

## Teaching Academy Innovation Award Application

### SECTION 1: CONTACT INFORMATION

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Location: In front of my class! →



### SECTION 2: INNOVATIVE USE OF REMOTE RESPONSE DEVICES IN THE CLASSROOM

Remote response devices, commonly known as “clickers”, have become an integral part of my general chemistry instructional methodology since the spring of 2008. They constitute the single most significant, and I believe effective, innovation in my teaching in the last decade. Clickers serve three primary purposes that are directly related to my overall teaching philosophy:

- Clickers provide nearly instantaneous feedback on student learning both to the instructor and to the student. A primary goal I have as a teacher is to create an environment in which students feel secure, significant, and connected both to me and to other students. Clickers have become an indispensable tool for me in achieving such a learning environment. Feedback from clickers builds student confidence as they answer questions correctly or learn from their mistakes. (The grade penalty for incorrect clicker answers is slight, so a student’s participation is a low-risk activity.) They also build connections between students as they work together to solve problems, and enhance a sense that I’m aware of their work in class and responsive to their needs.
- Clickers facilitate an effective “question and answer” format for content delivery. In my teaching, I focus heavily on providing high-quality, well organized content. A question and answer format is a particularly effective tool for content organization that lends itself naturally to clicker delivery. Students have access to the clicker content both during and after class as all clicker questions, answers, and answer analyses are also posted online after class.
- Clickers contribute to a varied learning environment that stimulates active learning processes. Variation in content delivery helps address the needs of students with a wide range of learning styles and also aids in maintaining students’ attention over the course of a full lecture period. Keeping students engaged in the learning process is particularly challenging in large classes. Clickers naturally stimulate a high level of participation not only in answer submission but in the problem-solving process that precedes it. Evidence for this is as simple as listening to the noise level in the classroom when clicker questions are delivered!

The use of clickers in my classes is woven into a broader instructional fabric involving PowerPoint content slides, chalkboard mini-lectures, and in-class worksheets. Clicker questions are all embedded within PowerPoint slides, although many are also presented on in-class worksheets. Students are free to work together or individually during any clicker question. Once student answers are submitted, a graph of student responses is generated and displayed. In most cases, the correct answer is then highlighted on the question slide and an answer analysis is presented either on the slide or verbally. If student performance on a question is poor, I will often re-teach the relevant concept immediately, allowing students to re-submit answers to the question before

showing the correct answer. All clicker questions are posted on WebCT after class along with highlighted answers and answer analysis.

**SECTION 3: EVIDENCE OF STUDENT LEARNING**

Two forms of evidence of student learning associated with the use of clickers are presented here. The first is an overview of student perceptions drawn from mid-semester surveys and end-of-semester evaluations, and the second involves two specific examples of student learning that I believe typify the student learning experience.

In preparation for a Teaching Academy presentation, I gave a survey to my CHEM 112 students near the mid-point of the spring 2008 semester. Students were asked to rate various learning aids in terms of “how beneficial they were to your learning in this class so far.” Results for three relevant learning aids are displayed in Table I. Students clearly perceived all of these learning aids to be beneficial, with 79% rating clickers as either helpful or extremely helpful.

Table I: CHEM-112 Survey Summary (~150 respondents)

Category	Percentage of Responses			
	Not helpful at all	A little Helpful	Helpful	Extremely helpful
Handouts and worksheets	0.6%	7.2%	32.3%	59.9%
<b>In-class use of clickers</b>	<b>3.0%</b>	<b>18.0%</b>	<b>53.3%</b>	<b>25.7%</b>
WebCT posting of notes, handouts, keys, etc.	1.2%	20.0%	28.5%	49.7%

Later that spring, two NMSU instructors visited my CHEM 112 lecture in conjunction with the Teaching Academy’s Peer Coaching program. They engaged students in a dialogue related to the classroom learning environment, and collected a survey of students in which written comments were strongly encouraged. Of the ~130 students who returned this survey, *over 50 explicitly mentioned clickers* in response to the question “What most helps you learn in this class?” Numerous other responses made references such as “working out problems in class” that are closely associated with clickers. In contrast, there was almost no mention of clickers in response to the question “What least helps you learn in this class?” Representative comments include:

