THESIS

ASSESSING THE ATTITUDES OF HOSPITALITY STUDENTS TOWARDS THE USE OF A CLASSROOM RESPONSE SYSTEM (CRS)

Submitted by

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In partial fulfillment of the requirements

For the Degree of Master of Science

Colorado State University

Fort Collins, Colorado

Spring 2010

COLORADO STATE UNIVERSITY

March 26, 2010

WE HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER OUR SUPERVISION BY ERIC MILHOLLAND ENTITLED **ASSESSING THE ATTITUDE OF HOSPITALITY STUDENTS TOWARDS THE USE OF A CLASSROOM RESPONSE SYSTEM (CRS)** BE ACCEPTED AS FULFILLING IN PART REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE.

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ABSTRACT OF THESIS

ASSESSING THE ATTITUDES OF HOSPITALITY STUDENTS TOWARDS THE USE OF A CLASSROOM RESPONSE (CRS)

A Classroom Response System (CRS) is a technology instructors can use to promote active learning. Researchers have shown a number of benefits of CRS use, including anonymous student response, better attendance, increased peer instruction, higher test scores, better grades, and the ability to use contingent teaching methods. Compared to traditional methods, contingent teaching allows instructors to gain real-time understanding of what students know and comprehend. Instructors then can use CRS-based feedback to employ learner-paced instruction.

Previous researchers focused on CRS use in disciplines like math and physics. A literature review did not locate any previous studies about using CRS in hospitality education. Regardless of the course studied, researchers found CRS was most effective when used as a tool to reinforce sound pedagogy. This study investigated the attitudes of hospitality students regarding the technology. The study was conducted over a three-semester period, and was comprised of hospitality students (n=117) in an introductory food science course in which a CRS was used. Students responded to additional statements on standard course evaluation surveys. Students also wrote comments about their CRS experience in this class.

Survey responses indicated students felt CRS encouraged discussion and participation, helped reinforce course concepts, and increased class enjoyment. Additionally, students suggested using CRS in more of their hospitality courses and in more courses university-wide. Students written responses indicated similar opinions as the surveys. Students indicated CRS helped them understand concepts, engage in discussion, and motivated them to attend. Others said using the device was fun and would recommend it to other students and for other classes.

The results showed hospitality students have an overall positive attitude regarding CRS. This research indicated hospitality educators may want to use this technology to enhance instruction. As future versions of the technology evolve to become even more interactive, additional research should be conducted to see how CRS use will change in the future.

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ACKNOWLEDGEMENTS

There are a number of people without whom this project simply could not have been accomplished. I would like to thank my advisor and mentor, Dr. Jeffrey Miller, for his unceasing faith in me as a student and an instructor. I can truly say that without him, none of this would have been possible. I thank Dr. Susan Gould for her invaluable help and guidance, both as a teaching colleague and an incredible resource for a beginning researcher. I would like to acknowledge Dr. Raymond Hogler for generously sharing his valuable knowledge and expertise. I also express my sincere gratitude to Dr. Christopher Melby who, along with Dr. Miller, believed in me enough to give me the opportunity to find my true passion in life.

In addition, I would like to thank all the students who participated in this study. Their feedback and willingness to help were vital to the success of this research. I also thank them for the support, encouragement, and kind words. Teaching them has been the most challenging, rewarding and inspirational part of my educational experience.

To my lifelong friends (especially Eric and 'the boys'): thanks for keeping me sane and grounded. To my unbelievable family: your unceasing love and support have made me the man I am today. To my fiancée Michelle: I will spend the rest of my life showing you just how much your love means to me. I thank you all for your love, support, kindness, and encouragement throughout this process.

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INTRODUCTION

Through time, technology has been used as a tool for education. Whether it was an abacus or a computer, teachers continuously have sought new and different ways to increase student knowledge and understanding. One technology currently utilized to achieve these goals is a Classroom Response System (CRS). Also referred to as an Audience Response System (ARS) or Personal Response System (PRS), CRS encourages student participation and increases classroom interaction. Additionally, the technology allows instructors to gain real-time feedback from students.

A CRS device, often called a "clicker," allows students to respond to questions posed to them by an instructor. There are a number of different types of this device, and many popular brands resemble a handheld television remote control with five to ten response buttons. Most types utilize either a Radio Frequency (RF) or Infrared Radiation (IR) signal to enable the handheld units to broadcast to a receiver.

Each student in the classroom has his or her own CRS device that is synchronized to the student's name or identification number. When an instructor wants to encourage student participation in a discussion, or wishes to assess the level of understanding of a course concept, they present the class with a multiple choice statement or question. Students then respond by pushing one of the corresponding buttons on their CRS device. Each handheld unit electronically transmits each response to a receiving device linked to

a computer. Using interface software, the instructor can immediately view the overall class response to the question. This feedback helps the instructor determine how well the class understands the concept.

There are a number of studies regarding CRS use at the university or college level. A majority of this research examined the technology's use in disciplines such as biology, chemistry, math, physics and statistics. A review of the literature did not reveal any previous studies concerning CRS use in hospitality education. This research was intended to address that gap in the literature.

A CRS had recently been implemented into a hospitality course on this campus. This purpose of this study was to investigate student attitudes regarding the use of CRS in this course. The results of this research can help hospitality educators understand how their students might think and feel about the introduction of this technology in hospitality courses.

