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Classroom Performance Systems, Library Instruction and Instructional Design: A Pilot Study and Some Observations

Abstract: To explore how effective CPSs (Classroom Performance Systems) are in the classroom, specifically for library instruction, this pilot study considered the question: Does the use of a CPS improve student retention of information presented in class as measured by pre-and post-test scores? The use of pretest and post test measurements for retention of information attempted to assess the impact of instruction using the CPS for a single session and the usefulness of CPS for the delivery of instruction generally. The data collected included the results of a 5-item pretest and a 6-item post test completed by 48 freshmen college students. While scores improved for both groups improved after instruction, scores for the group using the CPS with instruction showed somewhat greater improvement than the non-CPS group. The author also discusses the role of instructional design in the development of the study and other considerations for future studies.

Classroom performance systems (CPS), also called personal response systems, audience response systems, or clickers, are presentation tools that immediately record and graph audience responses to a question, transmitted with a hand-held keypad to a PC with a receiver. CPSs aggregate and present this collected feedback and through presentation software project it on screen. Though some version of this technology has been in existence since the 1970s, they have evolved over time from expensive, cumbersome and costly hard-wired systems to become accessible and user-friendly instructional tools. The business community, an early adopter group, used the CPS technology as a means to facilitate meetings and conferences. [1] By the mid-1990s, educators in medicine and the sciences were writing about their experiences using this tool, often for facilitating instruction or lecture sessions in large classrooms and lecture halls.[2] With time, improvements like greater portability and affordability, easy integration into presentation software, simpler installation, and simpler use of imbedded video clips made CPS technology more accessible than ever to anyone who teaches and wants feedback on their instruction technique or their audience's learning. [3]

A limited number of publications in the literature have reported on the use of CPSs in library instruction. The content of library instruction or information literacy sessions delivered in the computer lab or computer classroom setting is frequently structured around describing database structure, content and features; determining appropriate search terms and strategies; and, identifying parts of index records and applying searching techniques – competencies which, depending on the taxonomy, fall into the learning domains involving the verbal information skills and/or intellectual skills. [4] Instruction librarians seeking to improve the design and delivery of this kind of instructional content in computer lab settings have begun exploring and testing the use of CPSs in their instruction, as reported on the ACRL Instruction Section website in 2005. [5] Hoffman and Goodwin provide details about the technology, its installation and use and have reported on some different applications for CPSs in library-related instruction and presentations. Feedback on student understanding of search techniques and database features, and the immediate recording of assessment data are some of the apparent benefits of this technology, particularly for library instruction. Hoffman and Goodman have also suggested that CPSs add a quality to the delivery of instruction that is "game-like" and others, like Hatch, have reported a kind of novelty effect at work—an improved performance attributable only to the added interest in a new technology.[6]

There is little hard data on the effectiveness of CPSs. Therefore, to explore how effective CPSs are in the classroom, specifically for library instruction, this pilot study considered the question: Does the use of a CPS improve student retention of information presented in class as measured by their responses to pre-and post-test question? The use of pretest and post test measurements for retention of information is intended in this study

to assess the impact of instruction using the CPS for a single session and the effectiveness of CPS for the delivery of instruction generally.

While assessment using pre- and post testing and intermediate feedback measures like those used with CPSs have been argued to be less useful than other types of assessment in determining student learning outcomes or the long-term information seeking behavior of students[7], studies using CPSs in other disciplines for immediate feedback and assessment have had some positive results which suggest that they may be as or more effective than lecture alone for the understanding concepts or retaining information.[8] Setting aside the debate about the long-term impact of the types of library instruction, the use of pre-and post test assessment in this study was intended to compare the impact of instruction with the CPS and without it for the short-term retention of information, and as a means of evaluating the value of this technology as a tool for the delivery of library instruction, rather than the long-term impact of instruction itself.

METHOD

Design

To explore this question and hopefully suggest directions for future studies, this pilot study of the use of Classroom Performance Systems in library instruction sessions was developed for freshmen classes offered at the Alpharetta Campus, an extended campus for Georgia State University and Georgia Perimeter College. Freshmen classes in Communications or English Composition were purposively selected for this study that took place over a 12 month period from April 2006 to April 2007.

