

How to Best Use Clickers (CPS) As an Assessment Tool

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Last summer at TIE I attended a workshop led by two science teachers from Boulder Valley. They were demonstrating the use of 'clickers' in high school classrooms. I was immediately fascinated by their use. It was so exciting for me as an adult to use them that I instantly saw how they could motivate and engage students. When we returned to school this fall I spoke with my principal about the systems. Coincidentally, my principal had just attended an administrator meeting at the district level where they were surveyed using the CPS. She was very enthusiastic about trying to help me introduce them to ThunderRidge. I then contacted eInstruction and had one of their reps out to the school to demonstrate the system. I have also had a "loaner" set in my classroom since October and have learned how to use most aspects of the system.

Since their implementation in my classroom, I had become concerned with a few aspects of the system. I wanted to make sure that I was using the systems to their fullest potential and that the students were not only having fun while using them, but that they were being used as an effective assessment tool. **I had noticed that students were easily able to cheat off their classmates simply by looking at what others were answering. I was also concerned about the effectiveness of formally assessing students using only multiple-choice questions. I believed that if I did not address the issue of how to use them effectively for formal and informal assessments that I may not have been accurately assessing what my students really knew.** I had noticed an increase in the overall grades of some of my lower achieving students since I implemented the system, but I was concerned that the increase was either due to cheating or good guessing on multiple-choice exams.

Background

I teach Spanish IB, II and III at ThunderRidge High School in Highlands Ranch. I have students from all four grade levels in each class that I teach since language classes are elective courses at our school. My smallest class has 18 students and my largest class has 29 students. ThunderRidge is a part of Douglas County School District. Douglas County is a fairly wealthy district that is well funded. We have a very high graduation rate (94.7%). Most of the students who graduate from ThunderRidge go on to some sort of higher education.

Because our district is concerned about providing our students with the best and newest technology to help increase student involvement and achievement, I found myself in an interesting position concerning the use of the clickers. Since I was the first person in my school to use the systems, I had become the in-building expert on the systems and their uses. I had found this to be a particularly precarious position since I had never had formal training on the system and the software. I wanted to make sure that I knew how to best recommend their use to my colleagues. I recently led 3 hour-long in-service sessions demonstrating the basic uses of the clickers. During these in-service sessions, I found that my knowledge concerning uses of the software was lacking. I currently have been using the system to assess students both formally and informally using "teacher managed" assessments which means that everyone in the class has answered the same question at the same time before moving on to the next question. While this had not been particularly concerning when I had informally assessed my students to see how they are progressing, it became a concern while formally assessing them since I felt as though it was too easy for the students to cheat.

I also was concerned that their grades had been inflated due to the multiple-choice format. I had been using the CPS in all of my classes for reading quizzes

and thought that my students did not have to read as carefully as they had previously due to the test format. Since many of them can oftentimes “guess” the correct answer they did not read for detail. Previously I would use an overhead to put up the quiz questions that the students had to answer in complete sentences. With the clicker quizzes, many of them did not have to read as carefully because it was simply easier to determine the right answer when you had some choices rather than using open-ended questions. I recently had to give my level 3 classes a reading quiz the “old way” (on the overhead) and found many of them complained about the scores they received. They claimed they liked the clicker quizzes better “because they were easier”.

Since I had become the leader of this technology in my school, I wanted to make sure that I was able to use them in an effective manner. I also wanted to make sure that I was using them to assess what my students really knew, not what they could guess. The purpose of my action research was to determine if clickers were best used as formal or informal assessment tools. I also hoped to learn how others were using them to assess higher level thinking skills using the multiple-choice format. Exploring the different testing options the software offers provided me with more testing options as well.

Research Questions

1. How do clickers compare with more traditional ways of formal assessments?

I needed to determine if student achievement increased when students used clickers rather than responding to questions delivered via other methods. For example, were my students scoring higher on reading quizzes when they used the clickers or when they were required to respond to questions on an overhead?

2. What other testing formats are available for use with the CPS?

I needed to learn more about the testing options and systems available with the clickers. This allowed me to determine if there were ways to decrease academic dishonesty while using the clickers during formal assessments.

3. How can I use the CPS to ask higher-level questions since they are formatted to assess using a multiple-choice format?

In order to determine how to accomplish this, I spoke with other teachers who are more familiar with the systems. Researching the literature that is currently published on the systems also helped me answer this question.

4. How can I eliminate/prevent students from cheating on assessments while using the CPS systems during formal assessments?

I needed to explore the different testing formats that the system offered to see if there was a way to assess students at their own pace rather than as an entire class.

Method

Since my action research was mainly focused on how to best use existing software as well as solving instructional problems associated with that software, my study was an implementation project. In order to compare traditional methods of assessment with the clickers, I implemented a variety of testing formats in my third period Spanish 3 class. In order to keep the tests consistent, I tested over reading comprehension for both the traditional assessments and the clicker assessments. All tests were given in either multiple-choice or matching format in order to keep the testing format consistent across both traditional and clicker methods as the clickers tests were not able to test for short answer or essay questions.