LITERATURE REVIEW

Using a Classroom Response System to Promote Active Learning

One reason cited for using a CRS is because it can encourage active learning. Although active learning is difficult to define formally, what it clearly involves is understood.

> "Students must do more than just listen: They must read, write, discuss, or be engaged in solving problems. Most important, to be actively involved, students must engage in such higher-order thinking tasks as analysis, synthesis, and evaluation. Within this context, it is proposed that strategies promoting active learning be defined as instructional activities involving students in doing things and thinking about what they are doing" (1991, p. 1).

Regardless of the methods used to achieve student engagement, the goal of active learning is to encourage thinking and cognitive activity.

Unfortunately, promoting engagement in the classroom can be very difficult. As most instructors can attest, keeping a student's attention for the 50 minute span of the average class session can be a challenge. Researchers have shown that, during a 50 minute lecture, the average student attention can be as little as 15 minutes (Wankat, 2002). This lack of student focus may lead to less retention throughout class sessions. A study focused on measuring retention immediately after a lecture period showed students recalled 70 percent of material presented in the first ten minutes of lecture, but only 20 percent in the last ten (Hartley & Davies, 1978).

Taken in conjunction, these study results are logical. If students are not paying attention, they probably are not cognitively engaged. Without engagement, students' abilities to learn and retain information most likely are compromised. In fact, Mayer suggests cognitive activity is especially effective to promote meaningful learning (2004). These findings illustrate the important instructor task of engaging students in learning.

Active learning can have a significant impact on student knowledge and understanding. Researchers studying 6,000 students found that "interactive engagement" was twice as effective as traditional teaching methods in promoting understanding of course concepts (Hake, 1998). In this study, interactive engagement was defined as teaching methods that involve students in "heads-on and hands-on activities which yield immediate feedback through discussion with peers and/or instructors" (Hake, 1998, p. 65). Laws, Sokoloff, & Thornton (1999) showed that, compared to traditional instruction, active-engagement techniques led to more than a three-fold increase in the number of students who understood a concept. Additionally, Handelsman, et al. (2004) observed when students learn concepts through interaction with instructors and their peers, they are more likely to retain that information and are better able to apply it in other contexts.

Given these results, an instructor might begin incorporating activities into a classroom hoping to produce similar outcomes. Unfortunately, this may not be a successful pedagogical technique. Research shows learning activities should be specifically planned to engage and involve students in the learning process. As Prince (2004) put it:

> "Simply introducing activity into the classroom fails to capture an important component of active learning. [Rather,] the activities must be designed around

> important learning outcomes and promote thoughtful engagement on the part of the student. Adopting instructional practices that engage students in the learning process is the defining feature of active learning" (p. 226).

Researchers have suggested .CRS can promote this active learning style. One way active learning occurs is through classroom interaction. As most instructors can attest, students often are hesitant to speak out or even ask questions, especially as the class sizes increase. When CRS was introduced in a class, instructors reported a dramatic increase in student participation when compared to prior years (Beekes, 2006; Burnstein & Lederman, 2001). One researcher wrote, "In my experience there is nothing that engenders discussion in a large class to the same extent" (Lindenfeld, 2001, p. 82). Additionally, a comparison of CRS implementation studies showed "increased student engagement and participation" was one of the most prevalent findings among instructors (Fies & Marshall, 2006).

Benefits in the Classroom

Anonymous Responses

Another important feature CRS devices offer is anonymity. While the software records each individual student's response, in the classroom these responses remain anonymous. Every student's response is tallied on a histogram and shows up as a vote for that answer; but students have no way of knowing who voted for which response. This anonymity eliminates student anxiety towards answering questions in class for fear of being incorrect in front of their peers. Students reported one of the features that made CRS attractive to them was the personal anonymity of their answers (Draper & Brown, 2004; Nelson & Hauck, 2008; Trees & Jackson, 2007). In one study, 76% of students

responded they would be more likely to participate in a class opinion study using a CRS than simply raising their hands (Robinson & Ritzko, 2006).

When students were asked a question using CRS and one of the possible responses was 'I don't know,' few students chose this response (Draper & Brown, 2004). Research suggests the anonymity of CRS encouraged students to pick a response, even when they were unsure of the answer (Draper & Brown, 2004). Furthermore, once a student chose an answer, the response becomes 'theirs.' This choice gave students an emotional investment in that question, which lead he or she to pay more attention to the solution and any discussion or explanation that followed (I. Beatty, 2004; I. Beatty & Gerace, 2009; Wit, 2003)

Better Attendance

When instructors first began using CRS, many reported increased attendance in their classes without including any further incentive (Caldwell, 2007; Cue, 1998; Paschal, 2002; Wit, 2003). CRS can be utilized further to encourage and reward students for attending and participating in class. In large lecture halls taking attendance is nearly impossible, much less rewarding students who are there regularly. When students answer CRS questions, the interface software allows instructors to know who attended each day. If instructors utilize this feature and give credit for attendance, this can give further incentive for students to attend. When CRS was used in this manner, and linked to even a small portion of student grades (as low as 10%), instructors consistently reported increased attendance (Burnstein & Lederman, 2001; Caldwell, 2007; Nelson & Hauck, 2008)

In addition to attendance, CRS allows participation points to be awarded when students simply answer questions in class. This incentive encouraged students to respond to questions even when they didn't know the answer. Students reported being twice as likely to work on a problem presented in class if they could answer with CRS (as opposed to a show of hands); they were even more likely to respond if credit was given for an answer (Cutts, 2004).

