MasteringChemistry

School Name City College of the City University of New York, NY

Course Name General Chemistry II

Course Format Lecture, lab and workshop

Key Results A study showed that more students received As, Bs, or Cs when the Peer-Led Team Learning model was combined with implementation of MasteringChemistry.

Submitted by
Issa Salame, Assistant Professor

Course materials
MasteringChemistry and *General Chemistry: Principles and Modern Applications,* Petrucci, Herring, Madura, and Bissonnette

Background

The City College of the City University of New York (CCNY) is a senior college of the City University of New York (CUNY) in New York City. It is the oldest of City University's 23 institutions of higher learning, and was the first free public institution of higher education in the United States. The school enrolls approximately 16,000 undergraduate and graduate students, and approximately 77 percent of undergraduate students are classified as minorities. The six-year graduation rate for the 2007 cohort was 42 percent.[1]

General Chemistry II is the second course in a two-semester sequence and provides an in-depth introduction to the fundamental laws and techniques of chemistry for majors in science and engineering. Topics covered include chemical kinetics; chemical equilibrium; acids and bases; free energy, entropy, and the second law of thermodynamics; electrochemistry; advanced bonding concepts; metals and coordination chemistry; and nuclear chemistry.

Assistant Professor Issa Salame conducts research to better understand how students learn chemistry via various methods of teaching. He focuses on identifying and addressing common chemistry misconceptions, as well as improving students' conceptual understanding of chemistry. Salame teaches the General Chemistry II course and conducted a study to evaluate an integrated model using peer learning and online homework. His research paper, authored with Nathan Hershberger, "Studying the impact of combining online-homework and Peer-Led Team Learning on Students' attitudes and performance in General Chemistry," was published in 2013 in the *Journal of Academic Perspectives.*[2]

Challenges and Goals

CCNY uses the Peer-Led Team Learning (PLTL) model, a collaborative, small-group format emphasizing active learning via participation in a peer-led workshop. The model recommends employing students who previously succeeded in the course as peer leaders, and who will facilitate small groups of students in weekly, two-hour, problem-solving workshops.[3] One of the challenges of PLTL is the financial cost: implementation at CCNY required one peer leader per every 10 students, and the course enrolls approximately 200 students per semester.

The peer-led model has already been shown to have positive effects on student learning. The goal of Salame's study was to determine a way to implement PLTL at reduced administrative and financial costs. Acknowledging that recent online homework programs have been proven effective as learning resources, he hyphothesized that combining PLTL and online homework may increase learning and reduce administrative costs. MasteringChemistry was selected as the online homework component.

Implementation

The course consists of three components—lecture, laboratory, and workshop—integrated into a comprehensive presentation of course concepts. The laboratory component introduces students to common laboratory methods, including visible spectroscopy and titrations. The workshop is a peer-led, small group that focuses on problem solving and discussion of concepts in general chemistry.

Salame's study covers fall 2010 through spring 2012. The main difference in how the course was conducted during the period of study was the use of MasteringChemistry rather than paper-and-pencil homework.

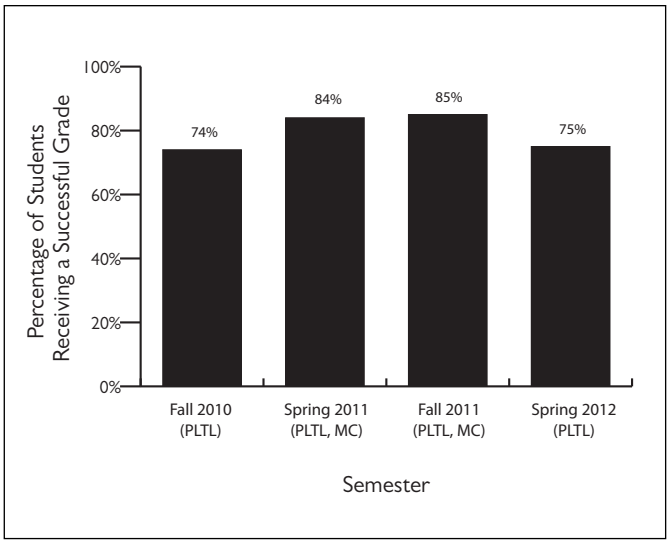

Figure 1. Peer-Led Team Learning and Combined Peer-Led Team Learning and MasteringChemistry Success Rates (A/B/C), Fall 2010–Spring 2012 (Total fall 2010 and spring 2012, *n* = ~400; total spring and fall 2011 with MasteringChemistry, *n* = ~400)

Students work on assigned homework problems during the weekly workshop. In fall 2010 and spring 2012, paper-and-pencil homework comprising problems selected by the peer leader was assigned. In spring and fall 2011, MasteringChemistry homework comprising problems selected by the professor was assigned.

