Evaluating a Wireless Course Feedback System:
The Role of Demographics, Expertise, Fluency, Competency, and Usage

Ronald E. Rice
Ulla Bunz
Department of Communication
School of Communication, Information & Library Science
Rutgers University
4 Huntington St., New Brunswick, NJ 08901-1071
rrice@scils.rutgers.edu; bunz@scils.rutgers.edu
fax: 732-932-3756

Abstract
Current pedagogical theory emphasizes the use of new computer-based instructional technologies for convergence, collaborative and participative learning, and in-class feedback. However, it is necessary to evaluate these technologies, especially to identify any student factors that might foster digital divides or differential outcomes. This study analyzes the influences on the student evaluation of a wireless course feedback system in two Master's classes, using a baseline influence survey, two later evaluation surveys, system data about answering review questions, and ratings and open-ended comments on the final course evaluation. Influences studied include demographics, variety of computer usage, web expertise, computer-email-web fluency, computer-mediated competency, levels of exposure to the system, and use of the system for in-class reviews and discussions. Fluency involved three dimensions, competency involved eight dimensions, and evaluation of the system included four dimensions. Different evaluation dimensions (training, easy to use, validity, fun, overall) were predicted (from 25% to 51%) by different combinations of prior web use, computer classes, exposure to the system, and different dimensions of computer-mediated competency (such as medium factors, interaction management, efficacy and overall CMC competency).

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The use of technology in general, and computer-based technology in particular, in classrooms is not a new phenomenon. Whether it is the use of overhead transparencies or Powerpoint presentations in public speaking (**Author**, 2002) or browsers and graphics programs in website design (**Author**, 2003b), use of computer-mediated technology for instructional purposes (Althaus, 1997), a mediated classroom designed as a virtual team (Walther et al., 2001), an online/virtual classroom (Hiltz, 1994), integrated learning management systems (Alavi & Dufner, 2004), or asynchronous learning networks (Hiltz & Goldman, 2004), almost all modern university classrooms nowadays include at least some use of computer-based technology. By 2002, as many as 80% of higher education institutions offered some forms of virtual or computer-mediated education (Alavi & Leidner, 2001). Online courses, curricula and degrees are being offered by a wide variety of university and institutions in the U.S. and Europe, including the U.S. Army and university consortia (Hiltz & Goldman, 2004). Computer-based instructional technologies can facilitate communication among participants while structuring group dialogue and decision making. These developments mean that courses may now combine face-to-face, traditional media, text-based CMC media and new digital media to deliver materials, coordinate group projects, provide access to processible information and discussions from the local as well as international institutions, and foster interaction among students and external participants (Coppola, Hiltz & Rotter, 2002). Crucial to the increasing wide-spread use of such technology are appropriate evaluations in a variety of settings.

After a review of some general issues in mediated classes, and a brief introduction to classroom response systems, this study seeks to find out how students respond to a new classroom technology – a wireless course feedback system – and what factors influence those evaluations.

Applying Instructional Technology

The concept and application of technology-mediated education in general and distance education in particular has shifted over the past 30 years (Rumble, 2001) -- from a transmission model of education towards a more constructivist model, facilitated by computer-mediated communication. Dede (1996), among others, emphasizes the importance of "learning-through-doing," which involves individualized presentational and "constructivist" experiences in problem-solving, case-based contexts, available to students on demand. Collaborative (group- or team-based) learning (Alavi & Dufner, 2004), grounded in constructivist learning and social learning theories, emphasizes the fundamental roles of direct interaction with information, and of social interaction in learning, suggesting that pedagogies and media that foster participation and collaboration will improve learning. Thus it is important to distinguish between the effects of the delivery (conveyance) technology vs. those of the instructional (convergence) technology. Hiltz and Shea (2004) and Swan (2002) argue that the most significant role of technology is to foster opportunities for interaction among the participants, which emphasizes the convergence aspect – classes become more "learner centered." Using new technologies simply to convey current content does not take advantage of pedagogical possibilities provided by new media. Teachers and students will have to understand the possible new roles and responsibilities that come with these technological developments -- they cannot just rely on "using" the medium in a traditional way for a direct effect (Gibson, 1996; Author, 2004).

