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Using clickers in class. The role of interactivity, active collaborative learning and engagement in learning performance

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ABSTRACT

As more and more educational institutions are integrating new technologies (e.g. audience response systems) into their learning systems to support the learning process, it is becoming increasingly necessary to have a thorough understanding of the underlying mechanisms of these advanced technologies and their consequences on student learning performance. In this study, our primary objective is to investigate the effect of clickers (i.e. audience response systems) on student learning performance. To do so, we develop a conceptual framework in which we propose that interactivity, active collaborative learning and engagement are three key underlying forces that explain the positive effects and benefits of clickers in enhancing student learning performance. We test these relationships empirically in a university class setting using data from a survey answered by students in a social sciences degree. The results provide strong support for our proposed framework and they reveal that the high level of interactivity with peers and with the teacher that is promoted by the use of clickers positively influences active collaborative learning and engagement, which, in turn, improves student learning performance. These results show the importance of clickers in improving the student learning experience and recommend their use in educational settings to support the learning process.

1. Introduction

Information technology (IT) has been recently considered a strategic resource in educational settings, offering educational institutions a unique opportunity to increase student motivation and enhance learning outcomes (Roblyer & Wiencke, 2003). Examples of technologies that have been adopted by educational institutions in recent years, and that have received considerable attention in prior research, include WebCT, Blackboard, tablet PCs and instant messaging. In this study, we focus on clickers, which have increasingly become an integral part of the student learning experience in some educational institutions and offer a high potential for learning performance improvements. Studied under different names, such as audience response systems, voting machines, wireless keypad response systems, or classroom communication systems, clickers are interactive remote response devices that transmit and record student responses to questions providing immediate feedback to both the students and the teacher about the learning process (Homme, Asay, & Morgenstern, 2004).

Despite recent interest in the role of clickers, several aspects prevent researchers from fully understanding their influence on student learning (see the meta-analysis of Kay & LeSage, 2009). First, existing knowledge comes primarily from qualitative analyses. These studies, while offering sound guidance and advice about the use of clickers in the educational context, provide little direction for understanding the mechanisms through which clickers influence the student learning process. There is a lack of quantitative studies which, if based on sound theory, would help us better understand the role of clickers in student learning and the underlying mechanisms that explain their ultimate impact on performance outcomes (Fies & Marshall, 2006; Kaleta & Joosten, 2007). Second, there is a noticeable lack of reliability and validity analysis of the measurement instruments used in prior studies, which makes it difficult to have a rigorous understanding of the phenomenon (Kay & LeSage, 2009). Third, according to Fies and Marshall (2006), it is surprising that much research analyzes the efficacy of clickers in individual mode. Given the emphasis on collaborative work in the US National Science Education Standards, the application of

clickers in group mode would be a better avenue for research. Finally, prior research has been conducted on a limited set of educational settings, mainly on technical and scientific subjects such as mathematics, chemistry, engineering and astronomy. Thus, it is necessary to study social science subjects for a better understanding of the general educational impact of clickers.

Addressing these gaps, our primary objective is to investigate the impact of clickers on student learning performance. We develop a conceptual framework in which we identify several mechanisms behind the effect of clickers on learning performance. We propose that the level of interactivity among students and between the teacher and the students that results from the use of clickers affects student collaborative learning and engagement and, in turn, learning performance. To test this framework empirically, we used clickers in peer group practices based on class-wide discussion, which offers an opportunity to improve students' attention and stimulate collaborative work. We collect real data from undergraduate students in a social science degree, study the reliability and validity of the scales and apply a quantitative approach. In this way, we aim to bridge the gaps identified and contribute to existing research with an empirical application that provides interesting implications about the use of clickers for student learning. Moreover, we contribute to the existing discussion about the generation and enhancement of engagement, recently identified as a research priority in the learning arena (Oncu & Cakir, 2011).

