Lecture Rule No. 1: Cell Phones ON, Please! A Low-Cost Personal Response System for Learning and Teaching

ARTICLE *in* JOURNAL OF CHEMICAL EDUCATION · MARCH 2013

Impact Factor: 1.11 · DOI: 10.1021/ed200562f

6 AUTHORS, INCLUDING:

Eva Y. W. Wong
Hong Kong Baptist University
28 PUBLICATIONS **101** CITATIONS

JOURNAL OF CHEMICAL EDUCATION

Technology Report

pubs.acs.org/jchemeduc

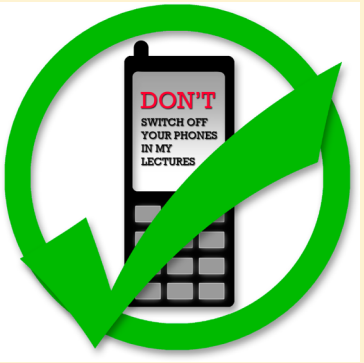
Lecture Rule No. 1: Cell Phones ON, Please! A Low-Cost Personal Response System for Learning and Teaching

Albert W. M. Lee,*[,†] Joseph K. Y. Ng,[‡] Eva Y. W. Wong,[§] Alfred Tan,[∥] April K. Y. Lau,[†] and Stephen F. Y. Lai[§]

[†]Department of Chemistry, [‡]Department of Computer Science, [§]Centre for Holistic Teaching and Learning, [∥]Knowledge Transfer Office, Hong Kong Baptist University, Kowloon Tong, Hong Kong SAR, China

Supporting Information

ABSTRACT: Every student has a powerful wireless signal transmitter, his or her cell phone, that can be used to replace the "clicker" as a personal response device. Our mobile phone-based response system (iQlickers) collects and analyzes the answers or opinions sent in by the students as SMS (short message service) messages. The statistic of the answers is displayed online in the lecture hall. On the basis of the statistic, group discussion and peer instruction can be conducted. No setup in the lecture halls and purpose-built response pads (clickers) or receivers are needed. The operation cost of our system is very low, but class interaction can be greatly enhanced.



KEYWORDS: *First-Year Undergraduate/General, Second-Year Undergraduate, Organic Chemistry, Physical Chemistry, Distance Learning/Self Instruction, Inquiry-Based/Discovery Learning, Problem Solving//Decision Making, Testing/Assessment, Student-Centered Learning*

In large size classes, interactions among students and with the instructor are usually limited. To gauge how well students understand the concepts being taught and to stimulate discussions, instructors often pose questions throughout lectures. However, students are usually reluctant to respond in fear of embarrassing themselves in front of the class. Straight talks and monologues become the norm in big lectures, which makes in-class learning passive and boring.

Various approaches have been suggested to alleviate passivity in lectures. One of the innovative means to engage students in class is the use of personal response devices (clickers) with which students can anonymously submit answers to multiple-choice questions.[1−4] Because of the anonymity factor, students are more motivated to give an individual response.[5,6] The instructor can then display the statistic of the responses to the class and initiate discussion among students. After the discussion, the instructor can prompt a second vote to ensure the concepts in question are well grasped. Teaching by telling is hence replaced with teaching by questioning and peer discussion.[7,8] Research has also indicated that, with the help of clickers, peer discussion enhances understanding even when none of the students in a discussion group originally knows the correct answer.[9,10]

Problems with Conventional Clicker Systems

Even though the cost of clicker systems has significantly decreased in recent years, they still cost US$ 1500−2000 for a 50-clicker set.[11] Distribution and availability of clickers to every student is another problem. Instead of distributing the clickers and collecting them after each lecture, some colleges choose to provide or subsidize each beginning student an individual clicker. Larger institutions may ask their students to check out the clickers from the libraries.[12] There are also issues related to hardware setup and maintenance. Receivers have to be set up in lecture rooms before each lecture. Most importantly, the number of classes that can use such a personal response system at a given time slot is limited by the number of clicker sets available in the institute.

Encouraging Students' Engagement through Interactivity

Every student has a powerful personal signal transmitter within arm's reach—the cell phone, which can be used to replace the clickers. In Hong Kong, there are only five licensed mobile phone network providers. SMS (Short Message Service) messages sent and received *within the same network are free*. Making use of these free SMS services, we developed a personal response platform called iQlickers for classroom learning and teaching. Our approach does not require students to use smart phones nor to have Internet connections in order to participate. There are also similar products in the market that utilize mobile devices such as phones, laptops, and tablets as response systems.[13,14]

The overall architecture of the iQlickers platform is outlined in Figure 1. The PC server is interfaced with five wireless

Published: February 26, 2013

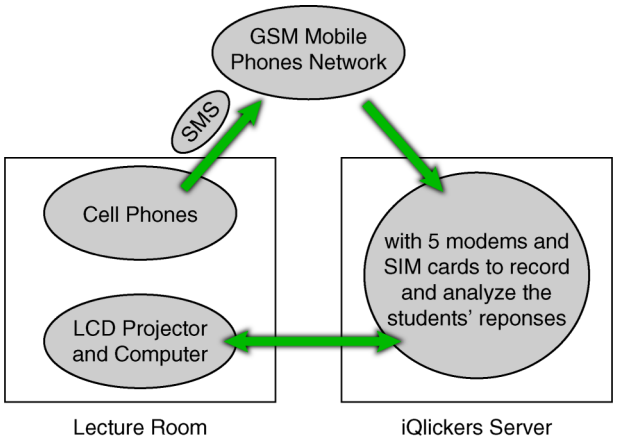


Figure 1. The overall architecture of the iQlickers platform.