Constructivist and collaborative approaches to student learning would argue that computer-mediated course technology should be used to foster greater participation,

collaboration, feedback, and involvement by course members. For example, Alavi (1994) found that MBA students who used information technologies to support their synchronous collaborative learning process rated their learning and satisfaction with the classroom experience higher, and obtained higher final test grades, than did students who did not use the system. Alavi and Dufner (2004) call for research of "technology-mediated collaborative learning environments that may be pedagogically superior to alternative forms of learning environments." Indeed, Hiltz's foundational book, *The Virtual Classroom* (1994) emphasizes the role of computer-mediated technology in fostering interaction, participation, and communication between instructor and students, and among students – what she calls "active dialog", rather than on any specific technology or the value of mediation per se.

However, it is not always clear how appropriate any particular technology is for all students. Possibly there are pre-existing differences, or variations in expertise and capabilities, that would make some students less receptive toward, or able to take full advantage of, new instructional technologies; or there are pedagogical and technological factors that make the most difference (Chu & Schramm, 1967; Clark, 2001). For example, the New Jersey Institute of Technology, which offers many courses in both online and face-to-face sections, provides prospective students a self-scoring survey to find out if they are suited to an asynchronous course (Hiltz & Shea, 2004). This survey includes 10 questions, including assessments of one's computer skills, and comfort with using new technologies. "Students who score below a certain cutoff point are told to speak to an advisor before selecting an online course, and those who score below a second cutoff point are told 'e-learning does not appear to be right for you'." Wang and Newlin (2000) provide a more psychologically-oriented checklist (self-efficacy, locus of control, participation in class) for potential online students. Other predictors of success and completion in online courses include prior computer skills, number of prior distance learning courses, college GPA, accessibility to the equipment, comfort and confidence with computer technology, responsibility toward completing assignments, interaction with instructor, internal locus of control, self-efficacy, independent learning style, convergers, time management skills, support from family and friends, etc. (Hiltz & Shea, 2004).

Digital divides – most generally defined as the difference between those who "have" technology and those who "have not" – are aligned along various issues, including social demographics (i.e., gender, ethnicity, social networks), education, and economics (Katz & Rice, 2002). Ideally, schools and universities ought to strive towards closing any pre-existing digital divides among their students. Thus, student success in a technology-intensive class is a combination of personality factors, technological ability, and related digital divide factors that include access to technology to develop not just technological ability, but also a positive attitude toward technology.

<div align="center">Classroom Response Systems</div>

One recent addition to the range of computer-based classroom instructional technologies are classroom response systems. These are designed to improve both interactivity and collaboration to supplement already existing content in a pedagogically sound manner, but in a different way than computer-mediated communication systems. This technology generally consists of software into which instructors enter multiple choice type of questions, and provide remote control units to the students. It has been referred to as "classroom communication system," "classroom performance system," or "instant feedback system." Questions are projected onto a screen throughout the lecture, and students use the remote control units to transmit their answers to the questions anonymously but in real time, by means of a wireless

signal to a small receiver set up at the front of the classroom, which in turn is connected to the laptop or computer running the program. This procedure provides feedback to both instructors and students. Since the correct answer will be displayed for all to see, students can confirm to themselves whether they chose the correct answer, and if not, they have an immediate review of what it should have been. Simultaneously, instructors can see how many students chose incorrect answers and may want to repeat a learning unit if the majority of students seems to have problems as indicated by incorrect answers. In addition, the class can engage in discussion about the reasons for the correct or incorrect answers, or related questions. Though a database in the software collects information on which student answered what question correctly, the classroom display is completely anonymous and not face-threatening to students. A number of companies currently offer this kind of technology, but the one used for this study and discussed here is called the Classroom Performance System (CPS) by a company called eInstruction (http://www.eInstruction.com).

Such systems have the potential to facilitate several classroom processes consistent with a more constructivist and convergence learning context:

- participation (all class members participate in the use of and publicly displayed results of the system)
- collaboration (the class configures the system for team use, and class members can develop questions as part of the in-class review, and debate both the questions and the answers)
- physical activity (provides a break from the more passive traditional class, allowing members to switch focus, engage in physical activity and social interaction)
- cognitive involvement (requires everyone to engage the questions, rather than just one or two who raise their hands)
- self-assessment (allows students to privately check whether they understand the concepts or not)
- shared knowledge (reaffirms joint understanding of a term or concept, as well as identifying common misunderstandings)
- review (engages students in real-time summary and review of class material)
- discussion (raises or rates topics for discussion by and among class members)

Several preliminary studies have been reported, all concluding that there is considerable promise in the technology. Abrahamson's (2002) review of "five years of CCS research with pedagogical techniques in a range of disciplines, educational levels, and institutional settings," concludes that

> Good questions asked in the right context have a remarkable property to transform a classroom. The environment becomes more lively and active. The atmosphere changes and becomes more "happy"! Students report that they understand the subject better, which is confirmed by quantitative studies. They work harder in class, but enjoy it more. There is also evidence that they do more out of class. Teachers become more aware of student problems with the subject matter. The benefits of a classroom communication system (CCS) extend over a remarkable range of disciplines, educational levels, and institutions.