2. What are clickers? Characteristics, advantages and disadvantages

Clickers are small transmitters that look similar to a television remote control. They are advanced technological devices that allow students to quickly answer questions that are presented in class. When the students answer the questions, the clickers' codes appear on-screen and students know that their responses have been recorded. A computer summarizes the responses and the results are automatically displayed in chart form, usually a histogram. Responses can be anonymous or linked to specific students through the clicker unit ID, allowing the teacher to know who gave correct and incorrect responses. Clickers are interactive and can speed up didactic lectures when teaching adults and/or active learners.

Clickers provide significant benefits to both the teacher and students (Bergtrom, 2006; Bullock et al., 2002; Simpson & Oliver, 2007). For the teacher, clickers provide immediate feedback about the student learning process and allow him/her to gauge the overall comprehension of the concepts involved in the material. Clickers are also very effective at engaging students in the class, promoting interactions among students, providing immediate feedback on their understanding of the lessons, and facilitating the active participation of students in the learning process by discussing the answers given to the questions. These features of clickers stimulate the development of student–teacher relationships and lead students to perceive the activity as entertaining, which, in turn, increases their willingness to participate in the class (Caldwell, 2007). In sum, this technology improves student understanding of complex subjects, individual progress and comprehension and teacher awareness of learning problems (Caldwell, 2007; Knight & Wood, 2005).

Despite these significant benefits of clickers, some disadvantages should also be noted. First, although the price of this technology has decreased in recent years, clickers may still represent a significant economic cost for some educational institutions, which may become a barrier to adopt and integrate them into the learning process. Second, despite the ease of use of the technology and the benefits that they provide, faculty members may be reluctant to introduce new technologies in class and may perceive high costs in terms of time and effort investments (Kay & LeSage, 2009). In addition, similar to other advanced technologies, clickers can generate frustration and unsatisfactory situations due to technical issues like failures or bugs.

Overall, the significant benefits identified lead us to expect a positive effect of clickers on student learning performance.

3. Conceptual framework and hypotheses

In this study, we provide a conceptual framework that identifies key mechanisms through which the use of clickers influences student learning performance (see Fig. 1). We propose that student perceptions of the interactivity with peers and with the teacher that result from using clickers promote active collaborative learning and engagement, which ultimately leads to enhanced learning performance.

As noted previously, by stimulating two-way communication during the process of answering questions and in the discussions about the correct answers, clickers increase the degree of perceived interactivity in the classroom both among students (interactivity with peers) and between the students and the teacher (interactivity with teacher) (Banks, 2006; Bergtrom, 2006; Caldwell, 2007; Mayer et al., 2009). Interactivity is conceived as a critical element in the learning process. It stimulates students to participate in the classroom -active collaborative learning- (Guthrie & Carlin, 2004; Thalheimer, 2003), and to develop a sustained behavioral involvement in learning activities -engagement- (Carnaghan & Webb, 2007; Kay & LeSage, 2009). The presence of these two elements is instrumental in enhancing students' learning performance. Only when students actively collaborate in the learning process can the teacher adapt the pace, style and topic of the lecture to better fit the students' needs, identify any misunderstandings so as to clarify them properly and punctually, and make sure that they have understood all the materials before continuing with the next learning step. In addition, active learning potentially promotes
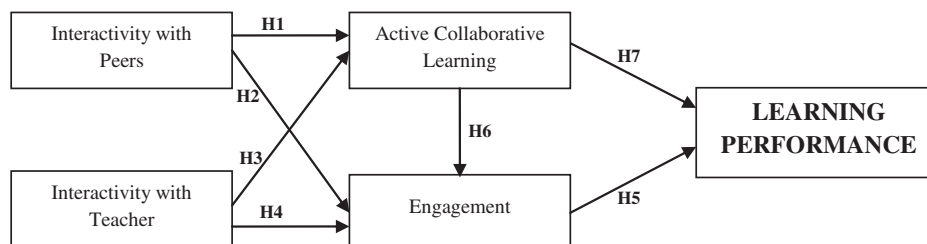

Fig. 1. Conceptual framework.