

College of Arts and Sciences



Drexel E-Repository and Archive (iDEA)
<http://idea.library.drexel.edu/>

Drexel University Libraries
www.library.drexel.edu

The following item is made available as a courtesy to scholars by the author(s) and Drexel University Library and may contain materials and content, including computer code and tags, artwork, text, graphics, images, and illustrations (Material) which may be protected by copyright law. Unless otherwise noted, the Material is made available for non profit and educational purposes, such as research, teaching and private study. For these limited purposes, you may reproduce (print, download or make copies) the Material without prior permission. All copies must include any copyright notice originally included with the Material. **You must seek permission from the authors or copyright owners for all uses that are not allowed by fair use and other provisions of the U.S. Copyright Law.** The responsibility for making an independent legal assessment and securing any necessary permission rests with persons desiring to reproduce or use the Material.

Please direct questions to archives@drexel.edu



Quantitative measures of personal response device effectiveness

Daniel B. King¹ and Shivani Josh²

¹Chemistry Dept., Drexel Univ., Philadelphia, PA, 19104 USA

²Biology Dept., Drexel Univ., Philadelphia, PA, 19104 USA

Abstract

The use of personal response devices (or "clickers") in the classroom is becoming more frequent. Quantitative results have been used to assess clicker effectiveness in both general and physical chemistry. Changes in classroom engagement were investigated in the general chemistry classes. In one term, the clicker use was optional, while in the other term, clicker use was tied to a participation grade.

In all classes, exam grades for students who consistently used clickers were higher than those for students who didn't. Information retention was tested with a comparison of student performance on clicker questions and related exam questions. In some cases, a clicker question was used as an exam question. In most cases, student performance improved on the exams relative to the in-class performance (as recorded with clickers).

Course Information

Personal response devices (clickers) were used in three different classes.

TDEC121 Winter 06:

- Second term general chemistry for engineers
- Clickers used in one of three lecture sections (all sections took common exams)
- Clicker use was voluntary (no participation credit)
- Enrollment = 172

TDEC121 Spring 06:

- Second term general chemistry for engineers
- Only one lecture section
- Clicker use tied to participation grade (full credit for answering 75% of questions)
- Enrollment = 101

CHEC353 Winter 06:

- Third term physical chemistry
- Clicker use tied to participation grade (full credit for answering 75% of questions)
- Enrollment = 34

Clicker Information

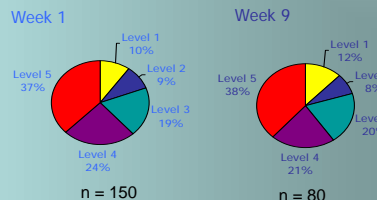


- RF clickers from Turning Technologies, Inc.
- Each student assigned clicker for the term – students picked up and returned same clicker each class period
- Generally 2-4 clicker questions per 50-min class

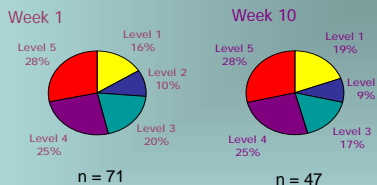
Classroom Engagement Survey (created by Eric Hamilton, Air Force Academy)

- Level 1: daydreaming, talking to other students
- Level 2: taking out notes, opening book
- Level 3: copying notes w/o thinking
- Level 4: not interested/engaged in material
- Level 5: learning the material, interested/engaged

TDEC121 W 06 (voluntary use)



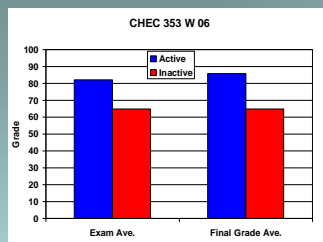
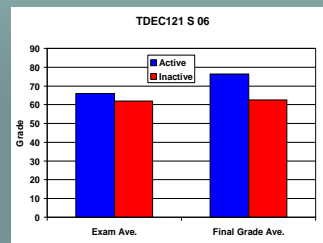
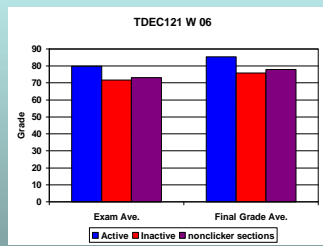
TDEC121 S 06 (participation credit)



Levels of classroom engagement were surveyed in general chemistry lectures at the beginning and end of the term. Regardless of whether clicker use was voluntary (Winter) or worth participation points (Spring), there was no change in engagement over the course of the term. Reasons?