Cox and Junkin (2002) found that faculty using eInstruction systems report that both faculty and students confirm greater student engagement in the classroom, high satisfaction, and gains in student learning across the disciplines. Everett and Ranker (2002) argue that "the theoretical and intuitive benefits seem to outweigh the preparation and set up costs. CPS use appears to increase active learning by devoting some classroom time to student involvement in

active feedback such as quizzes on lectures….The student endorsement of CPS use was strong, and the time studies indicate that the [time] commitment [required] for other faculty to use the CPS will have been significantly diminished. The major intuitive benefit for the researchers is a feeling of connecting with classes of traditionally very passive students and the time it makes available for other higher-order thinking." And Horowitz (2002), assessing a system called "Instant Feedback" at IBM's Corporate Management Development Center, reported that IBM's managerial students liked it very much (ranked it 6.6 out of 7), and their test scores improved by 27%.

As discussed above concerning educational digital divides, the use of a classroom performance system can only be justified if it does not disadvantage those students who have to be classified as digital "have nots" based on any or all of the above factors. However, it is possible that CPS provides exposure to technology and helps overcome digital divides, while enhancing classroom pedagogy at the same time. In the case of CPS as used in the study at hand, the technology was provided to all students at no cost, so neither demographics nor economics factor into the potential success or failure of the technology. However, personal ability to use technology – one's fluency or competency with computers and the Internet – were not controlled for, and thus, are of prime interest as influences on CPS outcomes.

Research Questions

There are of course various aspects of any system evaluation, including the level of training, how easy or enjoyable it is to use, and whether it helps or interferes with the primary task. As the CPS is a different kind of instructional technology, in ways that should foster collaborative, convergent, and participatory learning, it is important to identify how the actual participants assess the system. **RQ1: How do students evaluate the Classroom Performance System?**

In addition, various factors might influence the evaluation of the CPS technology apart from its actual use. Demographics such as age and gender are important controls, though such factors seem to be playing a smaller role in general computer-mediated communication and personal technology use (see Katz & Rice, 2002, for example, showing that there is no longer a gender digital divide in Internet usage in the U.S.) It can be argued that previous experience with technology would be a prime influence on how students will respond to the usage of this particular technology in their classroom. It is possible that students with less technology experience shy away from using CPS, and those with more experience are more likely to be comfortable with such technology, more likely to become more involved and participative in the course by using such technology, and thus more likely to positively evaluate the technology. It may be that certain kinds of technology knowledge or comfort – expertise, fluency, or competency – have differential influences on evaluation of the system. For example, greater expertise might sustain more positive evaluations of the ease of use or fun of a system. Greater computer-email-web fluency would allow users to integrate this new technology into their mental models more quickly, leading to more positive evaluations of training and ease of use. Greater competency with mediated communication, which is more oriented toward convergence than simply using computer tools to convey information, may lead to more positive assessments of the worth of the system. Depending on which of these do or do not influence evaluation of the system, future classroom implementations can take into account these possible differences, provide additional training, or avoid possible biased course outcomes due to differential levels of say, fluency or competency. Thus: **RQ2: How do demographics, computer/web technology**

experience, fluency and competency, along with use of the system, influence the evaluation of the Classroom Performance System?

Related to the evaluation of the system itself is how the use of the system may be associated with overall satisfaction with the course, leading to research question three: **RQ3: How does CPS use and evaluation influence evaluation of the course?**

Thus this research tests a fairly simple model of classroom technology use and evaluation, as Figure One shows.

[Figure One Goes About Here.]

Methods

Participants

Participants in this study were graduate students enrolled in one or two courses (Research Methods, and Mediated Communication in Organizations) in a Master's program at a large Northeastern research university. A total of 61 students were enrolled in both courses (37 and 24, respectively). However, 10 students were enrolled in both courses and thus completed any survey only once. Also, a few others completed only one of the baseline or evaluation questionnaires. For these reasons, the number of responses varies between 42 and 46, a maximum response rate of 90% (46 of 51, which is 61 minus 10).

