. In the current project clicker use was anonymous and so marks could not be awarded to students for active engagement. Many involved believed that this would not be an issue, since the novelty of the technology was assumed to be sufficient to stimulate interest and a newfound responsibility that would maintain or improve attendance. The lack of increase demonstrates that more was required to prevent attrition than the allure and novelty afforded by clickers.

Enjoyment

Research has suggested that students not only enjoyed lectures more but also perceived the lecturers in a more caring and positive light when clickers were used. While informal student comments in this study were largely positive, attitudes were neither as effusive nor widespread as described in previous research. One possible reason for this, discussed by Stowell and Nelson (2007), is that increased enjoyment may be more a function of a student-centred teaching style than the act of using a clicker. In classes that have not adapted teaching methods to align with the new technology, changes to enjoyment levels may be short lived or nonexistent. This supposition is supported by the success of student-centred teaching methods that don't use technology (such as problem based learning) and by studies in which clickers have resulted in lower levels of student enjoyment (Greer and Heaney, 2004)

Attention

Student attention often begins to diminish after 20 minutes or less (Jackson, Ganger, Bridge, & Ginsburg, 2005). Clickers provide an opportunity to stimulate attention by requiring students to consider and apply the information presented to them. Although questions in this project were introduced in 20 minute intervals or less, there was no notable increase in student attention. One reason for this may be the focus on technology at the expense of consideration of the rational for, or construction of, the questions. In the current project questions were deemed an opportunity for a brief

respite before continuing with the delivery of information. Consequently these were consistently of a lower cognitive order, regularly asking students to compute values based on formulas provided. Less attention was afforded to constructing cognitively challenging questions or scenarios that required the application of information to real world settings, or to the introduction of key threshold concepts in an interesting or original manner. Instead, it was assumed that inserting any question into their traditional lecture plan would engender the impact discussed in previous literature.

Engagement

Increased student engagement is one of the most touted benefits of clickers. The reasons for this engagement have not been clearly established though Robin and LeSage (2009) postulate it may be due to students being more involved in the learning process. From a pedagogic perspective greater engagement occurs when the module is designed to provide increased opportunities to invite, incorporate, and elaborate upon issues raised by students. If, as witnessed in the current project, clickers are applied to a traditional lecture format with no changes other than working three basic questions into regular large group teaching methods, levels of engagement will not change.

Interaction

For many academics increased interaction with students is a major motivator for the introduction of clickers. Beatty (2004) also stated that students were more notably articulate in their thinking and communication. Such positive results were not replicated in the current study, possibly due to an overreliance on technology to achieve this goal. Increased discussion and interaction is more likely to be contingent upon effective question design and delivery, scaffolding, and classroom management skills. While an effective tool to generate responses, without an understanding of more student-centred learning theories and how they can be implemented it is unlikely that button pressing alone will achieve the desired goals.

Peer Discussion

Increasing discussion time before requiring an answer offers students an opportunity to engage in discussion and to learn from each other in ways not possible in a traditional lecture environment. While clickers are useful tools to enable discussion they are not an essential component for peer learning or instruction, since this social

constructivist approach can be applied any classes, regardless of size or technology. The role of clickers is secondary to the lecturer's willingness to reconsider traditional teacher and student roles, and the impact this has on teaching and learning. Lecturers in the current study preferred to retain their more established roles which subsequently limited options for peer discussion and learning.

Contingent teaching

The option for the lecturer to modify their teaching based on immediate student feedback changes a traditional, static lecture into a 'dynamic learning experience' (Kennedy & Cutts, 2005) referred to as contingent teaching (Stuart, Brown, and Draper, 2004). This was not observed in the current project because, in reality, contingent teaching is difficult and requires a very adaptive, student-centred approach to teaching. While clickers can facilitate this quicker and more accurately than non-technological methods (e.g., coloured cards, hand raising etc.) they are not an essential component of contingent teaching and those who have the ability to teach in this manner may benefit from, but will not rely upon, clickers to help them do so.

Clarity

Carefully designed questions can help to identify student misunderstandings or areas in which students are experiencing difficulty. This was illustrated by Wood (2004), quoting a lecturer realising for the first time in 20 years that less than half of his students understood his material. The advantages of clickers to collect student feedback are apparent, but feedback is only as good as the questions that generate it, and failing to uncover student confusion for 20 years is as much an indicator of inefficient questions and feedback processes as evidence of the value of clickers. In the current study clickers failed to assuage confusion or misconceptions because of the type of questions asked. These tended to rely on basic problem solving such as calculating values based on formulae provided rather than testing students' grasp of key issues or threshold concepts and following up on areas of conceptual confusion.

5. Role of learning theories

According to Premkumar & Coupal (2008) the primary reasons for adopting clickers is to facilitate greater tutor-student interaction and engagement with the material.