Winter: since clicker use was voluntary, only students already engaged used clickers

Spring: since credit was given for any answer (correct or not), clicker use did not increase engagement



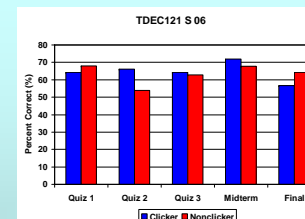
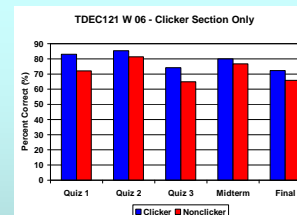
These figures show performance as a function of classroom activity, where active participation corresponds to >75% of questions answered. Performance is reported as averages of all exams and final course grade.

General Chemistry:

Winter: grades are compared for active students, inactive students, and students in nonclicker sections. Active students performed best on both the exams and the final course grade.

Spring: active students performed better than inactive students.

Physical Chemistry: improved performance of active students was larger than for general chemistry sections



Material included in clicker questions constituted about 20-30% of the material on each exam. Student performance (as % correct) was evaluated for these two categories of exam questions. In Winter (clicker lecture only), students did better on exam questions related to clicker questions (averaging 6.8% better). Students in the nonclicker lectures averaged 5.3% better on those same questions. In Spring, student performance was more variable, with students averaging only 1.2% better on clicker-related exam questions.

TDEC121 W 06 (ave. number of students)

	clicker right	clicker wrong	not answered
exam right	40.4	27.3	61.0
exam wrong	7.5	7.3	23.0

TDEC121 S 06 (ave. number of students)

	clicker right	clicker wrong	not answered
exam right	25.7	20.7	14.9
exam wrong	9.9	14.0	10.7

Student answers on clicker questions were compared to answers on corresponding exam questions. Each cell represents the intersection of the two categories (e.g., upper left corner is number of students who got both the clicker and exam question correct). The numbers correspond to averages of all students for all clicker question-exam question pairs during the term.

- > Most students who got the question right in class, got it right on the exam (clicker right, exam right)
 - > Winter = 84% (40.4/47.9); Spring = 72% (25.7/35.6)
- > Most students who got the question wrong in class, got it right on the exam (clicker wrong, exam right)
 - > Winter = 79% (27.3/34.6); Spring = 60% (20.7/34.7)
- > Improvements on the exam relative to the in-class performance exceeded the "control" (clicker question not answered)
 - > "Control": Winter = 73% (61.0/84.0); Spring 58% (14.9/25.6)

Students in the Winter section benefited more from the clickers than students in the Spring section. The decreased benefit for the Spring section could be due to the fact that those students were just answering to get participation credit; not answering to try to learn.

Questions about classroom use of the clickers:	TDEC121 W 06	TDEC121 S 06	CHEC353 W 06
More likely to attend class	84%	86%	92%
More likely to participate	99%	78%	100%
More focused on lecture	91%	72%	88%
Improved my understanding	89%	70%	100%
Attending class more fun	97%	58%	96%

Overall, students felt that the clickers were beneficial (based on end-of-term evaluations).

- > General chemistry: students who were "forced" to use the clickers (Spring) were less positive about the experience.
- > Physical chemistry: "forced" participation didn't dampen enthusiasm for the clickers.

Conclusions

- > Active students (>75% clicker questions answered) received higher exam and course grades in general and physical chemistry courses.
- > Clicker use did not improve amount of time students were engaged in the classroom.
- > Students that voluntarily used clickers did better on exam questions with related material than students who were "forced" to use clickers.
- > Students using clickers only for participation credit did not retain information as well as students who used clickers voluntarily.