In order to compare the achievement scores of my third period class, my fourth period Spanish 3 class took all of the same assessments in traditional testing

formats. This enabled me to use my fourth period class as a comparison group to the third period class that used clickers for the majority of the assessments. The other focus of my research was to determine which testing format available within the clicker software was best to use in order to keep students honest. I gave weeks two and three of clicker tests using the teacher-managed assessment. When assessments were given in this format, the entire class worked at the same pace. Week four assessments were given using the student-managed assessment option where each student worked at their own pace. At the end of the assessments, I surveyed the students about how much they cheat using the clickers and whether or not a certain format helped to prohibit that behavior.

Participants

The classes that participated in my action research were Spanish 3 classes. All of the students in those classes have studied Spanish for at least three years and therefore have a strong base of knowledge. There are 18 students in the third period class, which is actually a very small class for ThunderRidge as the rest of my classes have at least 26 students. There were nine female students and nine male students. It was a mixed grade class with five seniors, eight juniors and four sophomores. The class average at the beginning of the case study was an 84.2%.

My comparison group was also a Spanish 3 class. As with the third period class, all of the students in this class had studied Spanish for at least three years. This class was slightly larger, so in order to make the comparison group similar, I used the data from 9 males and 9 females from fourth period rather than using the data from all 26 students in that class. Their class average at the beginning of the study was an 85.2%.

I also interviewed other technology professionals in order to gain insight on how to ask higher order level questions using the clicker systems. Len Scrogan,

the director of technology for Boulder Valley School district, modeled for me how to ask these sorts of questions in a multiple-choice format. I also worked with Steve Huff from eInstruction in order to learn more about the software and the testing formats. The final group of people that I consulted with during the study was our district's technology team. Our district has recently taken an interest in purchasing these systems, and by interviewing the technology team I was able to ask their opinions on the software and its formats.

Data Collection Procedures

Before the testing of my classes begins, I attended a Clicker II workshop in Boulder given by Len and Steve. The two objectives of the workshop were to learn more about the systems and to learn how to ask higher level thinking questions using multiple-choice or matching formats.

In order to make the tests consistent in format and material covered, all reading assessments were given over stories in a book series (Leyendas Lationamericanas) that is a part of our district's curriculum for Spanish 3. The stories were purposely grouped together due to similar vocabulary and difficulty level. By using the same book, but different stories from the book, I was able to keep the content that I tested the same throughout the four weeks.

During the first week of testing the students were given two quizzes using traditional methods. The first was given on an overhead and the second was an individual test on paper. I also met with the district technology team on March 1st to conduct an interview about their knowledge of the systems.

The second week of testing I used the clickers to administrate two other exams delivered in the teacher-managed assessment mode.

For the third week of testing I again used the clickers to assess the students while making sure to write the tests using higher order thinking skills. I had recently attended a workshop that focused on teaching instructors how to use the clicker systems effectively with these sorts of questions. I compared the

results of the second week of assessments in which “knowledge” level questions were given to the higher level thinking question test in order to measure student achievement. I also surveyed the students in order to determine which of the clicker tests they feel better tested their reading comprehension.

The last week of the study I assessed the students using the student-managed assessment option in which each student worked at their own pace. I felt that this option would help eliminate some of the cheating that I felt was currently happening since I had previously used the teacher-managed assessments in which the class worked at the same pace. I surveyed the class after that week of testing in order to determine which testing format worked best to deter academic dishonesty.

Data Analysis

During these three weeks of study I kept track of each student's scores on all quizzes using an excel spreadsheet. All reading quizzes were worth ten points. I logged class averages on each quiz from both Spanish 3 classes. At the end of the case study I compared the averages of each traditional test to the averages of both types of clicker tests (student managed and teacher managed). I collected and displayed data from the surveys into tables to help me determine which tests the students felt best tested their knowledge. The survey about which sort of test is most likely to lead to academic dishonesty was also tracked in tables. These spreadsheets were used to display and graph the information acquired during the study.

Timeline

February 28th-March 1st

- Week one of testing using traditional methods
- Researched literature on higher level thinking questions and clickers
- Met with Douglas County Technology Experts to discuss classroom uses and find out what they could tell me about assessments.

March 7th-March 11th

- Week two of testing used teacher managed clicker assessments
- Continued researching literature

March 14th-18th

- No testing due to CSAP
- Finished research of literature

March 21st-25th

- Week three of testing using questions designed to be higher order thinking questions

March 28th-April 8th

- Week four of testing using student managed assessments
- Compiled and entered data into excel

April 11th-April 15th

- Analyzed data
- Compiled final report, findings and impacts of case study

Environmental Impact

Since I had been using the systems for a few months I was already well aware of the increase in student involvement and the enthusiasm that they brought to my classroom. I had been placed in a leadership role of sorts within our building concerning the technology and I was anxious to be able to offer sound advice on how to best use the systems. Within my own classroom this case study improved the way in which I used clickers to assess my students. The results of the study allowed me to compare student achievement on traditional tests to achievement on clicker tests. I was also able to determine the best sort of tests to deter cheating when using the systems. I knew that the systems are valuable, and since I completed this case study I now know how to best

implement their use especially with respect to formal assessments. Because of this study I am able to use the clickers more efficiently and effectively in my classes.

