Student response systems (AKA clickers) are being used widely by educators, and the pedagogical research that documents their benefits and drawbacks continues to increase. In this teacher-ready research review, I provide a brief overview of the current literature, review the research about clickers influencing student performance, provide an overview about how clickers are used in additional contexts, and close with recommendations and thoughts about the optimal use of clickers.

Keywords: clickers, student response systems, student performance, pedagogy, evidence-based instructional practice

Whether they are called audience response systems, student response systems, or clickers, this methodology (either dedicated hardware device or smartphone app) appears to be garnering more research attention as evidenced by a flurry of publication activity. Keough (2012) published a review of 66 clicker-centered studies focused on student outcomes and perceptions, with eight thematic trends emerging: (a) student performance in actual courses (vs. lab studies); (b) student satisfaction with clickers; (c) student perceptions of clicker impact on performance; (d) student perceptions of clicker impact on attention span; (e) clicker use in relation to class attendance; (f) student participation and engagement; (g) the role of immediate feedback as a component of clicker use; and (h) perceptions regarding ease of use. In this teacher-ready research review, I provide a brief overview about clickers, present some key research findings currently available, and end with evidence-based suggested practices. For an extensive bibliography of clicker studies across disciplines, see Bruff (2014).

Clicker technologies can be divided into two broad categories: hardware-based systems and software-based systems. In the hardware-based system, each student uses a physical device that is dedicated to clicker use; these are relatively small devices that can be held in one hand. When the student selects an option from the keypad, infrared or radio frequency signals are sent to a USB receiver that the faculty member uses, along with a computer with the clicker software, to capture and immediately display a composite of all student responses to the question or statement posed by the faculty member. Software-based systems rely on an app or computer program that the student can use on his or her own device (smartphone, laptop, tablet), and responses are transmitted via the Internet to the clicker software the faculty member is using, and these composite results can also instantaneously displayed to the audience.

Research About Clickers Impacting Student Performance

The effect of clicker use on learning outcomes is clearly mixed, with some researchers reporting a beneficial effect (e.g., Brady, Seli, & Rosenthal, 2013; Morling, McAuliffe, Cohen, & DiLorenzo, 2008; Poirier & Feldman, 2007; Shaffer & Collura, 2009), some indicating no effect (e.g., Elicker & McConnell, 2011; Fallon...
and at least one researcher reporting a detrimental effect (Anthis, 2011). Studies about clickers and student performance include both controlled lab studies experimentally testing for clicker use effects, as well as embedded classroom-based studies.

### Lab-Based Studies

Laboratory-based studies allow for greater precision and control over variables that might influence how clicker use may impact student performance and other variables. Not only is there some evidence from lab-based studies that clickers do enhance student performance (Anderson, Healy, Kole, & Bourne, 2013; Oswald & Rhoten, 2014), but also that the use of clickers may allow instructors the opportunity to save instructional time (Anderson, Healy, Kole, & Bourne, 2011). That is, once an instructor knows what her or his students know (or do not know) via the feedback that clicker technology can provide, classroom instructional time may be better used. In fact, operational concerns such as the effect of feedback and the timing of questions are being studied in lab-based studies (Lantz & Stawiski, 2014).

### Classroom-Based Studies

From a variety of classroom-based studies, the use of clickers has resulted in improved student performance (Brady et al., 2013; Roth, 2012; Shapiro & Gordon, 2012; Yourstone, Kraye, & Albaum, 2008). However, only small improvements in test scores were noted by Morling et al. (2008), and clickers did not improve learning by objective testing in the study by Patterson, Kilpatrick, and Woebkenberg (2010). Some classroom-based studies are now emerging about the specifics of how clickers are used and the student outcomes as well as individual difference factors. For example, when clicker use was made nonanonymous in a classroom-based study, student performance increased (Oswald, Blake, & Santiago, 2014). Interesting individual differences findings are emerging from the literature. Roth (2012) reported that lower performing students improved their performance with clickers in a calculus class, and Kang, Lundeberg, Wolter, delMas, and Herreid (2012) found that women perform better after engaging with ‘clicker cases’ than men. Some researchers address student performance, whereas others explore other variables such as student perceptions about clicker use; at least one study exists (White, Syncox, & Alters, 2011) where the precise nature of the study was to compare clicker use for checking student perceptions versus clicker use for points toward a final grade.

### Research About Clickers Impacting Other Variables

It is important to remember that when considering potential outcome variables, course grade is very much a macrolevel measure, and challenges abound when grade is used as the key outcome measure (Tomcho & Foels, 2008). Multiple researchers have studied grades in addition to other variables, and sometimes research focus exclusively on other variables such as student engagement, attendance, and absences.