An instruction module lasting about 20 minutes was developed to present following concepts 1) physical differences in scholarly journal and non-journal

publications 2) content differences in journal and non-journal publications 3) database features that sort scholarly journals from other publications and 4) online resources that describe periodicals, including scholarly journals. The overall performance objectives for this module of instruction were

1. Looking at the covers of scholarly and popular magazines, the learner will be able to distinguish scholarly publications from those that are not scholarly.
2. Given a list of characteristics for publications, the learner will be able to select those that describe scholarly publications.
3. Using the descriptions of databases provided on the library website, the learner will be able to select those databases that include at least some scholarly journals.
4. The learner will be able to create a list of scholarly articles using the sorting features of a given database
5. Using a directory database, and a given publication title, the learner will be able to determine whether or not the publication is considered a scholarly journal.

The independent variable was the use of the CPS during instruction. The post test scores were the dependent variables. The post test responses for the 2 experimental sessions and 2 control sessions would be compared and the expectation was that there would be a difference in scores between the two groups.

Selection of classes

Forty eight freshmen students from two Communications 1201 and two English 1102 classes participated. Classes were identified for inclusion in the study when the instructor requested a library instruction session and discussed the instruction needs of the class with the librarian. Because the module content, identifying scholarly journals, is potentially relevant to the research papers and projects of many courses, if the librarian determined that the module was applicable for the class, and if the instructor agreed, the module was included as part of the instruction session. However, the resources used for demonstration and discussion were selected based on the research needs of the class and varied slightly from class to class. The first two classes were

selected by a coin toss to be either a CPS or non-CPS session. The last two were assigned the opposite types of sessions or treatments provided for the first two classes.

Sessions Using the CPS

Classes were conducted in a 40 station computer lab with Internet access. Students were given individual key-pads with which to answer questions by selecting a button on their keypad. A sample question in the presentation software was put on the screen for the students to try out the keypad and the librarian explained that responses via the CPS were anonymous, unless the participant identifies him/herself. The sessions began with a 5 question pretest on the screen where answers to the questions were discussed immediately after all the responses were registered for a question. Responses were immediately graphed on the screen. Some of the questions were intended to draw the interest of the students—"True or False, a journal is the same thing as a magazine" and "True or False, just looking at the cover of a journal or magazine can tell you whether it is considered scholarly". The questions were also intended in part to be a transition to the discussion of the physical and content differences, which were discussed with the librarian holding up and passing around copies of journals and magazines. The lesson then segued into how students can make the distinction between scholarly and non-scholarly publications using the search features of the databases and tools that were in the online collection. The demonstration and discussion of online tools and strategies that followed next were based on topics similar or related to the research interests of the assignment. Feedback from the class was solicited at 3 to 4 key points in the session when the students are asked to look at a screen shot of a database and answer a question by selecting a button on their keypad or answer a *Try This* question on the screen that

could only be answered by following a search sequence. At the end of the class, students used the CPS keypads to answer an on screen post test. Answers were not reviewed on screen for the post test.

Sessions without the CPS

For the non-CPS sessions, students were given a written version of the 5 question pretest. They were asked to complete the test, and to put a randomly assigned number, not their names, on the tests. After the pretests were collected, the librarian reviews the answers to the questions, also using this review to begin the discussion. The discussion, procedure and demonstration followed the same sequence as for the CPS-assisted class, except that the feedback component was conducted by polling the audience with a show of hands. Using the presentation software, the same screen shots and feedback questions were used during the discussion and demonstration. A written version of the same post test used in the CPS session was given using the randomly assigned numbers for matching with the pretest.

Analysis

The data collected from this study included the results of the 5-item pretest and 6-item post test completed by 48 students. All data collected was entered and tabulated on SPSS 16 (Statistical Package for the Social Sciences) software. A review of the descriptive data in Table 1. indicates improvement from pretest to post test scores for both the experimental (CPS) group and the control (non-CPS) group after instruction. For the non-CPS group, mean scores improved from the pretest (M=60, SD=15) to post test (M=72, SD=25). The same is true for the mean pretest scores (M=56, SD=22) and post test scores (M=81, SD=21) for the CPS group. Comparing the amount of

improvement for both groups from pretest to post test, scores in the non-CPS group improved an average of 12 points, with 17 of the 21 students in this group improving their scores. The CPS group improved their scores an average of 25 points from pretest to post test and all but 2 students in the group improved their scores.

