Clickers in Classroom

Findings from the Review of Research Literature

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What Clickers are?

- A personal response system more technology-driven than traditional:

  ...but not quite as sophisticated as today’s mobile handheld devices

  No-Tech Hand Rising

  Low-Tech Response Card
“10,000 Feet” Question: Why Clickers?

Active Instruction/ Engaged Learners:
Engagement/
Feedback/
Motivation

What we Expect

Transfer

What we Control…

Conceptual Understanding
Deep learning/
Discovery/
Conceptual growth

What we Target…
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<th>Type of research</th>
<th>Method &amp; Design</th>
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<td>Generic Clicker Issues</td>
<td>e.g., Physics, Chemistry, Math, Biology, Nursing, Business, Computer, Engineering</td>
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Clickers in Classrooms

Findings from Conceptual Research
Effective Clicker Questions…

Are formative rather than summative (e.g. exam & homework);

- Clicker question **should have a clear formative purpose**:
  
  **content** (What? - *static cognitive skills: recall, recognize*)
  
  **process** (How? – *dynamic cognitive skills: analyze, synthesize*)
  
  **learning strategy** (Why? - *metacognitive skills: integrate, extrapolate*)

- Clicker questions **should target misconceptions**:
  
  **Oops-go-back questions** – follow with a clearer question on the issue;

- Qualitative questions usually superior to quantitative ones:
  
  **Promote articulation and argumentation**

Instructional Strategies for Clickers Classroom

Traditional strategy:
- attendance and “ice breaking” clicker questions
- lectures augmented with 3 to 5 formative clicker questions
- “right” answer provided with the posting of the histogram

Peer/group-learning strategy (Mazur):
- mini-lecture;
- associated clicker question (ideally one to reveal misconceptions)
- posting of the actual histogram
- group activity discussing the posted histogram;
- same clicker question posted again;
- new histogram posted along with the “right” answer;
- if needed, more clarifying material presented by the instructor
Instructional Strategies - continuing

Question-Driven Instruction:
- Reverts Mazur’s peer-learning strategy
- Introduces question cycles as the core part of the course;

The question-driven instructional cycle:
- start with a question (conceptual, not recall)
- engage student in small-group work;
- collect answers – post histogram;
- whole class discussion;
- closure by the instructor as needed:
  e.g., mini-lecture, general observations, one more topic-related clicker question

Clickers in Classrooms

Findings from Empirical Research
Clicker vs. Non-Clicker Classroom

**Context:** Lectures on clinical topics for Year 5 medical students;

**Design:**
- Cohort stratified by gender and then randomized in 2 groups;
- Two faculty thought both topics with and without clicker;
- 4 measures of performance/ behavior:
  1) multiple-choice assessment tool;
  2) course evaluations;
  3) instructor survey; and
  4) classroom observations;

Findings:

- no significant difference in students’ performance outcomes on tests;

- for one faculty, student evaluation significantly increased when clicker used
  (traditionally this faculty used passive lectures; the other active lectures)

- classroom observations showed that:
  students were more active in clicker lectures for both instructors;

Weaknesses:

- There is no description of clicker strategies for the two instructors;

  the implicit [wrong] assumption: regardless of how the clicker questions
  are developed and deployed the impact on learning is the same;

- Both instructors were exposed to clickers for the first time; their perception
  of technology could significantly bias the effectiveness of tool use;
Clicker questions vs. WebCT quizzes

Course: Chemistry for nursing;

Experimental design with 4 groups:

1) Clickers; 2) WebCT quizzes; 3) Clickers & WebCT; 4) Control group

Prior knowledge:

Group Assessment of Logical Thinking (GALT)

Exit performance:

Teacher-written exams &
Standardized test: American Chemical Society exam (ACS);

Clicker questions vs. WebCT quizzes - continuing

Findings

For teacher-written exams:
- WebCT quizzes group performed significantly higher than any other group;
- Clicker group performed significantly lower than any other group;

For ACS standardized test:
- Clicker group performed significantly higher than any other group;

Weaknesses

Only 41 students for all experimental treatments;
small group size – questionable power and effect size;

No explicit discussion about the nature and structure of clicker questions;

No explicit discussion about the relationship between: clicker questions and teacher-written exam questions;

Clicker activity used a group activity while WebCT quizzes involved an individual activity;
Peer-learning **With** and **Without** Clicker Technology

- Theory-driven research: “Conversational Framework”;
- Isolates the impact of clicker technology: same instructional strategy (active learning/peer-instruction) for both treatment and control group;
- Each group was both control and treatment group
  - switched between Use and Non-Use of clickers;

**Major findings**

- *limited incremental impact* on improving class satisfaction:
  - Students that used clickers in the first half, found the course significantly less interesting when the clickers were removed;
  - students who started without clickers found the course equally interesting in both segments

Peer-learning With and Without Clicker Technology

**Major findings - continuing**

- Clicker effects *limited to exam questions similar* to classroom clicker questions;

- Clickers have *positive effect on performance* for both low and high ability students;

- Students were *more comfortable* participating and answering questions when clickers used, but *less comfortable* asking questions;

**Weaknesses**

- small class size (below 40; one exception: 72)
  - facilitated the implementation of traditional peer learning … but
  - hard to transfer to large groups;

- students part of a co-op honors program
  - rises questions about the transfer of results to heterogeneous large groups ;
Clickers in Classrooms

Empirical Research Tools (Surveys)
Surveys for Clicker Research


  - Developed two scales: learning (5 items) and engagement (6 items);
  - Administered these scales at the end of the semester for 3 disciplines (physics, communication, astronomy);

- Highlights of the results/conclusions:
  - use of clickers meaningful if students already understand the role of feedback and accept the benefits of active learning;
  - interactivity in classroom highly dependent on instructor’s pedagogy

- Major weakness - no explicit discussion about:
  - the nature of the questions used by each instructor, and
  - the relationship between questions and the pedagogy (instructional strategy) used be each instructor;
Surveys for Clicker research - continuing


- Developed an instrument with 6 scales:
  - Audience Response Technology Questionnaire;

- Evidence of construct validity presented for three of the six scales

- Survey administered online three times/semester for three courses (communication, forestry, leadership)

- Major weakness:
  - Final scales not balanced (# of items vary);
  - No explicit link to the clicker strategies used in each course;
  - No analysis of the relationship of this instrument and student performance outcomes
Conclusions

Clickers enhance not replace good teaching & learning strategies
- instructors need to believe in the benefits of active instruction approaches
- students need to understand the role of feedback and accept the benefits of active learning

Clicker questions need to have a formative purpose:
- provide feedback to both students and instructor
- be different from exam and homework ones
- expand focus from content to process and to learning strategy issues

Clicker technology can increase student participation and satisfaction:
- students are more comfortable participating and answering questions
- student evaluation in clicker courses are more positive

Clicker researchers started to develop more comprehensive tools:
- to survey students’ learning, engagement, and attitude
- to understand the impact of this technology on the instructional process
Other useful research papers:

**Descriptive:**


**Surveys:**


**Review:**


Online Resource:
Classroom Response System Bibliography

Author: Vanderbilt Center for Teaching

Source:
http://www.vanderbilt.edu/cft/resources/teaching_resources/technology/crs_biblio.htm

Highlights:

- Two major categories of papers:
  1. General Audience; 2. Discipline-specific Audience

- Over 100 citations, many of them with active links to the actual paper;

- Well maintained resource with up-to-date citations;
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