Peer Instruction

Another active learning style promoted by CRS is peer instruction or peer learning. Peer learning can include the class interaction that was discussed previously, or it might involve a more structured peer learning exercise. One example is the *think-pair-share* peer instruction technique pioneered by Dr. Eric Mazur. He used this pedagogy technique in his introductory physics courses at the Massachusetts Institute of Technology in 1991. This technique involved the presentation of a key course concept, followed by a multiple choice question presented to the class. Students were asked to think about the question for a couple of minutes and then formulate an answer. After this, students pair up and each student tries to convince his or her partner of the correctness of their answer. Following this discussion, the class answered the question using a CRS (Crouch & Mazur, 2001).

Data were collected on how students answered these questions before and after discussing the solution with their partners. On average, 32% changed their answers from incorrect to correct, while only 6% changed from correct to incorrect. Given that 40% of students initially answered correctly, the number of correct answers nearly doubled when using this peer instruction technique (Crouch & Mazur, 2001).

Dr. Mazur also found peer instruction techniques could increase test scores. During each semester, every physics student in the program completed a pre and post-test over certain key concepts. When department instructors used a traditional teaching method, they recorded an 8% increase in scores. When instructors used peer instruction techniques, the recorded gains ranged from 14 – 25%, with an average of 19.3%. Additionally, these scores increased in each of the six years the tests were administered, despite five different instructors having taught classes in the department (Crouch & Mazur, 2001).

Other researchers reported similar findings when utilizing peer instruction techniques and CRS in their classes. One such anecdote involved an instructor who was presenting a basic course concept to his class. He believed the class understood what was being taught; but when he gauged their conceptual knowledge using a CRS, he found only about 50% answered the question correctly.

> "For me, this was a moment of revelation. I was not so much disappointed by the result as elated by the realization that for the first time in over 20 years of lecturing I knew, on the spot (rather than after the next mid-term examination), that over half the class didn't 'get it:' had not understood either the question or my presentation of the phenomenon. Because I had already explained the phenomenon as clearly as I could, I simply asked the students to debate briefly with their neighbors and see who could convince whom about which answer was correct. The class erupted into animated conversation. After a few minutes, I asked for a revote, and now over 90% gave the correct answer" (Wood, 2004, p. 797).

While a variety of research points to the effectiveness of peer instruction, many students also find this technique helpful. One student responded that peer learning was effective because he or she heard the explanation from a classmate.

> "You are learning from people around you...maybe someone at the other side of the room [who] understands a lot better than you, or the members of your group, and that [person] starts explaining it" (Boyle, 2003, p. 8).

A different student claimed the reason a classmate's explanation of a topic can be helpful was because peers were "speaking the same language."

> "I think you can learn a lot easier from the people [who] are the same age as you...if they've just grasped it then they can explain it in sort of easier terms than the lecturer...you suddenly understand it when a minute before it was difficult"(Boyle, 2003, p. 8).

When surveyed, another student reiterated the same conclusion.

> "It's a language that you can understand between two students...whereas if its put forward by the professor he knows the deep meaning behind everything – he might make it more complicated than it needs to be" (Boyle, 2003, p. 8).

Even when specific peer instruction techniques are not employed, students reported several other ways CRS use helped them during class. Some liked the ability to compare their responses to the rest of the class (Bunce, VandenPlas, & Havanki, 2006; Draper & Brown, 2004; Nelson & Hauck, 2008). When answering incorrectly, students found reassurance knowing he or she wasn't the only one who didn't understand a concept (I. Beatty, 2004; Draper & Brown, 2004). Students also said utilizing a CRS gave them the opportunity to discuss their answers with fellow classmates (I. Beatty, 2004; Boyle, 2003; Caldwell, 2007; Draper & Brown, 2004; Wit, 2003), and hearing other students' reasoning helped clarify their own thinking (I. Beatty, 2004).

Potential Achievement Gains

Research indicated another potential benefit of using a CRS was an increase in student achievement. Caldwell (2007)correlated CRS use with an almost two-fold increase in the number of students earning an 'A' letter grade. Similar results were seen in classes where students were required to take a 'pass or fail' exam at the courses'

conclusion to measure their understanding. In a study of nearly 4,400 students, the pass rate on these exams increased from about 54% to over 84% (Poulis, Massen, Robens, & Gilbert, 1998). The researchers also found a reduction in the standard deviation of the average scores when using a CRS. So, 30% more students pass the exams using a CRS, and a much more consistent achievement level was observed throughout these classes (Poulis, et al., 1998).

The increased student success in these classes was linked to several reasons. Because CRS instruction utilized a variety of methodologies that differentiate it from traditional techniques (contingent teaching, increased attendance, more student interest and engagement, active learning), isolating any single method to explain these results is impossible. The combination of these methodologies generally is recognized to influence increases in student achievement (Nelson & Hauck, 2008; Poulis, et al., 1998).

Feedback and Contingent Teaching

A principle benefit of CRS use is gaining timely student feedback. When CRS is used as a formative assessment tool, instructors receive immediate feedback as to how well the material is understood. If the class response indicates a clear command of a topic, the instructor can move on to the next topic and know with some certainty that learning or understanding was achieved. However, if responses indicate a lack of subject comprehension, the instructor has a clear indication more time should be devoted to that concept. This style of instruction, called 'contingent' or 'agile' teaching, is an ideal pedagogy for utilizing the immediate feedback CRS provides.