modems. The modems, each charged with a prepaid phone card (SIM card) from one of the five network providers, receive incoming SMS answers from the students.[15−17] To send in their answers via SMS, students text their individual answers (a number or a letter for multiple choices questions) to one of the five phone numbers of the prepaid phone cards, which corresponds to the same local service provider to which the students have subscribed. The SMS answers are logged onto the iQlickers server via the GSM network and the SIM cards installed in the modems networked to the server. The iQlickers software analyses the students' responses. Statistic of the responses shown as bar charts is sent back to the lecture room's computer for immediate display.

Compared with the commercially available personal response systems, our iQlickers platform does not require setting up of any signal receivers inside the lecture rooms. There are no purpose-built response pads (clickers) either. The students' cell phones are their own personal signal transmitters. The wireless modems interfaced to the PC cost US$ 25 each and the operation cost is minimal. SMS messages sent within the same local mobile phone server provider is *free of charge* for both parties. The prepaid SIM cards installed inside the modems networked to the iQlickers server cost US$ 7 each for 6-month period. The only fixed operational cost is to replace or recharge (that will keep the same set of phone numbers) the SIM cards every six months. A setup and configuration guide that describes the hardware and software needed to set up iQlickers as well as steps to install and configure iQlickers can be found in the Supporting Information.

The iQlickers platform was tested in our introductory and intermediate organic chemistry courses. The atmosphere of the lectures became very lively and engaging. Students' cell phones become handy teaching and learning tools in lectures via the iQlickers platform. Therefore, please do not turn off your mobile phones in my lectures.

■ ASSOCIATED CONTENT

Supporting Information

A setup and configuration guide. This material is available via the Internet at http://pubs.acs.org.

■ AUTHOR INFORMATION

Corresponding Author

*E-mail: alee@hkbu.edu.hk.

Notes

The authors declare no competing financial interest.

■ ACKNOWLEDGMENTS

Financial support from Teaching Development Grant (TDG/05-06/I-07), OBTL Grant (OBTLG/1011/04), and Strategic Development Fund (SDF11-0930-P04) of the Hong Kong Baptist University is gratefully acknowledged.

■ REFERENCES

(1) Mazur, E. *Peer Instruction: A User's Manual*; Prentice Hall: Upper Saddle River, NJ, 1997.
(2) Crouch, C. H.; Mazur, E. *Am. J. Phys.* **2001**, *69*, 970−977.
(3) Green, P. J. *Peer Instruction for Astronomy*; Pearson Education: New York, 2003.
(4) Duncan, D. *Clickers in the Astronomy Classroom*; Pearson Education: San Francisco, CA, 2006.
(5) Landis, C. R.; Ellis, A. B.; Lisensky, G. C.; Lorenz, J. K.; Meeker, K.; Wamser, C. C. *Chemistry ConcepTests: A Pathway To Interactive Classrooms*; Prentice Hall: Upper Saddle River, NJ, 2001.
(6) Bunce, D. M.; Flens, E. A.; Neiles, K. Y. *J. Chem. Educ.* **2010**, *87*, 1438−1443.
(7) Addison, S.; Wright, A.; Milner, R. *Biochem. Mol. Biol. Educ.* **2009**, *37*, 84−91.
(8) Woelk, K. *J. Chem. Educ.* **2008**, *85*, 1400−1405.
(9) Mazur, E. *Science* **2009**, *323* (5910), 50−51.
(10) Smith, M. K.; Wood, W. B.; Adams, W. K.; Wieman, C.; Knight, J. K.; Guild, N.; Su, T. T. *Science* **2009**, *323* (5910), 122−124.
(11) (a) Turning Technologies Home Page. http://www.turningtechnologies.com (accessed Feb 2013). (b) Poll Everywhere. http://www.polleverywhere.com/ars-comparison (accessed Feb 2013)
(12) For example, see Brown University: http://www.brown.edu/cis/Faculty/Tools/PRS.html (accessed October 2012).
(13) Poll Everywhere: http://www.polleverywhere.com (accessed Feb 2013).
(14) TopHatMonocle: www.tophatmonocle.com (accessed Feb 2013).
(15) McClean, S.; Hagan, P.; Morgan, J., *Biosci. Educ.* **2010**, *16*. www.bioscience.heacademy.ac.uk/journal/vol16/beej-16-4.pdf (accessed Feb 2013).
(16) Morris, N. P. *Bioscience Edu.* **2010**, *16*. www.bioscience.heacademy.ac.uk/journal/vol16/beej-16-1.pdf (accessed Feb 2013).
(17) Goh, T.-T.; Hooper, V. *J. Inf. Tech. Edu.* **2007**, *6*, 441.