Also, to compare the scores between groups for this type of quasi-experimental design [9], a two independent samples t-test was used to compare the difference scores between pre- and post tests for both groups and indicated greater improvement in scores for the CPS group ($t(46) = 2.39$; $p < 0.02$).

As a pilot study, the selection of a limited number of participants and the limited amount of data gathered about the participants restrict the generalization or extrapolation of the data to other types of groups.

Table 1. Descriptive Statistics

Control Group	N	Mean	Std. Deviation	Minimum	Maximum
pretest	21	60.00	15.49	40.0	80.0
posttest	21	72.04	25.42	0.0	100.0
Experimental group	N	Mean	Std. Deviation	Minimum	Maximum
pretest	27	56.29	22.21	20.0	80.0
posttest	27	81.44	20.77	17.0	100.0

Discussion

This study attempted to obtain data that would provide a snapshot of the effectiveness of CPS technology in an instruction setting for teaching essentially verbal information and intellectual skills as a component of a library instruction session. An analysis indicates that though the short-term retention of information for the experimental group improved more significantly than the control group, both groups improved their

knowledge of the lesson content. Though the data collection was quasi-scientific in nature, the author hoped that the process of incorporating, using, and attempting to gauge learning using the CPS in instruction, would, in addition to providing data, suggest the value of the tool or ways it could be more effectively used in this instructional setting.

The Role of Instructional Design

The use of instructional design (ID) was a key element in attempting to make the instruction sessions pedagogically equal for this study. While there are many ID models, they generally share a combination of the following components: an analysis of learning environments, task analysis, developing performance objectives, developing assessment instruments, developing instructional strategies, selecting instructional materials and the formative and summative evaluation of the instruction (evaluation of both the instruction and the development process). The author developed the instruction module for this study following the traditional Dick, Carey and Carey design model.[10]

In developing the instructional strategy element, a section in the ID model which includes selecting instructional strategies and sequencing the instruction, the author followed the "Events of Instruction", a widely-used rubric developed by Gagné which describes the phases of the instructional process. [11] A list of these categories of events and the corresponding activities for our sessions are described in Table 2[12] with the corresponding session events for both CPS and non-CPS groups.

The events of instruction for the non-CPS control group mirrored the events as much as possible for the experimental CPS group in the lesson planning. For every event or activity that was managed by the CPS, a manual equivalent for the control group was substituted. In-class feedback, for example, was essentially the same for both types of

sessions: where the CPS session students would perform a search based on instructions given and then respond to an on-screen choice 1,2,3,4 or 5 with their key pads , the non-CPS session would perform the search and the librarian would poll the class for a show of hands, “How many would select answer 2?” While this might have influenced the responses of some of those who wanted to answer with the majority or change their response, in-class feedback responses were included, again, as an event of instruction,and were not analyzed. This conflict was less likely with the CPS which polled the class anonymously and revealed and graphed answers all at once on screen.

What became evident in incorporating the use of the CPS into the session, and is apparent in Table 2, is how neatly the technology fit into the lesson planning. The CPS reinforced specific lesson events: *Stimulating recall* with an on-screen practice test which helped initiate a discussion of the topic, *eliciting performance* with the use of a practice question allowed students to get *feedback* on their own learning, *assessing performance* with an on-screen post test and recording the assessment were events or processes in instruction which were facilitated by the CPS. In addition, using the immediate results of feedback tests displayed on screen made it feasible for the librarian to assess the group’s level of understanding: when feedback scores from the class were low, the librarian could repeat instruction or to use another example. The graphical