Contingent teaching relies on learner-paced instruction. As described above, teachers pace their instruction according to class needs. When a concept is mastered,

continue instruction on the topic is not needed. Conversely, when a concept proves problematic, more time can be spent addressing the difficulties and class misconceptions. This method can be quite different from a traditional teaching method, or what has been called a 'Ballistic' model (I. Beatty, 2004). In the traditional model, an instructor 'launches' his or her lesson plan and hopes the information 'hits' as many students as possible. Unfortunately, a teacher only really recognizes how well students received this instruction *after* seeing the results of a quiz or exam. By this time, however, it is usually too late for either party to address the problem.

Among the many problems traditional, ballistic-style teaching can create is a "house-of-cards" effect (Poulis, et al., 1998). For instance, an instructor presents a basic concept in a class, but does not know students aren't grasping the topic. When the instructor presents new material building on the previously covered topic, these student have little chance of comprehending a more advanced subject because they still don't understand the basic concepts. With only a shaky knowledge base to build on, students may construct their future learning on misunderstandings or incorrect assumptions. Such a poor foundation could lead to frustration, and ultimately failure. Indeed, a fundamental aspect of effective instruction is addressing student misconceptions (Bransford, Brown, Cocking, & National Research Council (U.S.). Committee on Developments in the Science of Learning, 1999)

Using a Classroom Response System does not Guarantee Success

Implementing and using a CRS is not a panacea that automatically generates educational success. If an instructor just starts to use a CRS hoping to generate the benefits discussed (i.e. attendance, engagement, interaction, active learning, better

grades), he or she may be in for a rude awakening. For example, Van Dijk, Van Der Berg, & Van Keulen (2001) found that simply using a CRS *did not* automatically lead to more student interaction than a traditional lecture. To achieve all of these benefits effectively, CRS should be thought of as a tool to reinforce pedagogical goals and objectives. As Draper & Brown wrote, "The benefit does not depend simply on the technology but on how well it is used on each occasion to promote, through learner interactivity or contingent teaching or both, thought and reflection in the learners" (2004, p. 93).

Simply utilizing a CRS does not guarantee a higher level of student comprehension and achievement. Two studies failed to show significant increases in student test scores when utilizing a CRS (Bunce, et al., 2006; Nelson & Hauck, 2008). However, both studies researchers found the teaching methodology used in these classes may have contributed to these results. In one classroom, the CRS question results were shown automatically to students before the polling period ended. The researchers observed students were not answering questions until they saw their classmates' results, and concluded these students were not actively engaged in solving these problems (Bunce, et al., 2006).

Another study attempted to measure course grade performance by comparing the frequency of CRS use in a class. This study compared a low-use frequency (only 50 times during the semester) with a high usage (about 270 times). The high usage class showed only a minimal gain of about 4% in overall course grades when compared to the low usage class, and only a 3% increase over courses that didn't utilize a CRS (Nelson & Hauck, 2008). However, the researchers found higher average attendance in the high

usage class. The high usage class also showed a significant correlation (at the $p<.01$ level) between attendance and student grades (Nelson & Hauck, 2008).

Student Perceptions toward the Technology

Investigating student attitudes towards CRS use is important. In the Nelson & Hauck (2008) study comparing frequency of CRS use, students in high use classrooms gave significantly more favorable responses to questions such as "The use of [CRS] helps me prepare better for exams," "I learn more as a result of using the [CRS]" and "I remembered lecture material more as result of [CRS]" (Nelson & Hauck, 2008). In the other study, 67% responded they "enjoyed the [CRS] questions," 71% said "The [CRS] questions helped me learn to the material covered in class," and 83% were "confident in my and my partner's answers to the [CRS] questions" (Bunce, et al., 2006). These results support the idea that even though students may not always see an increase in test scores or course grades, they feel like CRS is contributing to their learning and overall success.

As previously explained, formative instruction and contingent teaching are some of the key reasons to use a CRS. However, if an instructor asks a question but chooses not to use the information (by being inflexible in their teaching), the opportunity for contingent instruction is foregone. This not only bypasses a pedagogical benefit, students may be affected detrimentally. Students reported an overall negative reaction to CRS use when they felt like the technology was being used for its own sake and not for the benefit of the class (Draper & Brown, 2004). Additionally, these students wrote the "Main focus of lecture seems to be on [CRS] use and not on course content," and "Sometimes the lecturer seems to be asking questions just for the sake of it" (Draper & Brown, 2004).

Effective Classroom Response System use Incorporates Sound Pedagogy

Researchers have shown an essential key for CRS to enhance pedagogy is utilizing effective questions. Beatty, Gerace, Leonard, & Dufresne (2006) suggested each question is most effective when it is constructed with three specific pedagogical goals in mind: a content goal, a process goal, and a metacognitive goal. A content goal should focus on the question, "What piece(s) of the subject material do we want to illuminate?" (I. D. Beatty, et al., 2006, p. 32). An instructor needs to identifying the specific topic he or she is trying to teach. A process goal focuses on "What cognitive skill do we want students to exercise?" (I. D. Beatty, et al., 2006, p. 32). For example, if an instructor wants students to be able to apply learning, student knowledge must include more than 'just the facts.' They must understand the *how* and *why* behind a concept before they can apply their knowledge in various settings. A metacognitive goal answers the question, "What beliefs about learning and doing…do we wish to reinforce?" (I. D. Beatty, et al., 2006, p. 33). As Beatty, et al. asked, (2006) "Is [it] about memorizing and applying rules and equations or about reasoning and making sense of the physical world?" (p. 33).