Possible Future Actions

Our school and administration have already begun to discuss the purchase of these systems. I feel as though Douglas County is technologically behind both Cherry Creek and Boulder Valley schools in the implementation of this technology. I also believe that our district technology team is taking an increased interest in the clickers for many of the reasons that many of the other larger school districts have begun to use them. They increase student involvement, they allow teachers to assess kids with more frequency and less paper work and most importantly they give us the ability to assess our students both for learning and of learning. This study has allowed me to be a sound leader during our district's adaptation of the clicker systems.

Findings

Since the conclusion of my action research, I am now able to answer all of my research questions. My literature search also helped to answer all four of my questions in some capacity. The findings below are from my case study and student surveys. The one aspect of my research that was not as helpful as I had hoped was the interview with my district's technology staff since I knew more about the clicker systems than they did. The rest of my findings to my questions are listed below.

1) How do clickers compare with more traditional ways of formal assessments?

After comparing my third period class that took only two traditional tests and six clicker tests to my period 4 class that took all of their reading tests via traditional testing modes, the overall averages do not indicate that clickers are necessarily a better testing format than traditional tests. The class average from period three was a 6.1 and the class average from period 4 was 6.0. We can conclude that the .1-point increase in achievement means that simply using a different means to administer the exam will not necessarily improve achievement. (See graph 1 in the appendix)

The one set of data that makes a possible argument for using the clickers over traditional tests is the comparison of third period's averages across all types of tests. Their class average for the traditional tests was a 5.6 %. When this class used the clickers they achieved slightly higher test scores. When using the teacher managed assessment mode, their class average was 6.4% and when using the student managed assessment mode they scored an average of 6.7%. Their scores dropped again while using the clickers for the higher order thinking questions quiz, but I believe those simply to be more difficult tests since they require the students to think on a different, more complex level. This data tells us that the students' scores increased by about 1 point when using the clickers instead of traditional tests. (See graph 2 in the appendix)

Part of the reason for the slight increase in achievement while using clickers in third period may be because students prefer to take the clicker tests than traditional tests. When the students were surveyed, 90% of the respondents indicated that they preferred clicker exams to traditional exams even though 48% of the class said they felt both tests to be equally "difficult". This suggests that although achievement may not increase greatly by using the clickers, student engagement during the exam does increase and makes testing a little more enjoyable. (See Survey results in the appendix)

2) What other testing formats are available for use with the CPS?

Part of my research allowed me to test the 'student managed assessment mode' available on the software. Previously I had used the 'teacher managed assessment mode' in which all students responded to the same question at the same time. The questions in the teacher managed mode had to be typed into the CPS software and were displayed with a projector along with the CPS bar that allows students to see who has answered the question. Using this mode, we all had to wait until everyone in the class had responded before moving on to the next question.

The student managed assessment mode is much more conducive to formal testing for two reasons: 1) Each student has their own copy of the exam and 2) Students are able to work at their own pace. Since each student has their own copy of the exam using this mode, it was a much faster way to create exams since I typed them in Microsoft Word first rather than the CPS software. I also think that this mode discourages academic dishonesty since every student works at his or her own pace. When I surveyed my students about the testing formats, 65% of them said that it is more difficult to cheat on the student-managed assessments.

3) How can I use the CPS to ask higher-level questions since they are formatted to assess using a multiple-choice format?

As part of my research for this study, I was able to attend a "Clicker II workshop" in Boulder led by Len Scrogan from Boulder Valley Schools and Steve Huff from eInstruction. The workshop was extremely helpful in providing strategies on how to ask higher order thinking questions within a multiple-choice format. The following are all questioning techniques I learned at the workshop that are presented in multiple-choice format and also require higher-level thinking:

Multiple Choice Questions:

1. Construct items in a form different from that originally presented.
2. Use novel pictorial materials to measure principals that require students to apply knowledge.
3. Provide for a condition contrary to fact.
4. Use analogies to measure relationships.
5. Select examples of principles or concepts.
6. Discover relationships among similar topics.
7. Identify assumptions and analyze criteria.
8. Use charts and tables.

Matching Questions

9. Match examples with terminology.
10. Use novel pictorial material

True-False and Yes-No Questions

11. Require students to respond to new situations
12. Students are presented with a problem situation and are asked to justify conclusions from data.

Multiple Choice, True-False, Recall and Check All That Apply Questions

13. Learners respond to a simulation-like question that presents a brief realistic scenario, highlights a real-world cause-and-effect relationship, and asks learners to make a decision to display their understanding of this relationship.