MasteringChemistry homework problems are randomized; students did their own work online and were not allowed to print problems and return later to plug in answers. The MasteringChemistry assignments included a mix of Mastering problem types, both with and without hints, were available before lecture, and were due within ten days. Students worked on assignments during PLTL workshops and on their own time.

The peer leader's goal in the workshop was still to facilitate discussion, emphasize time on task, and foster a social and collaborative atmosphere. Because students were using MasteringChemistry in the session, which was also providing immediate feedback and guidance as students worked, the peer leader was able to manage a larger group of students, with a ratio of 40 students to one peer leader.

Using MasteringChemistry during the workshop benefited students by enabling them to work at their own pace and providing them with continuously available help beyond the program's online hints and guidance. Because students worked in groups, they were also able to discuss with each other any problems and conceptual questions as they arose.

Assessments

Spring and fall 2011

30 percent	In-class exams (best two of three)
30 percent	Final exam
20 percent	Lab and workshop
10 percent	Quizzes
10 percent	MasteringChemistry homework

Fall 2010 and spring 2012

35 percent	In-class exams (best two of three)
35 percent	Final exam
15 percent	Lab
10 percent	Workshop and homework
5 percent	Quizzes

Results and Data

To understand the impact of integrated MasteringChemistry and PLTL use, both quantitative and qualitative data were evaluated. The student success rate—the number of students earning an A, B, or C—increased during the two semesters that both PLTL and MasteringChemistry were in use (Figure 1).

The Student Experience

Student feedback was gathered in several ways, including a Likert-type questionnaire, a short answer questionnaire, and student interviews.

One-hundred-eighty students responded to a survey about their experience with the integrated model. Student questions were on a five point scale with 1 meaning *strongly disagree* and 5 meaning *strongly agree*. Overall, students answered favorably to questions about the combined MasteringChemistry and PLTL approach, with the average of most questions being just under 4. The question, "The combination of online homework and PLTL helped me learn the course material," earned a 3.91; "The combination of online-homework and PLTL motivated me to study," earned a 3.58.

Students were also asked what they appreciated most and to list three things they found useful about the combined format. For both questions, the most popular responses were the hints, guided solutions, and answers—all key components of MasteringChemistry tutorial questions. Other top responses included practice problems and the human component.

Students comments included:

- "[MasteringChemistry] pushed me to study the material in a timely manner, and the PLTL allowed me to find help on questions and problems I didn't know how to do."
- "[MasteringChemistry] contained several challenging questions, which could be on future exams. I became more motivated."

Conclusion

Combining peer learning with MasteringChemistry over the course of two semesters resulted in more students succeeding in the course. In addition, students provided positive feedback about the combined model.

Salame's research paper states, "The results thus far help to substantiate the sound pedagogical methods of the integrated approach as a viable, cost effective model to help improve teaching and learning. This is important because finding ways to employ sound teaching pedagogies while remaining within the confines of the budget is of the utmost importance."[4] Students were given the tools, time, and attention throughout the semester to help them succeed, and the findings show that this had a positive impact on learning.

[1]http://www.ccny.cuny.edu/institutionalresearch/upload/Fall_2013_09042014-2.pdf.

[2]Salame, Issa I., and Hershberger, Nathan J., Studying the impact of combining online homework and Peer-Led Team Learning on students' attitudes and performance in General Chemistry, *Journal of Academic Perspectives,* Volume 2013, No. 2, http://www.journalofacademicperspectives.com/back-issues/volume-2013/volume-2013-no-2/.

[3]D. Gosser, M. Cracolice, J.A. Kampmeier, V. Roth, V. Strozak, *Peer-Led Team Learning: A Guidebook*. (Upper Saddle River, NJ: Prentice Hall 2001).

[4]Salame, Issa I., and Hershberger, Nathan J., Studying the impact of combining online homework and Peer-Led Team Learning on students' attitudes and performance in General Chemistry, *Journal of Academic Perspectives,* Volume 2013, No. 2, http://www.journalofacademicperspectives.com/back-issues/volume-2013/volume-2013-no-2/, p. 9.