When used to address such instructional deficits their introduction should be accompanied by associated changes in teaching practice (Uhari, Renko, & Soini, 2003). Failure to ground clicker use in student-centred learning theories may have superficial benefits (Beekes, 2006; Duncan, 2005) but will not achieve greater engagement or deeper understanding of the material. This lack of theoretical grounding may explain the lack of consistent findings purporting the academic benefits of clicker over non-clicker classes (Duncan, 2005; Martyn, 2007) where even initially high levels of satisfaction can be affected by a failure to successfully integrate technology and pedagogy (Simpson and Oliver, 2007). It has been suggested that the success of clickers is due more to the successful application of student-centred learning theories than the technology (Caldwell, 2007), a sentiment supported by Lasry (2008), who demonstrated that in a student-centred learning environment clickers do not add to the amount of conceptual learning or to exam performance. Morling, McAuliffe, Cohen, & Dilorenzo (2008) suggest that, by applying more constructivist learning theories, the same results can be achieved by lo-tech options. It is the change in teaching methods that engages and challenges students and, therefore, the pedagogy and not the technology that should remain the focus of the lecturer's attention.

6. Lessons from learning theories

To counter reliance on the traditional transmission approach to large group teaching lecturers need to focus on how students learn and require guidance on how to apply theory to practice (Young, 2010). The points briefly discussed below draw on aspects of student-centred learning theories that may result in more engaging learning.

Timing for learning

The initial five minutes of a class is the best recalled portion of a lecture (Burns, 1985) and provides a good opportunity to recall previous learning sessions or to introduce key concepts. This also helps to set the tone of the class and to establish a more receptive frame of mind for learning (Elliot, 2003). Secondly, since students' attention span tends to decrease after 20-30 minutes (Caldwell, 2007) much information presented after this is effectively lost. Learning activities that require active participation should be combined with periodic breaks to relieve student fatigue

and ‘restart the attention clock’ (Middendorf and Kalish, 1996). The third aspect is the end of the class, which provides an opportunity to consolidate learning, to identify conceptually murky areas, and to remind students how outcomes have been fulfilled.

Reconsider ‘teaching and learning’

Students make sense of new information by amalgamating it with past experiences and understanding (Driscoll, 2005). The organisation of class is important, not only to present information in a logical and progressive manner, but to provide opportunities to reflect on material and to allow for equilibration (Piaget, 1985). This is not a style of learning traditionally associated with large group teaching and facilitating this requires a shift in traditional classroom roles: for the lecturer, a move from disseminating information to a passive class to more engaging, student-centred methods; and for students to take more responsibility and autonomy for their own learning (Duell, 1986). Such changes cannot be accommodated within traditional structures nor achieved by the introduction of a quick fix such as clickers. It requires a revision of the epistemology and practices underpinning the teaching of the module, and associated changes in structure and expectations.

Increase communication

Increased communication is a key component of an active learning environment (Vygotsky, 1978). Peer learning has been described by students as a highly effective method of learning (Maddux et al. 1997) and it enables the development of negotiated student learning based on a shared background. Students have reported that having a concept explained in a language they understand can be more effective than an instructor (Nicol & Boyle, 2003) while the process of interpreting and explaining information to a peer results in deeper engagement with the material (Robin & Le Sage, 2009). Two methods to help lecturers adapt their teaching to a more hands-off, student-centred style are scaffolding and guided participation (Driscoll, 2005). In the former, the lecturer gradually reduces the direction and support offered to students in direct proportion to the increase in their own autonomous learning. Guided participation is a broader concept and refers to shared endeavours between more expert and less expert participants interacting in a less specific or structured manner.

Opportunities for practice

Traditional large group teaching includes few opportunities to practice the skills discussed in class. Students learn better when they can actively engage with the material during class (Mayer & Wittrock, 2006; Wittrock, 1990) and can see its application in the real world (Hoekstra, 2008). The class should include opportunities for exploring concepts and applying the theoretical to the practical. This mix of new and old, theoretical and practical information results in a more effective, deeper understanding of the subject matter. When physically applying the theoretical is not possible in the classroom several options are available. Brown (1997) suggests a list of activities that include: rounds, three minutes each way; silent reflection; buzz groups; brain storms; syndicates; snowballing; fishbowls; and crossovers. These should be employed in a range of contexts and situations to ensure the newly acquired knowledge can be transferred to different settings (Driscoll, 2005).

7. Conclusions and Future work

Clickers have enjoyed a degree of success and have many strong advocates. Their presence, however, does not automatically solve the problems associated with large group teaching. This inaccurate assumption was witnessed firsthand by the attitude and expectations of lecturers in the current study, who made no other change to their teaching methods or environment other than to incorporate a small number of clicker questions into their established lectures. While not detracting from the well documented advantages of clickers and their ability to promote student engagement, they nevertheless have limitations and can only truly make the transition from a novelty 'pay attention device' (Hoekstra, 2008) to a genuine learning tool when used in conjunction with pedagogically sound practices grounded in more student-centred learning theories. Failure to do so will result in little change in student engagement and interaction regardless of the technology used and may actually have an adverse impact by: encouraging non-verbal, anonymous communication; repeated exposure to questions that are not sufficiently cognitively challenging or varied; or by simplifying complex issues to a series of multiple-choice responses. The only way to ensure greater student involvement is to engage in teaching methods that both require and make it easy for students to actively participate. Clickers can be hugely beneficial in achieving this goal, but cannot achieve it alone.

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