I used strategy number 2 (Use novel pictorial materials to measure principals that require students to apply knowledge) for two clicker tests in order to see if my students noticed a difference between the two types of testing (higher order

thinking vs. simple knowledge level questions). The class average in period 3 was lower than the other clicker tests, but I believe this is due to the fact that the tests were more challenging and in a format that the students were not accustomed to. The students in fourth period actually increased their achievement slightly on the higher order thinking tests in comparison to the first set of exams given. (See period 4 data in the appendix)

When I surveyed my students to see if they had noticed a difference in the two sorts of tests (knowledge based questions vs. higher order thinking questions) 85% said they had noticed a difference in the two kinds of exams. Fifty-eight percent said they felt the higher order thinking tests to be more challenging than previous tests and 43% said they felt that the higher order thinking tests most accurately tested what they really learned about the readings (39% said each group of tests equally tested their learning and only 18% thought the knowledge level questions most accurately reflected their learning). (See Survey results in the appendix).

4) How can I eliminate/prevent students from cheating on assessments while using the CPS systems during formal assessments?

My literature search was very helpful in answering this question. (See literature review in the appendix) One way most professors who use clickers at the college level is to have their policy concerning clickers and cheating in their syllabus. Douglas Duncan, a CU professor, addresses the cheating problem in his book Clickers in the Classroom: How to Enhance Science Teaching Using Classroom Response Systems. Duncan feels that in order to prevent dishonest student behavior while using clickers, that instructors discuss their expectations of clicker use at the beginning of the terms. He states, "Tell them what you consider cheating when using clickers." (Duncan, 2005) I believe this to be very sound advice and a necessary precaution at the beginning of the year in order to make your expectations concerning academic honesty very clear to all students.

The results of my student surveys concerning academic dishonesty were very helpful when deciding which testing format works best to discourage cheating. The results were also very disheartening to me as well since so many of my students admitted to seeing cheating and even cheating themselves while testing with the clickers. A shocking 87% said they had observed another student cheating with the clickers since we began using them in class. When asked if they had cheated while using the clickers, 40% responded that they had. (See survey results in the appendix)

The students also said (65%) that it is easier to cheat on the tests where everyone clicks in at the same time (teacher managed assessment mode). They also said that the higher order thinking tests made it more difficult to cheat (61%) while using the clickers. (See survey results in the appendix)

Implications for Practice

My action research has led me to a few logical conclusions surrounding clickers and formal assessments. Although using clickers instead of traditional testing methods does not increase achievement, when giving formal assessments using the clickers it is best to use the student managed assessment mode rather than the teacher managed assessment mode. The reasons the student-managed mode is a better format are that it allows students to work at their own pace and also discourages cheating. The teacher managed assessment mode should be used to do comprehension checks during class or to play review games, but never as a formal assessment since this mode makes it easier for students to cheat.

Using higher order thinking questions in formal exams is also helpful in discouraging cheating while using the clickers. However, since these questions

are often times more “difficult” it may be wise to include both higher order thinking questions and knowledge level questions on exams. It is also important to do a few of the higher order thinking exams as practice before giving one as an official test grade since the students often times are not used to thinking about multiple-choice questions in that manner.

Academic dishonesty while using the clickers is an obvious problem that must be discussed during the first week of school. Cheating policies in class syllabi must include expectations of clicker use as well as consequences for using them dishonestly. It is also very important to tell your students during the first week of clicker use as to what you consider cheating to be. In order to discourage cheating on formal tests only the student managed tests should be used. Including higher order thinking questions in formal exams will also discourage cheating.

This study has been very valuable to my classroom. It’s implications for practice will allow me to more accurately administer formal exams with clickers as well as prevent and discourage academic dishonesty.

Appendix

Student Surveys

Survey 1: Clickers and Dishonesty

- 1) Have you observed another student cheating with the clickers since we began using them in class?
 - a. Yes **87%**
 - b. No **13%**
- 2) Have you cheated using the clickers?
 - a. Yes **60%**
 - b. No **40%**
- 3) Which sort of clicker tests is easier to cheat on?
 - a. The kind where everyone clicks in his or her answers at the same time. **65%**
 - b. The kind where everyone has his or her own copy of the test and works at his or her own pace. **5%**
 - c. It is equally easy to cheat on both kinds of tests. **30%**
- 4) Did the higher order thinking clicker tests (the one where you had to put the excerpts from the story in order and the one where you had to put the pictures in order) make it more difficult to cheat on the tests?
 - a. Yes **61%**
 - b. No **8%**
 - c. Equally easy to cheat on the higher order thinking tests as it was to cheat on the other clicker tests. **31%**