Researchers also have shown employing these types of focused questions can lead to increased learning. When instructors posed questions focused on reinforcing course content, they consistently saw increased student performance on quizzes and exams (Gier & Kreiner, 2009). One research wrote, "The only 'rule' for question design is that each question's structure and content reflect specific learning goals" (Caldwell, 2007, p. 19).

The question types that potentially promote the most learning are not easily answered by students. Some researchers recommend questions have at least two answers

that appear 'equally right' to students (Wit, 2003). When students see the results, and two answers are chosen almost equally, this creates an ideal learning and discussion opportunity. At this point, peer instruction (e.g. the *think-pair-share* exercise described earlier) or a class-wide discussion can be extremely effective to clarify these misconceptions. Half the class reinforces their understanding of the topic by explaining it to someone else, and the other half learns the concept *because* they answered incorrectly in the first place.

For this learning method to be effective, the instructor needs to explain the goals of using a CRS. Because the overall objective is student learning, instructors should de-emphasize when student answers are "correct" or "incorrect," instead focusing on the reasoning behind these answers (I. Beatty, 2004; Dufresne, Gerace, Mestre, & Leonard, 2000). This idea can be difficult for students to understand, given that most learning experiences they have had focused on a "right" or "wrong" answer. However, to utilize the technology to its full potential, instructors need to make these learning objectives known to the class (Van Dijk, et al., 2001).

Additionally, researchers have suggested instructors should discourage students from simply guessing. Because no emotional investment is involved in a "guessed" answer, students feel very little connection to that response, regardless of whether they guessed correctly or incorrectly (I. Beatty & Gerace, 2009). To reinforce this idea to students, instructors can present one of the answers as "I don't know" (Wit, 2003). By including this choice, students can still answer a question truthfully, but avoid a guessed answer that holds no value to themselves or the instructor. However, researchers found

they repeatedly needed to point this option out to students, along with explaining the importance of not guessing an answer (Wit, 2003)

Summary

Using a Classroom Response System can have numerous pedagogical benefits. Many instructors began using them to promote active learning and increase student engagement in the classroom. Researchers have found a number of additional potential benefits from using this technology. These include: increased student responses because of anonymity, improved attendance, and peer instruction. Some researchers correlated CRS use with higher grades and increased test scores, but these results were not found universally. This indicated the technology alone is not responsible for these results. Rather, gains in student achievement were attributed to the particular way a CRS was utilized. Based on these findings, effective CRS use should involve sound pedagogical techniques.

METHODS

Participants in this study were hospitality students in an introductory food science class taught at a midsized (25,000 enrollment) university. The class averaged between 40 – 55 students per semester. It was required for all hospitality students and taught by the same instructor during the three semesters of study.

Our department believes its students need a solid foundation in the chemistry and physics of quantity food preparation. This foundation is essential because, regardless of the specific area where students wish to work, each one constantly will deal with food; customers always become hungry and need to eat. These students acquire a fundamental knowledge of how to select, buy, prepare, cook, and serve food. This knowledge should equip students to deal with this challenging aspect of hospitality management.

This class was designed specifically to give hospitality students a fundamental understanding of food principles and applications, such as when they should use baking soda as opposed to baking powder. As listed in the course syllabus, the learning goals of this class were:

- To apply scientific principles to the study of food.
- To relate composition of foods to standard food preparation techniques.
- To apply the function of ingredients used in food preparation with emphasis on the consequences of modifying amounts or kinds of ingredients to meet various restaurant/food service needs, such as cost, customer, and dietary preferences.

- To apply food principles to realistic hospitality management situations.

Several instructional techniques were utilized in this course, including lecture, discussion, group projects, in-class exercises, and in-class group quizzes. Students were expected to read course text chapters prior to the material being covered in class. This was encouraged by having students take open-book, online quizzes over this material throughout the semester. Quiz questions were generated randomly from a large question bank. Therefore, every student received a slightly different version of the quiz.

Students used their CRS device every time the class met, except exam days. The majority of CRS questions were in one of three categories. (1) Formative questions: Used to gauge existing student knowledge of a topic before it was presented in class. (2) Summative questions: Used to measure student understanding of a subject after it was presented in class. (3) Application questions: Used to assess deeper levels of student comprehension. These questions went beyond memorization of facts or figures and investigated whether learners understood how and why things work. CRS also was used in this class to facilitate contingent teaching. A more specific example of how contingent teaching was utilized is included in Appendix C.

The research data for this study were collected for three consecutive semesters of this class, beginning with Fall 2008. The study's aim was to focus on hospitality students' opinions, so only data from students in this major were analyzed

Data were collected using end-of-semester student course survey forms. Along with the likert-scaled statements already presented on these forms, participants were asked to respond to additional statements regarding the use of CRS in the classroom (See Appendix A). Students were also asked specifically to provide written comments

regarding CRS use in the classroom. Data collection followed Colorado State University (Institutional Review Board) IRB regulations for limiting potential physical and/or psychological harm when researching human subjects. A letter was read to students stating the potential risks of the study. The letter explained student participation was voluntary and would not affect their course grade in any way (See Appendix B). As per university regulations, the instructor was not present in the room while course survey forms were completed or collected. The instructor was not given access to the survey results until after grades were assigned.