In the first class in which the CPS system was used, students chose their own numbered CPS wireless remote unit (ranging from 1-32) and corresponding numbered adhesive tags they could stick to their notebooks to remind them of their specific respondent ID and CPS unit number throughout the semester. These numbers were not seen or recorded by the instructors. Students in "Mediated Communication in Organizations" added a "1" in front of their randomly chosen CPS unit number, so their identification numbers ranged from 101 to 132. Students in "Research Methods" added a "2" in front of their CPS unit numbers for a range from 201 to 232. Thereafter, at the beginning of sessions where the CPS was used, students passed around the box of CPS units and selected their own numbered unit. This procedure guaranteed anonymity, while allowing tracking of responses across time, and matching of questionnaire with student review data.

Measures

Course participants completed three questionnaires, one baseline and two evaluation surveys; the study tracked two kinds of CPS usage during the semester; and the participants completed the normal, university-wide instructional ratings course evaluation forms at the end of the semester.

Questionnaire 1. The first questionnaire consisted of 114 items and was administered during the second week of classes, one week before the CPS technology was first used. This baseline survey contained four sets of questions: (1) demographics and usage, (2) a web expertise scale, (3) a computer-email-web fluency scale, and (4) a computer-mediated communication competency scale. Table One provides descriptive information of these four scales and subscales, including scale reliabilities, from question sets 2-4. Appendix A provides the specific wording of the demographic, usage, and constituent scale items, details about which items represent which subscales, and which items were reverse-coded.

[Table One Goes About Here]

Q1: Demographics and computer use. Set (1) included nine questions asking for gender, age, years of Internet usage, number of computer classes taken, and frequency of web access from a number of locations (home, work, school, public terminal, other).

Q1: Web expertise. Set (2) included 12 questions taken from the Georgia Tech (1998) web survey that asked whether one has performed a particular activity or not (such as changed one's browser startup page) and were used to classify subjects in web expertise groups. The total number of these activities was used to group respondents, according to the Georgia Tech operationalization, into four levels of expertise based on the number of the listed tasks that respondents had done via the Web: 0-3, novice; 4-6, intermediate; 7-9, experienced; and 10-12, expert.

Q1: Computer-email-web fluency. Set (3) included 50 items comprising the CEW fluency scale (**Author**, 2001), consisting of three subscales (computer, email, and web). The CEW fluency scale is oriented toward technical and applied skills. It focuses on one's ability to use the technology itself. It does not focus on purposes for which a technology can be employed, for example in mediated communication. Following the lead of the Committee on Information Technology (1999), the term "fluency" was used during development of the scale as it implies at least three concepts of increasing importance as information technology is becoming more and more prevalent in our society. The three concepts are: (1) fluency entails a lifelong learning process, (2) fluency implies personalization of skills on levels of sophistication, and (3) fluency is composed of three kinds of knowledge: contemporary skills, foundational concepts, and intellectual capabilities (Committee on Information Technology, 1999). A measure that goes beyond general computer skills to also tap into email and web fluency seems an important potential influence on evaluating a new instructional technology.

A scale-development study by **Author** (2001) reported a principal-component factor analysis with varimax rotation resulting in a four-factor solution: computer skills (Eigenvalue = 2.3, 10.8% of variance, alpha = .85), email skills (8.9, 42.3%, .89), web editing skills (1.3, 6.2%,.82), and web navigation skills (1.7, 8%, .84). Combining the two web subscales resulted in a higher reliability alpha of .92 (a result found in follow-up scale development tests).

Q1: Computer-mediated communication competency. Set (4) included 43 items comprising the CMC competency scale (**Author**, 2003a), consisting of eight sufficiently reliable subscales (comfort, contextual factors, efficiency, interaction management, medium factors, general usage, effectiveness, and rapport). In the current study, all were sufficiently reliable except for the contextual factors subscale, so it was excluded from further analysis.