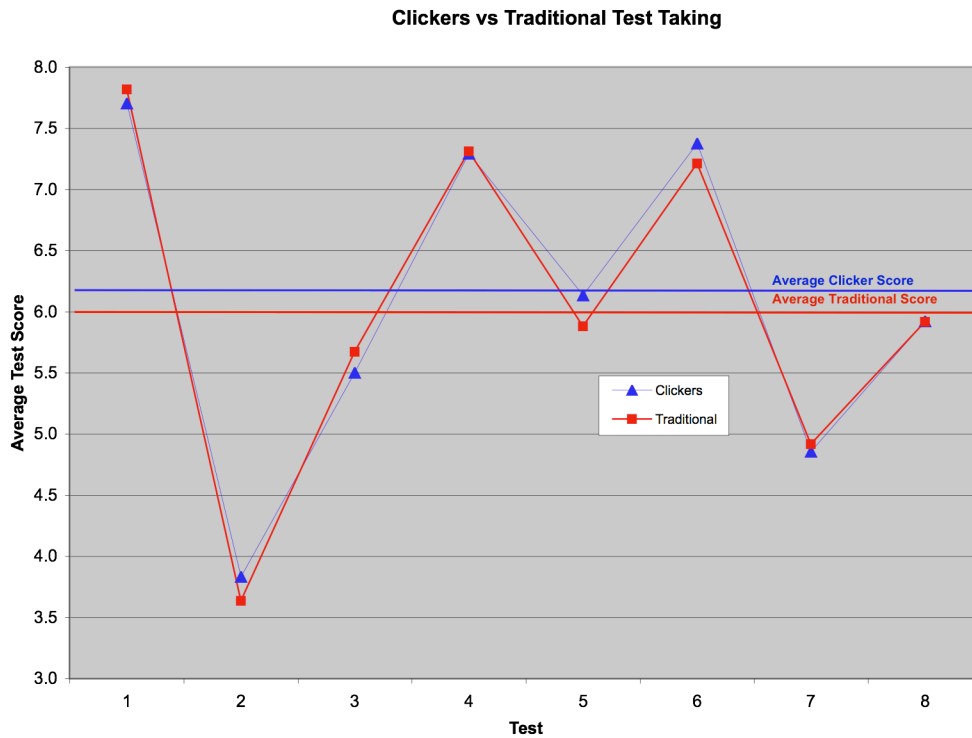
Survey 2: Testing Formats

These surveys were given after completing the higher order thinking quizzes. Therefore, "this weeks tests" refer to the higher order thinking tests and "last weeks tests" refer to the knowledge-based tests.

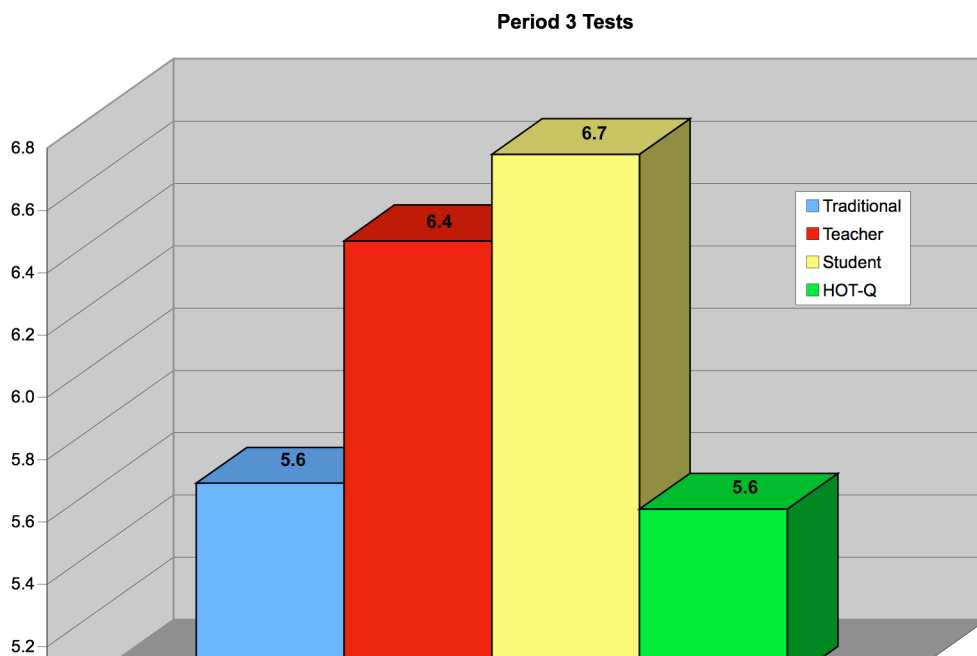
- 1) Which sort of tests do you feel are more difficult?
 - a) Traditional tests (overhead, written tests) **55%**
 - b) Clicker tests **1%**

- c) They are equally difficult **44%**
- 2) Which sort of assessment format would you prefer to take?
 - a) Traditional test (not using clickers) **10%**
 - b) Clicker test **90%**
- 3) Which sort of tests do you feel are "easier"?
 - a) Traditional tests **7%**
 - b) Clicker tests **45%**
 - c) They are equally difficult **48%**
- 4) Think about the clicker tests we took over the last few weeks. Did you notice a difference in the tests from last week and this week?
 - a) Yes **85%**
 - b) No **15%**
- 5) Which group of tests did you feel more challenging?
 - a) The last weeks of tests **25%**
 - b) This weeks tests **58%**
 - c) Equally challenging **17%**
- 6) Which of the tests do you feel most accurately reflected what you really learned about the readings?
 - a) Last weeks tests **18%**
 - b) This weeks tests **43%**
 - c) Each group of tests equally tested my learning **39%**