RESULTS

Results comprise students' opinions regarding CRS use in this course. The results consist of responses to the additional statements on end-of-semester student course surveys, and student written responses. The likert-based responses, which make up the quantitative data set, are presented in Table 1. The written student responses produced the qualitative data. The quantitative and qualitative data were complementary, and many written student responses were linked thematically to the statements presented in Table 1. Each additional survey statement is discussed further (hereafter referred to as S1 – S6), along with additional themes that emerged from the qualitative data.

As these data were collected on student course survey forms, some written responses reflected personal feelings about the instructor. When necessary, responses were shortened or omitted to only include information pertinent to CRS use.

As the study used a likert scale and not an ordinal scale, the researcher did not attempt to analyze the different levels of student agreement or disagreement to the additional survey statements. A level of agreement is indicated by both 'agree' and 'strongly agree' and a level of disagreement is indicated by both 'disagree' and 'strongly disagree.' Attempting to further ordinalize those terms after gathering student responses would be unfounded. Additionally, because agreement or disagreement were presented as individual categories, the researcher felt the addition of levels within these categories unnecessarily convoluted Table 1.

Table 1: Responses to Additional Statements on Student Course Survey

Please note: The terms 'i>clickers' or 'clickers' represent the brand of CRS used at this study site.

Statement Number	Additional Survey Statement	Students Agree (%)	Students Neutral or Undecided (%)	Students Disagree (%)
S1	The i>clicker questions were helpful in reinforcing course concepts.	93.1	6.0	0.9
S2	Using the i>clicker encouraged me to participate in classroom discussions.	88.8	6.9	4.3
S3	Class discussions were helpful in reinforcing course concepts.	88.8	9.5	1.7
S4	I enjoyed using i>clickers in this class.	77.3	13.3	9.4
S5	I would recommend the use of i>clickers in other classes in this department.	84.0	10.7	5.3
S6	I would recommend the use of i>clickers in other classes at this University.	86.3	11.0	2.7

Students responses were based on a 5-point likert scale, with 1=strongly agree and 5=strongly disagree. A response of 3=neutral or undecided. Student responses of 1 and 2 were combined to show general 'agreement' with the statement. Likewise, responses of 4 and 5 were combined to show 'disagreement.

Reinforced Course Concepts

Over 93% of students responded that CRS helped reinforce concepts presented in this course [S1]. This idea was further confirmed in students' written comments.

- "The i>clicker questions help reinforce concepts."

- "I like the fact that the i>clicker points counted towards participation & didn't penalize you if you missed a question. The i>clicker questions also helped reinforce concepts and got you engaged in class."

Thematically similar to the idea of reinforcing concepts is the notion that CRS use helps increase student knowledge or understanding in the course. Examples of this repeatedly show up in the written comments.

- "The (i>clicker) helped to increase my knowledge."
- "I loved using the i>clickers & thought it was a great way to help students understand the information better. I also thought it was a great way to stay participated [*sic*] in class."

Encouraged Classroom Discussion

Almost 89% of students responded that CRS encouraged them to participate in classroom discussions [S2]. An identical percentage also responded that class discussions helped reinforce course concepts [S3]. Inductively, these concepts can be combined to say that 89% of students felt CRS encouraged them to participate in class discussions, and these discussions helped reinforce course concepts. The written responses further corroborate these ideas, with multiple students saying that CRS encouraged discussion, and helped them stay active and involved in the learning process.

- "The i>clicker helped me participate."
- "I loved having the i>clicker. It was a great way to stay involved in the learning."
- "I feel that i>clickers in the class increase vocal class participation."
- "The i>clicker was helpful because we figured out the answers on our own and it maintained focus."
- "i>clicker questions were great! It thoroughly helped my understanding of subjects and encouraged me to engage in discussion."

These responses support research in which instructors reported CRS use made students more likely to ask and answer questions (Beekes, 2006; Elliott, 2003).

Recommendations for further use

The vast majority of students (84%) said they would recommend using CRS in other department classes [S4], and over 86% recommended using CRS in other university classes [S5]. The student's written comments substantiated these ideas.

- "[I] would recommend using i>clickers again."
- "The clickers were nice to see what other students thought & where we stood as a class. I recommend them for everything."

Enjoyment of use

Over 77% of students responded they enjoyed using CRS in this class [S6]. Written comments further attest to this idea.

- "[I] enjoyed i>clicker use in classroom."
- "i>clickers were fun."

While simply using a CRS can contribute to the overall fun of a class, it can also be employed in specific ways to purposefully increase enjoyment. For instance, when talking about emulsifiers, a common example is to discuss mayonnaise (an emulsified mixture of lemon juice, oil, and egg yolks). Along with talking about how egg yolks work to form a stable emulsification of oil and water, the following question was presented:

> "True or False: The competitive eating record for mayonnaise is four 32 ounce jars in eight minutes."

This question usually elicited disgusted looks and comments like "gross" or "sick." However, it was also designed to evoke discussion and try to make the class more fun.

While overuse of these question types of could take away from the learning experience, their occasional inclusion seems to fulfill their purpose, as evident by this written response:

- "The funnier options using the i>clicker (i.e. absurd answers and fun questions) made the class more enjoyable."

Attendance

A theme that emerged from the written responses, which was not included in the additional survey statements, was attendance. Many students indicated that CRS use motivated them to attend class. Students received points when they attended and used their CRS to answer questions, which accounted for nearly 25% of a student's overall class grade. Many students indicated this was a great incentive to attend class sessions.