- *“Clickers are great because I can instantly know if I’m on the right track or completely wrong.”*
- *“The most helpful things in this class are the clickers and worksheets because they help me to stay engaged in the lecture the entire time. They also help me learn through my mistakes.”*
- *“The way Dr. Smith utilizes the clickers is effective because we get immediate feedback. It’s much better to attempt problems & calculations & figure out what you’re doing wrong than wait to find out on a test.”*
- *“Worksheets and clickers really keep me involved and engaged in the class material. Clickers give instant feedback, which really helps. Also, Dr. Smith is awesome. I don’t know how he makes chemistry fun!”*

These comments highlight two of the obvious benefits of clickers – student engagement in the learning process and providing of learning feedback. The final comment also illustrates how clickers make class more enjoyable for many students.

End-of-semester teaching evaluations for CHEM 112 in the fall of 2007 (before clickers) and spring of 2008 were also analyzed. Since student evaluations in my courses have always been high, my goal was to evaluate whether there were any significant *adverse effects* on student perceptions during the initial clicker

implementation period. In summary, there were not. Students rated the course with respect to “visual aids, handouts, and demonstrations” with a score of 3.82/4.00 in the fall compared with a score of 3.81/4.00 in the spring. Overall course evaluations changed from 3.89/4.00 in the fall to a slightly lower score of 3.72/4.00 in the spring.

Effectiveness of student learning may be demonstrated on a concept by concept basis through analysis of student performance on clicker questions both before and after an instructional segment. Two examples are given here:

- Example #1: CHEM 112 (3/19/2008)

In this example, students were asked to determine the value of the equilibrium constant for the equation

$\text{H}^+ + \text{OH}^- \rightleftharpoons \text{H}_2\text{O}$ ;  $K = ?$  They were already familiar with the reverse of this equation and the value of its equilibrium constant,  $\text{H}_2\text{O} \rightleftharpoons \text{H}^+ + \text{OH}^-$ ;  $K_w = 1.0 \times 10^{-14}$ , and they had been taught previously that when an equation is reversed, the equilibrium constant is inverted. Hence the correct answer to the question is that  $K = 1/K_w = 1.0 \times 10^{14}$ . However, the percentage of students correctly answering this clicker question was only 14%, with the majority of students selecting the incorrect answer that  $K = K_w$ . After viewing this answer distribution, I reviewed concepts related to how reaction direction impacts the value of the equilibrium constant. Upon reopening the clicker question, the percentage of students answering correctly rose to 89%.

- Example #2: CHEM 112 (4/4/2008)

Near the end of CHEM 112, students learn how the pH of a buffer solution is close to the  $\text{pK}_a$  value for the acid component of the buffer, and that buffers are created during the course of any titration involving a weak acid or base. However, students have a common misconception that when a weak base is titrated to its buffer region, the pH is near the  $\text{pK}_b$  value of the base rather than the  $\text{pK}_a$  value of the base's conjugate acid. On this date, students were quizzed specifically on this concept near the beginning of class, with a correct response rate of only 20%. It is quite interesting to see students respond when a performance graph on a question such as this is displayed – they seem almost riveted for a few moments. It is an ideal teaching opportunity that would be lost without the clicker dynamic. In this case, instruction was given immediately following collection of student answers to correct this misconception, but without reopening of the question. Near the end of class, students were required *apply this concept* in a titration curve sketch. The correct response rate on a clicker question related to this concept was 72%, a marked improvement even with some 30 minutes of mostly unrelated instruction between the two clicker questions.

In summary, student response to clickers has been enthusiastic not only with regard to their “enjoyment” of the class but with respect to their self-perception of learning. There is also evidence, on a concept by concept basis, that clickers-assisted instruction is effective in my General Chemistry courses.