Comparison of Period 3 (clicker tests) and Period 4 (traditional) Test Scores Graph 1



Graph of Period 3 Test Scores Graph 2



Period 3 Data

Period 3 Students	Traditional 1	Traditional 2	Teacher 1	Teacher 2	Student 1	Student 2	HOT-Q 1	HOT-Q 2	
1	8	4	6	5	7	7	10	10	
2	7	5	7	7	4	7	6	4	
3	5	3	4	6	7	7	1	8	
4	8	3	6	10	5	7	3	7	
5	6	7	3	7	10	10	4	6	
6	6	3	5	5	6	8	2	7	
7	7	3	4	9	4	7	3	6	
8	9	3	8	8	5	10	5	8	
9	9	2	5	9	6	4	1	5	
10	9	1	7	7	7	8	6	4	
11	9	8	8	9	9	8	10	10	
12	7	2	3	6	1	7	2	5	
13	8	5	7	7	8	8	6	3	
14	8	0	6	7	4	6	7	4	
15	7	5	2	7	7	6	5	5	
16	8	3	4	8	8	7	7	8	
17	7	7	6	6	5	8	7	6	
18	8	3	9	8	6	7	3	6	
	7.6	3.7	5.6	7.3	6.1	7.3	4.9	6.2	
		5.6		6.4		6.7		5.6	

Period 4 Data

Period 4 Students	Traditional 1	Traditional 2	Teacher 1-give	Teacher 2-give	Student 1-give	Student 2-give	HOT-Q 1-giver	HOT-Q 2-given	
1	2	8	2	9	7	7	5	8	
2	2	5	8	7	7	10	3	4	
3	5	4	8	5	5	10	5	7	
4	3	4	8	10	6	10	5	8	
5	9	6	8	9	8	9	6	8	
6	10	5	4	9	7	9	10	8	
7	7	6	7	7	7	8	5	7	
8	9	2	8	7	6	7	5	6	
9	7	2	7	7	8	9	6	7	
10	9	8	8	9	7	9	10	6	
11	6	3	7	7	8	10	5	8	
12	5	2	9	6	8	5	5	6	
13	10	10	10	10	10	9	10	8	
14	6	5	8	10	8	10	2	6	
15	3	4	6	5	7	9	4	7	
16	10	7	10	7	10	8	3	7	
17	8	4	6	2	7	10	2	6	
18	5	7	9	6	8	10	5	6	
	6.4	5.1	7.4	7.3	7.4	8.8	5.3	6.8	
		5.8		7.4		8.1		6.1	

Comparison of Period 3 and Period 4 Averages

		Traditional 1	Traditional 2	Teacher 1	Teacher 2	Student 1	Student 2	HOT-Q 1	HOT-Q 2	
Period 3	Clickers	7.7	3.8	5.5	7.3	6.1	7.4	4.9	5.9	6.1
Period 4	Traditional	7.8	3.6	5.7	7.3	5.9	7.2	4.9	5.9	6.0
	Difference	-0.1	0.2	-0.2	0.0	0.3	0.2	-0.1	0.0	

Literature Review and APA Bibliography

Throughout the second semester of the 2004-2005 school year, I have been attempting to answer four questions that I consider to be vital to the continued use of clickers in my classroom. The questions that I have chosen to research and study are:

1. How do clickers compare with more traditional ways of formal assessments?
2. What other testing formats are available for use with the CPS?
3. How can I use the CPS to ask higher-level questions since they are formatted to assess using a multiple-choice format?
4. How can I eliminate/prevent students from cheating on assessments while using the CPS systems during formal assessments?

Questions 1, 2 and 3 are being answered directly through my research and data collection from two of my Spanish 3 classes at ThunderRidge High School as well as through attending trainings designed to further my knowledge of the CPS software. I had hoped to find some information about what the "experts" think in terms of best formal assessment uses with clickers, but after numerous hours of searching for articles based on formal assessments using clickers I realized that much of the research that is currently available focuses mostly on student engagement and achievement. I have used various search engines in my search such as: Google.com, Wilson web, ERIC and Lexis Nexus. Although I have had difficulty finding research pertaining to formal assessments and which testing formats are most effective, I did find a few references available with respect to questions 1 and 2. Question number 3 was answered during a clicker workshop presented in Boulder by Len Scrogan of Boulder Valley School District and eInstruction representative Steve Huff. The literature and recommendations from that workshop will be included in this paper as well. Question number 4

was the only question that I was able to research on-line through the use of the Google search engine. I used the key words "clickers and cheating" and also searched "clickers and formal assessments". I attempted to use the other search engines in this inquiry on academic dishonesty with respect to clickers, but received no results for those searches. Most of my research in the area of academic dishonesty will be related to the preventative measures other professors and teachers who currently use the technology take in order to discourage and/or prevent cheating in their classrooms.