The CMC competency scale is a more applied measure than the CEW fluency scale, as it indicates how adept people are at using computer-mediated technology for various communication and interaction purposes. The underlying model and initial item inventory (114 items representing 17 constructs) were originally conceptualized by Spitzberg (1997; see also Morreale, Spitzberg, & Barge, 2001), though not tested. **Author** (2003a) tested, revised, and shortened the instrument to 41 items in eight constructs. When submitted to a principal component varimax rotation factor analysis, these eight constructs loaded as seven constructs with Eigenvalues above 1, as one of them combined two of the previous constructs, forming the construct re-labeled comfort. Finally, exploratory factor analysis was conducted on all items deleted from the original eight constructs. Four constructs emerged, but only one of these constructs showed acceptable reliability. Interpretation of the items, describing issues of enthusiasm, leadership, and connectedness, lead to the labeling of this construct as rapport. The remaining constructs use the original labels proposed by Spitzberg in his model.

Exposure to the CPS. Depending on their enrollment, students were classified in the data into three CPS exposure groups: group 1 (*n* = 22) was the "low exposure" group and consisted of students only enrolled in "Research Methods" where they used the CPS technology in four

classes. Group 2 ($n = 15$) was the "medium exposure" group and consisted of students only enrolled in "Mediated Communication in Organizations" where they used the CPS technology in six classes. Finally, group 3 ($n = 10$) was the "high exposure" group and consisted of students enrolled in both courses and thus exposed to the CPS technology in a combined 10 classes.

 Applications of the CPS. Of the many possible uses of a CPS system, the two courses applied CPS in the following ways:

- have the system present a small set of questions prepared in advance to review specific concepts in the class lecture, have the students transmit their responses, have the system display the distribution of responses, and then have the students discuss the correct and incorrect answers
- allow students to devise a small set of questions themselves about concepts they want to review or discuss, enter those into the system during class, and then follow the same display, response and discussion processes
- to demonstrate content analysis, provide a short transcript and have the students "vote" on which of five *a priori* themes best represent the text, and, based on the disagreements across the five themes, revise the operationalization of the themes and revote until acceptable convergence
- to stimulate discussion, present various answer choices for a controversial topic that has no correct answer, allow students to cast their opinion vote, and discuss the merits of each answer choice

However, we did not measure the durations of any of these specific kinds of exposures.

 CPS collection of in-class reviewing answers. Whenever CPS is used for a classroom interaction, the database can keep a record of answers transmitted by each specific CPS unit, and the actual correct answer for a particular question. If students are identified through their remote control unit ID number, instructors can track individual learning, devise individualized study guides, and gauge attention and involvement throughout any given class period. Since data collection was anonymous in our study and the ID numbers of the remote control units were not linked in the CPS database to specific student names, we cannot connect any external data (such as course grades) to review answers provided through the CPS units. However, analyzing the frequencies of the data collected through the use of the CPS units, for purposes of reviewing the particular class material, helps recognize tendencies in involvement from which instructional strategies can be developed. We gathered the system data on whether each individual user provided a correct or incorrect answer to each question in each respective class, and then computed the overall percent of review questions answered correctly throughout the course, and entered that into the questionnaire database for the respective ID number.

 Questionnaires 2 and 3: Evaluation of the CPS. The second and third questionnaires both consisted of 20 questions (**Author**, 2003c) evaluating the CPS along four dimensions: training, ease of use, perceived validity of responses given, and fun (see Appendix B). The CPS evaluation questionnaire was developed for a study that compared automatic grading sheets (students mark multiple choice answers on a grid sheet, which is scanned into a computer system that can then compute and provide examination/quiz grades) and CPS for the administration of survey questionnaires (**Author**, 2003c). Acceptable to high reliability alphas in that study (ease of use .86, perceived validity .65, fun .93, training .97) warranted using the questionnaire for the current study.

 The CPS evaluation questionnaire was administered once after approximately seven weeks (T2), and again after approximately 14 weeks (T3). Table Two provides the descriptive

statistics, as well as the alpha reliabilities, and correlations and t-tests across time, of each of the four dimensions and the overall mean CPS evaluation scale at both time periods. Because the measures were equally reliable at both time periods, were very highly correlated across the time periods, and did not significantly differ in mean values across time, we used the T2 values in the regression analyses because of the slightly higher sample size. These similarities also imply that the students had had sufficient exposure to, and use of, the CPS, by the time of the first evaluation survey. Put another way, learning the system was very easy so that participants were able to evaluate the system reliably after several uses in the classroom. A related interpretation is that participants form their evaluations of this system very quickly and thereafter do not revise those evaluations.