#### SECTION 4: RELATIONSHIP TO THE TEACHING ACADEMY

I have participated in three Teaching Academy events related to the use of remote-response devices in the classroom. The first was as a participant in Michele Shuster's presentation “Engaging Students with ‘Clicker’ Technology” (2/26/08). Her presentation expanded my view of how clickers could be used, particularly in “re-teaching” questions, and confirmed that much of what I was doing initially was right. I was also a co-presenter in two Teaching Academy events related to teaching large classes; “Improving Student Engagement and Learning in Large Classes” (3/8/08) and “Teaching Large Classes: Can You Hear Me Now?” (1/26/09). The use of clickers was a central, but not exclusive, topic for both of these presentations.

## SECTION 5: LETTERS OF SUPPORT FROM STUDENTS

In Recommendation for the Teaching Academy Innovation Award

February 19, 2009

To whom it may concern:

It is with highest regards that I nominate Dr. Smith for the Teaching Academy Innovation Award. I had the privilege of taking his General Chemistry 112 course in the summer of 2008. Dr. Smith is an incredible teacher, not only because of his systematic and thorough teaching methods, but also because of his innovative use and vast incorporation of technology into his lectures and coursework.

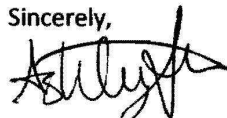
The variety of techniques which Dr. Smith implemented met the demands of all learning styles. Along with each topic expressed in the book, he utilized power point slides to guide lectures. In addition, multimedia, videography, pictures and diagrams were incorporated on a daily basis to further explain concepts and help students visualize reactions. Interjecting "clicker" questions with remote response devices allowed students to utilize new information as it was being introduced and get immediate feedback on answers and progress. This helped to facilitate what areas Dr. Smith needed to spend more time addressing.

Not only was technology a major portion of the success of students in class, but also it was a key in solidifying and mastering concepts outside of class through a program called "Owl" by Thomson learning. Owl is a web-based homework system, which gives students immediate feedback on their work. Unlike regular paper homework, the online homework gave students the opportunity to do each problem as many times as needed until material was learned. Students frequently learn by making mistakes. The program offers explanations for wrong answers, alleviating confusion for students by allowing multiple chances to get the problems right. This allows learners of various speed and levels to learn at their own pace while providing them the same opportunity to learn the material thoroughly.

Dr. Smith's innovative methods of teaching shaped the way I learn and taught me how to be successful in the sciences. I have earned an A in all of my chemistry courses thus far and believe much of that success is from techniques I learned in his class. He organized his lectures into sections and gave worksheets along with the clicker questions in order to ensure students were getting as much practice as possible. Utilizing various resources, Dr. Smith made difficult material tangible to all students.

Furthermore, great teachers are not ones who "give right answers, [rather] pose the right questions"—Claude Levi-Strauss. Dr. Smith not only posed the right questions, he gave us the tools and resources needed to be successful. I was terrified of chemistry and he turned that fear into a love and passion for the field. His dedication and care for seeing students grow is indescribable. His creative use of technology and thorough teaching methods make him the best candidate for the Teaching Academy Innovation Award.

Sincerely,



Ashley Foster

Sarah Prezioso  
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To: Whom It May Concern  
RE: Professor David E. Smith

I am writing this letter to support Professor David E. Smith for the NMSU Teaching Academy Innovation Award. He is one of the best professors I have had or will ever come across, in all aspects of teaching and personality. I had the pleasure of taking his CHEM 111 Fall 08' semester class at the recommendation of Dr. Johnson when I signed up for my first semester of classes, being that I am a freshman. It was then that I found out how great a professor he really is.