Question #1 How do clickers compare with more traditional ways of formal assessment?

Though numerous sources cited the importance of continued student assessment throughout courses to increase student achievement, only one source mentioned a comparison to other traditional ways of formal assessments. McGraw-Hill publishing has a web site devoted specifically to the use of clickers in classrooms. McGraw-Hill is one of a few publishing companies who offer clicker lessons/assessments to go along with their textbooks. When comparing clicker tests to more traditional tests, they state:

Tests and quizzes can be given with CPS either electronically or with paper. Yes, you can give paper-based tests with CPS. Your CPS system replaces the scantron (or bubble sheet). Students move at their own pace through the paper test entering their objective answers independently with their CPS response pad. (What can you do with cps?)

Their comparison to traditional bubble sheet tests suggests that the formats are considered comparable. The major advantage that I have found when using clickers instead of the scantron is that the CPS software, thus making grading a much easier task on behalf of the teacher, grades the exams automatically. As

the McGraw-Hill site points out "Tests and quizzes are graded in a matter of seconds – not hours, days or weeks!" (What can you do with cps?)

Wayne State University also has implemented the use of clickers in some of their larger classes. They suggest that when using CPS for formal assessments that you have a paper back up to use until instructors are very comfortable with the technology (Mertz, 2004). This is also important in case the students want to contest any of their answers that were recorded by the system. It basically makes allows the student and instructor to make sure that the answers were "clicked" in correctly. For example, if a student did not monitor his/her test numbering, they could potentially answer many questions incorrectly due to a numbering mistake. However, if there were a paper back up to consult, the student would be able to prove his/her intended answers.

I am hoping that my action research within my classroom will further explore research question #1 as I am comparing two Spanish 3 class in which one uses a traditional pen/paper test and the other uses clickers to see if there is a difference in student achievement with the two different formats.

Question #2 What other testing formats are available for use with CPS?

The McGraw-Hill site pointed out the option of students moving at their own pace through tests. Before I began this research project, I had been using the teacher managed assessment mode with the CPS. After attending a workshop in Boulder on February 15, 2005 led by Len Scrogan from Boulder Valley Schools and Steve Huff from eInstruction, I learned more about the student managed assessment mode. The main difference between the two modes is that the entire class answers one question at a time using the teacher managed mode and does not move on to the next question until the teacher "ends" the current question. While using the student managed assessment mode, each student

receives a paper copy of the exam and then works at his/her own pace to complete the exam. The students see a screen on the overhead where their clicker number is posted along with the current question they are answering. Students are able to move backwards and change answers if they so desire. This assessment mode is much more conducive for a formal assessment in that the student are not all answering the same question together at the same time (Scrogan, 2005).

Question 3: How can I use the CPS to ask higher-level questions since they are formatted to assess using a multiple-choice format?

During the Clicker II workshop, Len Scrogan spoke with a group of teachers who have begun to use the clickers in their classrooms on the construction of higher order thinking questions. Within Bloom's Taxonomy, these questions are not knowledge level questions, but rather fall under the category of comprehension, application, analysis, synthesis or evaluation. Len presented us with thirteen different ways to construct higher order thinking questions while using a multiple-choice, matching, and true-false (yes/no) format. The following information is taken from handout provided by Len at that training.

Multiple Choice Questions:

1. Construct items in a form different from that originally presented.
2. Use novel pictorial materials to measure principals that require students to apply knowledge.
3. Provide for a condition contrary to fact.
4. Use analogies to measure relationships.
5. Select examples of principles or concepts.
6. Discover relationships among similar topics.
7. Identify assumptions and analyze criteria.
8. Use charts and tables.

Matching Questions

9. Match examples with terminology.
10. Use novel pictorial material

True-False and Yes-No Questions

11. Require students to respond to new situations
12. Students are presented with a problem situation and are asked to justify conclusions from data.

Multiple Choice, True-False, Recall and Check All That Apply Questions

13. Learners respond to a simulation-like question that presents a brief realistic scenario, highlights a real-world cause-and-effect relationship, and asks learners to make a decision to display their understanding of this relationship.

Len also provided us with valuable examples of each questioning strategy and then had us work on creating higher order thinking questions that we could use in our own content area. Attending Len's workshop was extremely helpful and beneficial to all of those in attendance because we learned how to use the clickers to make students think at a higher level while using the technology.

Michele H. Jackson and April R. Trees from the University of Colorado at Boulder suggest including questions with no right answer in order to generate discussion or illustrate a concept (Jackson et al, 2003). What valuable advice! This is a great suggestion in that it would force students to work collaboratively towards either figuring out a solution to a problem or simply to get them to interact and exchange opinions. These sort of questions would also force students to think at

a higher than "knowledge" level while defending their point of view or collaborating with other students.

Question #4 How can I eliminate/prevent students from cheating on assessments while using the CPS systems during formal assessments?