- "[I] really liked the i>clickers because we got points for going to class."
- "I love classes where you are rewarded for coming."
- "The i>clicker motivated me to come to class."
- "I liked earning points for coming to class. It makes it fairer [*sic*]."

However, one student responded that having almost 25% of their grade based on attendance and/or participation was too much.

- "I wish so much of the grade wasn't based on coming to class though."

This response was a good indication that while many students enjoyed being rewarded for regular class attendance and participation, some might find this practice restrictive.

DISCUSSION AND CONCLUSIONS

Discussion

The results indicated an overall positive student attitude toward CRS use in this class. It also indicated CRS use helped achieve many of the desired outcomes found in the literature. Because the main reason a CRS was implemented in this class was to serve as a pedagogical tool to enhance learning and understanding, it was encouraging that students viewed it as a means to achieve these things. Additionally, a CRS was chosen for this class in hopes of increasing active learning. As seen in the literature and through personal experience, attaining discussion and active involvement in the classroom can be difficult. Responses indicated CRS use was helping to accomplish these course goals. Additionally, while CRS may not have been designed to increase student enjoyment, data indicated they have the capability to achieve this end.

The data identified some unintentional gains achieved through CRS use. When the technology was initially considered for this class, increasing attendance was not an implementation goal. Certainly, having almost 25% of their course grade determined by attendance and participation may have contributed to this finding. This benefit appeared to be well received by most students, and is certainly welcomed by the instructor. Pedagogically speaking, increased attendance may result in improved student knowledge and understanding of course concepts.

Conclusions

As previously stated, these results indicated hospitality students had a positive attitude towards CRS use. This finding could be important for hospitality education as the literature review did not produce any previous research on CRS use in this field. Knowing this, hospitality educators can investigate how this technology might enhance future instruction. A number of hospitality courses are offered on this campus. Based on survey responses, students would welcome CRS use in these other classes. Likewise, hospitality educators at other learning institutions might find this research helpful when they consider utilizing or upgrading technology in their classrooms.

Additionally, many students responded they would like to see CRS used in more classes at this university. This desire has already begun to be realized. Remarkable growth in CRS use on this campus has occurred over the past few years. During fall semester of 2006, CRS were used in only 10 classes. By spring semester of 2009, that number increased to 71 classes or sections using the technology. In the last full academic year (2008/2009), the campus bookstore sold over 7,100 CRS units to students. That number is roughly 28% of students at the university. Additionally, since they were first used on this campus in 2006, the bookstore has sold over 15,000 new and used CRS units (Gearhart, 2009, personal communication). This does not include the multitude of students who purchased their CRS devices online or from friends.

Limitations

Some limitations to this study included selection issues. Two different instances of forced selection were observed for this research. The first occurred because the technology was considered required material for the class. Students were expected to

purchase their CRS devices ($35 dollars at the university bookstore) and bring them to class. As mentioned earlier, students received almost 25% of their grade from daily CRS use. The second instance of forced selection occurred because the course being studied was required for all university hospitality students. Additionally, no other sections or instructors of this course were available for hospitality students. Students, however, were specifically given the option to decline participation in the research. Throughout the three semesters this research was conducted, every student agreed to participate in this study.

Another potential limitation was restricted amount of space and time for written student comments. The space for written comments on the student course surveys was less than half of a regular sheet of paper. Additionally, when the survey was given at the beginning of class (the lecture/discussion would follow completion of the survey), students may have felt pressured to limit their written comments if the rest of the class had to wait for them to finish.

Implications for Future Research

With such a deluge of research demonstrating the many positive gains of CRS use, the technology has established itself as an important pedagogical tool. As more and more instructors use CRS, seeing how this technology changes their classrooms would be interesting. An idea for further research might be to conduct a mixed-method, longitudinal, campus-wide study of attendance, student performance, and instructor attitude. This research could investigate a number of aspects of CRS use, including: Identifying any potential demographic grouping of instructors opting for/against CRS, looking for correlation between student demographics and enjoyment or attitude

regarding the technology, investigating how, or even if, the technology is promoted by the university to instructors. This type of study could provide a more complete picture as to how the technology may impact both learning and teaching on this campus. Additionally, this type of research might illustrate further the effects of adopting CRS as a pedagogical tool.

As technology continues to grow and change, CRS will reflect these advancements. Even with the success CRS has already seen in the classroom, some feel the present state of this technology is just the tip of the iceberg:

> "I believe there is an excellent case to be made that current response systems represent only the first, humble step in an exciting, but as yet little explored territory of pedagogical tools that have the power to transform teaching and learning in formal education" (Abrahamson, 2006, p. 2)

There are already concerns with inherent limitations existing in the present versions of the technology. Some CRS opponents criticize it as a learning tool because it does not allow for free response. Many popular versions of the technology only give students a limited number of responses which to choose from, all pre-selected by the instructor. Successfully using existing versions of a CRS may rely on the instructor's ability to properly predict troublesome concepts and ideas. Incorporating some form of free response into the technology might help assuage these concerns.

Furthermore, with the continued growth of personal instant communication (text messaging, instant messaging, twitter, etc), it may only be a matter of time before CRS evolves to use these technology types. Some instructors have started to use text messages as a way to poll their students. By using websites that collect and display text messages in real-time, instructors can receive more information from students than with current versions of a CRS. As CRS technology incorporates these advances, further research will

be needed to understand how these changes affect pedagogical strategies and outcomes. Additionally, as CRS use increases on campuses and schools across the world, many researchers and educators are anxious to see which technological advancements will help CRS grow and evolve into an even more personalized pedagogical instrument.