Table 2. Events of Instruction

Event	***Internal Process***	***CPS Group Activity***	***Non-CPS Group Activity***
Gain attention	Stimuli activates receptors	Discuss the research assignment to locate journal articles for a paper/presentation	Discuss the research assignment to locate journal articles for a paper/presentation
Inform learners of objectives	Creates level of expectation for learning	*Pose questions:* What are journals? How do you find journal articles? How do you use our databases to find them?	*Pose questions:* What are journals? How do you find journal articles? How do you use our databases to find them?
Stimulate recall of prior learning	Retrieval and activation of short-term memory	Initiate pretest. Pass out keypads, use CPS to record /graph responses	Pass out paper pretests
Present the content	Selective perception of content	Review answers to pretest. Use pretest questions to frame and initiate discussion. What is different about journals? Discuss/describe physical and contents differences Use paper samples of journals/other serials, pass out to class.	Review answers to pretest. Use pretest questions to frame and initiate discussion. What is different about journals? Discuss/describe physical and contents differences Use paper samples of journals/other serials, pass out to class.
Provide "learning guidance"	Semantic encoding for storage long-term memory	Demonstrate: use of resources relevant to assignment, identify specific sources	Demonstrate: use of resources relevant to assignment, identify specific sources
Elicit performance (practice)	Responds to questions to enhance encoding and verification	Use CPS to ask on screen *Try this* feedback questions; the CPS prompts responses	Ask *Try this* feedback questions; provide time for practice
Provide feedback	Reinforcement and assessment of correct performance	CPS graphs feedback responses on screen; discuss results; review and ask additional practice questions as needed	Requests responses by a “show of hands”; review and ask additional practice questions as needed
Assess performance	Retrieval and reinforcement of content as final evaluation	Use CPS to complete on screen post test	Pass out, complete paper post test
Enhance retention and transfer	Retrieval and generalization of learned skill to new situation	Pass out handouts/tip sheets on session, review objectives and how they were addressed—What did we do, how did we do it?	Pass out handouts/tip sheets on session, review objectives and how they were addressed—What did we do, how did we do it?

presentation of audience feedback also helped retain the attention of the class group and allowed them to monitor their own level of understanding.

Conclusions and Observations

Research on the use of CPS technology for library or information literacy instruction to date has been limited to specific case studies or the observations of those implementing and using CPSs for different applications in classrooms or other settings.[13] The data provided by this study are also far from conclusive, but the process of developing the study design, as a whole, raised some issues that may be significant considerations for future studies. These are 1) the role of instructional design in developing the study design, 2) the use of the CPS to facilitate classroom management and other dynamics at work in the classroom to improve learning outcomes, and 3) the usefulness of CPSs for domain-specific learning.

Equalizing the different sessions by attending to the instructional design, organization and strategy of the sessions, the author attempted to get a clearer picture of the other factors influencing learning, with or without the technology. The fact that the learning outcomes increased for both the control and the experimental groups after the sessions in this study suggests, though not conclusively, that the design of the sessions and delivery of content were as equivalent as possible and that the instructional design process worked to some degree for both sessions. However, as a "media comparison study" where a session's instruction events were aided by technology as compared to a session where they were performed manually, this study was attempted specifically to isolate and examine the media as the variable in the treatment or session.

Media Comparison Studies

Instructional designers have debated the value of media comparisons, like this one, where the analysis of learning outcomes is based on the delivery of instruction using one type of media as compared to delivering the same content using another type of media. From a meta-analysis of an array of media comparison studies spanning many years, Robert E. Clark concluded that the use of media in instruction is no more significant to learning outcomes than the type of delivery truck is to the quality of the groceries it delivers to the store. As a method of delivery, the truck does not change the quality of the content it delivers. Likewise, the value of instruction based on learning outcomes is determined by the instructional content, organization, and strategy, not the type of media that presents or delivers it.[14] Others examining the research have concluded differently -- that the "truck" can and does make a difference especially when you consider whether your "truck" is delivering ice cream, produce or canned goods. [15] Citing a number of studies, Kosma completely refutes Clark's arguments saying that "method must be confound with the medium"[16], that both the delivery and the method are parts of the instructional design. "In good designs, a medium's capabilities enable methods and the methods that are used take advantage of these capabilities" [17] says Kosma, though it may be a matter of finding or perhaps stumbling upon how medium and method, the design and the technology, can work together. Shoffner et al. point out that the "trick is to figure out what makes them [the media used] useful in what situations in order to leverage their strengths and avoid their weaknesses."[18]

That the lesson design and the technology used for this study would likely be a good match became apparent when, in setting the events of the session, the potential uses for the technology immediately fell in line with design and could be easily matched to the

specific instruction events. In delivering instruction for the sessions in this study, the technology enabled or reinforced the specific events as described previously. This, and the improved scores for the CPS group in the study, support the suggested importance of leveraging the capabilities of the media and hint that the successful use of media in instruction may depend in large part on how closely the media *can* be aligned with the instructional design.