What I most admire about Professor Smith is his remarkable ability to stimulate students and add personality to the course material. Students can feel the energy and optimism that he radiates when teaching. His dynamic teaching style makes students listen attentively to him and interact with him via clickers, which in my opinion was one of the best ways to get students to understand the material. The instant feedback that is received shows how well the class is taking in the lesson being taught. And in Professor Smith's class, if the feedback came back as scattered or there was any sign of hesitation or uncertainty emitting from the class, he would go back over what he had just taught to make sure we understood it as a whole. He is also extremely organized; his notes are always available online so that students could print them for further review. The time he spends to give feedback for the assignments helps everyone understand what the most common mistakes were, and provides individual feedback to each student with regards to his/her weak and strong points. He posts the correct solutions online after an assignment so that everyone can track their mistakes and learn from it right away and then he goes through the solutions in class.

Professor Smith does not only teach exceptionally well but he also cares a lot about the level of understanding of each student. He is one of those rare professors that take the extra effort to make sure all students that need extra help are accommodated, despite his busy schedule. I myself have been to office hours plenty of times, and each time he would make sure that I left understanding what I was doing or having obtained the answers to the questions I went to him about. His office hours are not the only time he can be found to answer questions; students can make appointments or just walk to his office for some clarification. He answers e-mails instantly. It is tough to mention all of his amazing qualities here and the ones mentioned above only scratch the surface. But it's safe to say that he is easily one of my favorite professors, one of whom I will continue to visit and ask for help.

We all have to strive to achieve the best. In universities, the effort of a professor makes all the difference in helping students reach their full potential. If we would have professors like Professor Smith teaching everything, then I am positive that every student will be eager to learn and achieve the most even in field that is as rigorous as chemistry.

Respectfully,



Sarah A. Prezioso

2/27/09  
2100 Boise Dr.  
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Dear Sir or Madam,

I would like to recommend Dr. David Smith for the Teaching Academy Innovation Award. Along with being an excellent classroom communicator, he effectively uses technology in his lectures. I took a class taught by him, Chemistry 111, last semester in the Fall of 2008. In it he used clickers and power point presentations. He explained concepts using some power point slides to reinforce the main points. These he would sometimes reiterate on the chalk board, where he would also work through the many calculations. After he explained a concept or problem using this range of media, he would often introduce a clicker question. Usually these questions would be handed out at the beginning of class on a sheet of paper. That way, students could choose to look at the slide on the screen with the question, look at the sheet of paper in their laps, or look at the chalk board where Dr. Smith might be writing the question out again. Generally he explained concepts so well that a good majority of the class usually answered correctly, but if a significant number of students answered wrong, then he would take the time to clarify the concept.

The questions themselves connected well with the lecture and the power point slides, so that we could immediately apply what he had told us. The difficulty level was well suited to the class. Sometimes he would throw in an easy "free-clicker point," but usually the class could complete the questions in the time allotted. Overall, his use of clicker technology enhanced my learning by making the class more interactive. It allowed everyone to respond back to what he was teaching at the moment, instead of class being a one-way communication lecture alone.

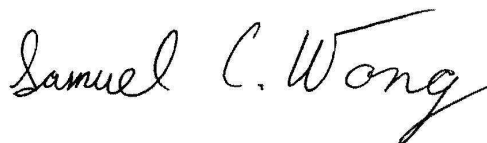
Dr. Smith would also use strings of clicker questions during review sessions. This allowed him to focus review on those areas where the class was most shaky.

A key factor in the class's response to clickers was that he was not very stringent as he graded them. Thus, students could feel comfortable working out the problems themselves and answering with their own best without feeling pressured to get the correct answer from classmates. Dr. Smith encouraged discussion in the class about the questions, but because we did not fear grades. We always understood that he was there to pass the class by learning well.

This semester three of my classes require clickers. In one, the teacher uses the technology almost as well as Dr. Smith, but she seems just a little less familiar with it. In the second, the clicker questions are often interruptions to the lecture. They review important material, but they are sometimes out of context with the presentation. In the last class, clickers are used only for attendance. My wider experience this semester makes me appreciate Dr. Smith's competent use of the technology.

In addition to commending Dr. Smith's use of technology, I am confident to recommend him as a lecturer to any student. He explained concepts clearly, and he had a confident and accessible style. In addition, every other student I talked to who took his class liked him

Sincerely,



Samuel Wong  
Pre-Nursing major