One common area of research interest involves how clickers affect student engagement (Hill & Smith, 2011) and the social environment of the classroom. Stowell and Nelson (2007) and Elicker and McConnell (2011) reported that when clicker, flashcards, and hand-raising methods of student engagement were directly compared, students were most positive toward clicker use. Hoekstra (2008) reported that when students in a clicker section of a course were compared with those in a ‘control’ section of a course, students in the clicker section reported increased activity, cooperation, and conceptual applications. There is greater comfort for some students in using a clicker versus raising their hand, particularly involving anxiety and the lack of anonymity in raising a hand (Stowell, Oldham, & Bennett, 2010). The trend of greater engagement via clicker use is a trend in recent studies (Brady et al., 2013; Fertner-Wood, Armistead, Marchand, & Morris, 2013; Han & Finkelstein, 2013; Landrum, 2013), with enhanced engagement emerging in student self-report measures of better attention and retention, reduced absenteeism, and higher teaching evaluations are emergent as well. Anderson et al. (2013) suggested that the use of clicker questions triggers cognitive engagement, and based on the generative theory of learning, students in clicker classroom should...
perform better compared with a more passive classroom environment. Perhaps just as importantly, from the student perspective, students believe that they are learning more when they use clickers (Sutherlin et al., 2013).

Active responding, coupled with instant feedback and the potential for anonymity, provide the potential for classroom advantages beyond hand-raising and the flashcard-raising methods. However, these benefits are related in part to a faculty members’ ability to use clicker pedagogy wisely, or as Trees and Jackson (2007) stated, “if students want to be involved and engaged, they are more likely to perceive clickers positively in terms of both learning and involvement processes” (p. 35). However, it is important to remember that not all students will have a positive experience in their use of clickers (Dallaire, 2011). Varied examples exist of the clicker being used as an instructional aide in the classroom (Anthis, 2011), including the demonstration of behavioral research outcomes (e.g., Langley, Cleary, & Kostic, 2007) such as the false memory effect and the levels of processing effect (Cleary, 2008). Other benefits are also possible, such as using clickers as a specific strategy for advancing the scholarship of teaching and learning (Landrum, 2013).

Recommendations

Recommendation #1: Carefully Consider Clickers as One Component of Your Overall Pedagogical Approach

Electing to use clickers in the classroom is not a pedagogical choice that excludes other pedagogical decisions. Graham, Tripp, Seawright, and Joeckel (2007) emphasized that clickers can be used in conjunction with conceptests, problem-based learning, and other active learning approaches. In a study designed to disentangle the pedagogy from the technology, Elicker and McConnell (2011) determined that “the questions themselves are what mattered in students’ perceptions of their usefulness rather than the response method” (p. 149; see also Anthis, 2011). Although strong pedagogy in the design of clicker content is warranted, Fallon and Forrest (2011) suggested that part of the beneficial effect could be the novelty or joy of using clickers (and over time, novelty would wane); a concern shared by Lantz (2010) as well. Christopherson (2011) also emphasized that the benefit of clicker use may be more attributable to the changes in pedagogy in the classroom rather than the implementation of clickers, or in her words, the clicker “simply helps instructors recognize some useful teaching moments” (p. 290). Furthermore, Blasco-Arcas, Buil, Hernandez-Ortega, and Sese (2013) reported that clickers lead to more interactions between students and teachers and peers, and it is that this enhanced engagement (i.e., generative theory of learning), which leads to improved student performance.

Recommendation #2: Think About Clicker Data Having Practical Applications in Addition to Measuring Student Performance

When examining clicker use from a cross-disciplinary perspective, Hoekstra and Mollborn (2012) generated data-based conclusions about the effective pedagogical use of clickers, such as (a) students tend to enter the course with ideas or assumptions that impede learning, and clickers can be useful in identifying student assumptions or misperceptions about the material to be learned; (b) discussions can be used to support teaching and learning, but with the use of clickers and exercises such as think-pair-share (share via clicker question), instructors can support the application and critical thinking skills of students when discussions are utilized; and (c) collecting real-time data from students (anonymously or otherwise) can be a powerful tool for the instructor to collect pedagogical data from students as part of theory testing, conceptual applications, and measuring the effectiveness of group discussions. Using clickers effectively can lead to deeper insights beyond student retention of content (for more ideas, see Landrum, 2013).

Conclusions

Under what conditions might clicker use be favorable, and under what conditions might clicker use be contra-indicated? Although this question is not yet directly addressed in the literature, Dallaire (2011) did suggest that in addition to the possible advantages of clicker use (such as gauging student mastery, stimulating discussion, evaluating problem-solving, understanding prior knowledge, taking atten-
dance), clicker-related hindrances include a student forgetting to bring a clicker to class and hardware/software malfunctions. As with any pedagogical intervention, instructors will need to be prepared for unexpected events, such as software failures. Ultimately, it is an individual decision to weigh the potential advantages (measurement of performance outcomes, faculty insights) versus the disadvantages (such as cost, learning curve) of clicker use, from both the faculty member and student perspectives.

It is clear from this brief teacher-ready research review that the clicker, when coupled with careful planning and specific, appropriate pedagogical goals, can be an effective tactic for increasing student engagement in the course, and in some cases, is linked to improved student performance. Researchers are continuing to develop those best practices in which clicker use and student performance can be supported and maximized.

References


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