Classroom management

The experience of conducting sessions with and without the CPS demonstrated how the CPS influenced the dynamics of classroom management. Though the use of computer labs and classrooms has become the norm for instruction librarians helping students discover and use online library resources, managing learners to keep them "on task" and "on the clock" has become a growing challenge for those teaching in these environments.[19] Instructors and librarians are finding that classes in lab settings add to the distraction of students surfing, emailing or facebooking their way through class.

Clicker sessions require students to provide feedback, either for a drill and practice question or an assessment response. Even though they may be assigned anonymously, as they were for this study, if a keypad does not register a response, it becomes obvious and the entire class may be left waiting on those few who were not on task, a sometimes powerful deterrent to off-task meandering. While the attention, direction and activities of the non-CPS classes were managed by the librarian, for the CPS sessions in this study, it was the system, not the librarian, which singled out those who were not following along and helped direct their attention and activities.

Using the CPS to manage the classroom dynamics--directing and engaging students and gaining their feedback-- may account for the difference in scores for the two sessions. Again citing Kosma, "Media will only make a significant application to learning…if their application is designed into the social and culture environments of learning. Media will contribute to ID [instructional design] when they are designed around the constraints and tasks that confront teachers and classrooms."[19] Directing and engaging learners are certainly some of these "constraints and tasks" which impact the dynamics at work in a computer classroom.

Future research with this technology should consider the importance of equalizing treatments by using systematic instructional design and a consistent instructional organization and strategy in order to help identify and isolate other factors at work with the use of a CPS in a given setting. Certainly more expansive studies on larger populations than the one selected for this study could more conclusively test whether the use of a CPS supports and improves the short-term retention of verbal information. The results provided here, however, may be influential to those teaching college freshmen. Future studies may also be developed to examine the possibility that this technology may have different roles to play in facilitating instruction depending on the domain of learning. A different type of study design might also address the effectiveness of using a CPS as an interactive technology for improving learning outcomes for other types of cognitive skills, like problem solving. Though outcomes may be different for instruction in other learning domains, for learning tasks that involve understanding simple associations or concepts and applying that information, the use of a CPS appears to improve learning outcomes for this type of content.

Endnotes

1. Simon Rines, "Interaction Stations," *Marketing Week* 18, no. 24 (1995): 35-38.

2. This is also suggested, though not directly stated, by Susan Hatch, “ARS Systems: Creativity and Planning Required,” *Corporate Meetings and Incentives* 22, no. 11 (November 2003): 11-12; Keith Champeau “Using Audience-Response Systems,” *Meetings and Conventions* 36, no. 1 (1999): 36-7; references to the use of CPSs appear in the literature from the mid-1980s for business resources and the mid-1990s for education, particularly science education resources. See also Carol A. Brewer, "Near Real-time Assessment of Student Learning and Understanding in Biology Courses," *Bioscience* 54, no. 11 (2004): 1034-1039; Ray A. Burnstein, and Leon M. Lederman. "Using Wireless Keypads in Lecture Classes," *Physics Teacher* 39 (2001): 8-11; Susan Hatch, “Press 1 for Active Learning,” *Medical Meetings* (March 1, 2003): 65-68; Anil S. Menon, Shannon Moffett, Melissa Enriquez, Miriam Martinez, Parvati Dev, and Todd Grappone, "Audience Response Made Easy: Using Personal Digital Assistants as a Classroom Polling Tool," *Journal of the American Medical Informatics Association* 11, no. 3 (May/ June 2004): 217-220, http://www.stfm.org/fmhub/fm2004/July/T.496.pdf (accessed October 14, 2007); Yvonne Steinert, and Linda S. Snell, "Interactive lecturing: Strategies for Increasing Participation in Large Group Presentations," *Medical Teacher* 21, no.1 (1999): 37-42; James L. Fitch, “Student Feedback in the College Classroom: A Technology Solution,” *Educational Technology, Research and Development* 52, no. 1 (2004): 71-81.