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APPENDIX A

Additional Student Course Survey Statements

Please answer the following questions on Part II of the student course survey.

I consent that my survey answers and written responses on this survey can be used for research purposes.

Yes, I consent - Answer (SA) Strongly Agree

No, I do not consent – Answer (SD) Strongly Disagree

The following components were helpful to reinforce course concepts:

RamCT quizzes

Strongly Agree Agree Neutral/No Opinion Disagree Strongly Disagree

Final Group Projects

Strongly Agree Agree Neutral/No Opinion Disagree Strongly Disagree

Exams

Strongly Agree Agree Neutral/No Opinion Disagree Strongly Disagree

In-class learning activities (e.g. meat-cooking exercise, menu planning, flour mixture components, quick/yeast bread activity)

Strongly Agree Agree Neutral/No Opinion Disagree Strongly Disagree

S3) Class discussion

Strongly Agree Agree Neutral/No Opinion Disagree Strongly Disagree

S1) i>clicker questions

Strongly Agree Agree Neutral/No Opinion Disagree Strongly Disagree

Please answer the following question regarding the use of i>clickers in this class:

S2) Using the i>clicker encouraged me to participate in classroom discussions.

Strongly Agree Agree Neutral/No Opinion Disagree Strongly Disagree

S4) I enjoyed using i>clickers in this class.

Strongly Agree Agree Neutral/No Opinion Disagree Strongly Disagree

S5) I would recommend the use of i>clickers in other classes in this department.

Strongly Agree Agree Neutral/No Opinion Disagree Strongly Disagree

S6) I would recommend the use of i>clickers in other classes at CSU.

Strongly Agree Agree Neutral/No Opinion Disagree Strongly Disagree

Please provide constructive written comments:

- What worked?
- How could the class be improved?
- Any additional comments regarding i>clickers in this class

APPENDIX B

Letter of Informed Consent

Thank you for participating in this study. The overall goal of this project is to assess student attitudes regarding the use of Classroom Response Systems (referred to hereafter as i>clickers) in this class.

While completing your normal course student course survey, you will be asked to complete survey questions and/or provide written information. I would ask that you fill out your responses to these questions in Part II of the student course survey, and provide any written comments in Part III. In addition to answering these questions, you will be asked to provide your consent to the use of your answers in this research. If you choose to answer the questions, but deny your consent for this research, your answers will only be used for course evaluation and improvement. Answering the questions should only take an additional 1-5 minutes of your time.

Your participation and constructive comments will help us assess student attitudes regarding the use of i>clickers. Specifically, we are hoping to evaluate their use in hospitality education. This information may lead to recommending the use of i>clickers in other classes in this major, department, and/or university. It may also lead to recommending the use of i>clickers in hospitality education at other colleges, universities, and educational institutions.

This project is for educational research only. There are no known risks. It is not possible to identify all potential risks in a research study; however, we have taken reasonable safeguards to minimize all known and potential, but unknown, risks. Your participation in this research is voluntary and will not affect your class grade in any way.

Additionally, this research is not tied to the traditional student course survey questions. Your decision to answer these questions will not affect your student course survey. As per university policy, I will only be given access to course surveys after your course grades have been submitted. You may stop participating at any time without penalty or loss of benefits to which you are otherwise entitled.

All information given by you will be confidential and used for research purposes only. No one will have access to any identifying information, such as name or major, except the investigators and the educators, and your name will not be used in any data analysis. Final reporting for the project will not disclose any names or other identifying information in order to maintain confidentiality.

The Colorado Governmental Immunity Act determines and may limit Colorado State University's legal responsibility if an injury happens because of this study. Claims against the University must be filed within 180 days of injury. Questions about subjects' rights may be directed to Celia S. Walker at (970) 491-1563.

Please feel free to contact any of the persons below if you have any questions regarding this project.

Dr. Jeff Miller, PhD., C.C.E., C.E.C.
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APPENDIX C

Contingent Instruction Example

During the second semester teaching this class, I enhanced my use of CRS. Specifically, I began to incorporate Review/Clarification questions into my teaching. These questions were based on the results of required weekly online quizzes. In an effort to encourage students to read the textbook chapters we would cover in class the next week, they were assigned a weekly quiz over this material. These quizzes were generated randomly from a large bank of questions, ensuring that every student took a slightly different version of the quiz.

If any particular question proved difficult (usually meaning it was answered incorrectly by 50% or more who saw it), I assumed the rest of the class might also struggle with this concept. So, I began to incorporate these questions into my teaching material. Specifically, when we came to this concept in the lecture, I would ask this question of the entire class. This afforded those answered the question correctly to clarify the concept to students who answered incorrectly, or who did not see this question on their quiz.

At first this technique led to a considerable amount of misunderstanding in the class. I labeled these questions "Quiz Review," which I believe confused several students. Many who did not have the question on their quiz would often express this concern. I repeatedly had to explain that students who *did* have this question struggled with the concept and I assumed the rest of the class might have the same issue.

Even though this technique reduced the amount of lecture time in the classroom, I found it was highly effective in enhancing my contingent teaching. Additionally, I

believe it illustrated to students all of these teaching methods can work together towards the common goal of increasing understanding. Personally, it also further illustrated the need to remain flexible and open to new instructional ideas.