Using Google as my search engine, I was not surprised to find that many higher education institutions that use the CPS have begun to include a section in their course policies about cheating and/or academic dishonesty while using clickers in their classes. Reagan Lake of the University of Maryland at British Columbia writes in her syllabus that if students are observed cheating during an exam they will receive a zero. The instructor continues to specifically mention clickers, saying " only those individuals attending lecture may take part in a CPS activity. Taking part for someone not in the room is dishonest and a violation of UMBC's Academic Integrity Policy" (Lake, 2004). In a survey of Iowa teachers using CPS in their classrooms, one teacher listed "ease of cheating" as an obstacle to overcome while using clickers (November 2004 Idaho CPS Users' Survey). R.L Mutel from the University of Iowa says that "possible cheating is a problem; students need to cover PRS with hands" (Mutel, 2005). *Note: PRS stands for polling response system-clickers are a type of polling response system.*

The University of Colorado at Boulder is considered to be one of the leading universities with respect to researching and exploring the use of clicker type systems at the higher education level. Instructors Michelle H. Jackson and April R. Tress state that student cheating while using clickers was important for two main reasons- 1) clicker activities were tied to student grades and 2) classroom culture could be affected. "If students see their peers routinely cheat *and get away with it*, we could we expect negative effects, including lower student morale" (Jackson et al, 2003). In order to determine if student were in fact

cheating during clicker activities and tests they surveyed their students about how many of them had observed cheating with the clickers. They did not specifically if the students had cheated themselves in hope that they would receive honest responses from the students. The results were very concerning- "at least 20% up to 58% of students observed cheating" (Jackson et al, 2003). During their conclusion of their report, they address the problem and recommend that clicker cheating behavior be targeted saying, " students need to trust that their assessment is fair and depends on honorable behavior. Until cheating is curbed, it is unlikely that clickers will achieve their full potential as a pedagogical tool" (Jackson et al, 2003).

Douglas Duncan, another CU professor addresses the cheating problem in his book Clickers in the Classroom: How to Enhance Science Teaching Using Classroom Response Systems. Duncan feels that in order to prevent dishonest student behavior while using clickers, that instructors discuss their expectations of clicker use at the beginning of the terms. He states: "Tell them what you consider cheating when using clickers" (Duncan, 2005).

Evidently, cheating while using clickers is obviously a problem that is wide spread and a concern to instructors who use them. Throughout this literature search, some of the most valuable suggestions offered are 1) Use the student managed assessment mode for formal assessments, 2) Have students cover their clickers with their hands and 4) Discuss your expectations and what you consider to be cheating while using the clickers with your students at the beginning of each class.

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ILT Competencies Met:

Reflective Practice

2. Use cycles of reasoning as tools for problem solving (with documentation for accountability and shared reasoning)

I met this competency through this project by focusing on two main problems that I wished to solve: 1) Determine how much cheating happens when using clickers and how to prevent/deter cheating and 2) How to best use clickers for formal assessments. I used the ADDIE process to work through the problem while doing my action research. The documentation is in the above project report.

3. Promote collaboration, partnerships, and relationships for full inclusion with stakeholders, clients, subject matter experts, team members, etc.

I met this competency through this project by collaborating with a number of different people. I worked with three of my classmates who were researching clicker problems as well. We created a common Web site and helped each other throughout the research process. I also worked with a few different experts as well; Len Scrogan from Boulder Valley School District and Steve Huff from eInstruction. I also collaborated with many people in my school and district. These people include: my department members, my principal, my building technology coordinator and our district technology team.

Planning and Analysis

9. Develop products and resources to support learning and performance

I met this competency through my action research project by using research to determine how to best use clickers as a learning resource. The results of my research will serve as a resource as to how to best use clickers for formal assessments in the classroom.

Evaluation and Assessment

10. Evaluate effectiveness of programs, products or practices

My action research project met this competency because it focused on the best practice use of a specific product, eInstruction's Classroom Performance Systems. My research focused on how to best use clickers effectively for formative and summative assessments. It also focused on how to prevent academic dishonesty while using the product.

11. Assess student/participant learning

I met this competency through my action research because I used the clickers for day-to-day assessments via performance measures on reading quizzes. I also based my decisions on how to use the clickers most effectively based on the data

that was gathered during my research. The entire project focused on how to best use the clickers for student assessment.

12. Utilize research methods to investigate a learning or performance problem, issue or trend.

I met this competency through my action research project. I used action research methods to solve two main problems I was encountering with the use of clickers in my classroom. Through the research, I investigated how to: 1) Best use clickers for formal assessments and 2) How to prevent/discourage academic dishonesty while using the clickers. For this project, I did action research in my own classes by comparing different types of CPS assessment modes, different types of exams and by using two different student surveys. I also did a literature search to see what other professionals had discovered with respect to these same issues. The final results and recommendations of my action research can be seen above in the project report.

Implementation and Change

14. Participate in an implementation process or change strategy

This competency was met through my action research project by gathering data on the effectiveness of the use of clickers for formal assessments and also gathering information on how to prevent cheating while using the clickers. The data and its analysis on this innovative technology will be used to guide future efforts of clicker use in my school.