3. Hatch, “ARS Systems: Creativity and Planning Required.”; Joe Huber and Shari Rohr, “Latest and Greatest Ed Tech Products for the 2005-2006 school Year,” *Library Media Connection* 24, no. 1 (August/September 2005): 20-22.

4. Robert M. Gagné, “What is Learned--Varieties,” in *Conditions of Learning and Theory of Instruction*, 4th ed. (New York: Holt, Rinehart and Winston, 1985), 46-69.

5. Kate Adams, “Clicker Culture,” ACRL Emerging Technologies in Instruction Committee “Tips and Trends”, April, 2005, http://www.ala.org/ala/acrlbucket/is/iscommittees/webpages/emergingtech/techtips/april2005.htm (accessed November 14, 2007)

6. Christina Hoffman and Susan Goodman, “A Clicker for Your Thoughts: Technology for Active Learning,” *New Library World* 107, no. 1228/1229 (2006): 430-33; Hatch, “Press 1 for Active Learning,” 66.

7. Rui Wang, “The Lasting Impact of a Library Credit Course,” *portal: Libraries and the Academy* 6, no. 1 (January 2006): 79-92.

8. Brewer, 1037-1039; T. Eric Schackow, Milton Chavez, Lauren Loya, and Michael Friedman, "Audience Response System: Effect on Learning in Family Medicine Residents," *Family Medicine* 36, no. 7 (July/August 2004): 496-504.

9. David J. Sheskin, *Handbook of Parametric and Nonparametric Statistical Procedures*, 3rd ed. (Boca Raton, FL: Chapman and Hall, c2004), 729.

10. Walter Dick, Lou Carey, and James O. Carey, *The Systematic Design of Instruction*, 6th ed. (Boston: Pearson/Allyn and Bacon, 2005).

11. The "Events of Instruction" are considered a standard rubric to follow in developing the external steps or activities which support the internal process of learning. Though other lesson designs are becoming popular, Gagné's "Events" continue to be used widely. See Rita C. Richey, "Robert M. Gagné's Impact on Instructional Design Theory and Practice of the Future," in Proceedings of Selected Research and Development Presentations at the 1996 National Convention of the Association for Educational Communications and Technology, 18th, Indianapolis, IN, 594-604, (Iowa State University, 1996).

12. Column 1 (events) and Column 2 (internal processes) are adapted from Robert M. Gagné, "Designing Instruction for Learning," in *Conditions of Learning and Theory of Instruction*, 4th ed. (New York: Holt, Rinehart and Winston, 1985), 304.

13. Hoffman and Goodman, "A Clicker for Your Thoughts," 432.

14. Richard E. Clark, "Media and Method," *Educational Technology Research & Development* 42, no. 3 (1994): 7-10; Idem, "Media Will Never Influence Learning," *Educational Technology Research & Development* 42, no. 2 (1994): 21-29; idem? Richard E. Clark, "Reconsidering Research on Learning from Media," Review of Educational Research 53, no. 4 (1983): 445-59.

15. Mary B. Shoffner, Marshall Jones and Stephen W. Harmon, "Paradigms Restrained: Implications of New and Emerging Technologies for Learning and Cognition," *Journal of Electronic Publishing* 6, no.1 (2000), http://www.press.umich.edu/jep/06-01/shoffner.html (accessed November 6, 2007).

16. Robert B. Kozma. "Learning With Media," *Review of Educational Research* 62, no. 2 (1991): 179-211. See also Robert B. Kozma. "Will Media Influence Learning? Reframing the Debate," *Educational Technology Research and Development* 42, no. 2 (1994): 7-19.

17. Kosma, "Will Media Influence Learning?," 16.

18. Shoffner et al., under "Clark's Grocery Truck," http://www.press.umich.edu/jep/06-01/shoffner.html (accessed November 6, 2007).

19. Dean S. Turner, “Making the Most of Networked Classroom,” *Media & Methods* 37, no. 7 (August, 2001): 24-26; “Managing the Networked Classroom,” *Media & Methods* 40, no. 3 (November/December, 2003): 30; Matt Villano, “Remote Control,” *Technology & Learning* 26, no.10 (May 2006): 8-11.

20. Kosma, “Will Media Influence Learning?,” 16.