[Table Two Goes About Here]

Evaluations of the course. Each course taught at any level (undergraduate, master's, doctoral) at the University is formally evaluated at the end of the semester, using a standard instructional rating survey. The survey sheet consists of 10 standard questions with 5-point rating scales, and, on the back side, four open-ended questions where students can write short comments. (The educational literature on student instructional evaluations is vast, and this particular course evaluation form has been analyzed and expanded based on that research – see **Author**, 2000). The anonymous surveys from each class are collected by a student and provided directly to a campus-wide Teaching Excellence Center, which processes all the forms, and some time the following semester provides the instructors a summary sheet with the mean responses for each question, as well as the original anonymous rating sheets with the written comments.

These questions, of course, are quite general, relating to the entire course, and so are not presented here as necessarily evaluating any aspect of the course specifically related to use of the CPS. The only numeric items from that form presented here are those most likely to capture some aspect of the instructional technology used: "The instructional methods encouraged student learning" (from 1=strongly disagree to 5=strongly agree), "I rate the teaching effectiveness of the instructor as…" (from 1=poor to 5=excellent), and an added question, "I learned more of the course material by using the CPS."

The instructional evaluation form also provides four open-ended questions: "What do you like best about this course?", "If you were teaching this course, what would you do differently?", "In what ways, if any, has this course or the instructor encouraged your intellectual growth and progress?" and "Other comments or suggestions." Some participants provided their thoughts on the CPS as part of these comments. Note that both the numeric ratings and the comments are not linked to CPS remote unit ID numbers, so only the overall mean ratings for the course (i.e., not at the individual level) are provided, and thus they cannot be associated with the above data.

However, as an exploratory extension of the project, we sent an email request to all class members three months after the course ended, asking them if they would send an email to a specific trusted third party (a School administrative assistant) with their CPS ID number, and their responses to the two formal evaluation questions mentioned above, and to a third question asking the extent to which they agreed that they had "learned more of the course material by using the CPS." Upon receiving the replies, the assistant removed all identification information, and provided the researchers with the responses and their respective ID numbers.

Results

Demographics, Computers Usage, Computer Expertise, CEW Fluency, and CMC Competency

Overall, students were predominantly female (72%), in line with the distribution of gender in the Master's program. Their ages fell into the ranges 20-24 (40%), 25-29 (32%), and

30+ (28%). Most of the participants have been using the Internet for 4-6 years (43%), or 7-9 years (34%). They have taken 1-2 (26%), or 3-5 (36%) computer classes with 17% having taken more than nine computer classes. Participants accessed the web very frequently from a variety of locations, including daily web access from home (81%), daily web access from work (78%), and weekly web access from school (30%). Participants accessed the web from public terminals less than once a month (36%) or never (47%), and accessed the web from any other place less than once a month (32%) or never (45%).

Based on the classification scheme by the Georgia Tech (1998) web survey, 38% of the participants could be considered expert, almost half were experienced web users, 13% had intermediate skills, and there were no novices. Participants rated themselves as high in CEW fluency overall (mean=4.69), with general computer fluency highest and web fluency lowest. Participants did not rate themselves nearly as high in CMC competency, with an overall scale mean of 3.83 (excluding contextual factors). All sub-competencies had ratings of around 3.9 except interaction management (3.7), and rapport (3.5). Please refer to Tables One and Two for means, standard deviations, and reliabilities of the main scales and subscales.

Use of CPS for Reviewing

In the course "Mediated Communication in Organizations," 26 questions were recorded across the various sessions. Of these, one question did not have a correct answer (that is, it was intentionally used to stimulate discussion of different possible answers). For 22 out of the remaining 25 questions, the majority of students (at least 50%) picked the correct answer. For one question, the largest group of students (44%) picked the correct answer, though this implies that more than half of the students picked an incorrect answer. Also, for two questions, the largest group of students (48% and 78%) picked incorrect answers. Thus, these frequencies indicate that the majority of students answered the majority of questions correctly. These students gained direct confirmation of their gained knowledge. In the case of three questions, more clarification on the topic was obviously needed, as the majority of students picked incorrect answers. As a result of using the CPS in these instances, the instructor received direct feedback during the class that confusion about the topic was still prevalent and could thus address those questions and concerns immediately.

Overall, the number of correct answers per student were fairly high in this course, ranging from 44% to 85%, with a mean of 69.5% (s.d. 11.6%, n=25). Whether the questions and topic were simple, the instructor explained well, or the students were especially bright is inconsequential. The important conclusion is that the in-class classroom performance system review allowed students to review or confirm what they had learned, and to clarify what they had misunderstood. As one student wrote on the semester-end instructor evaluation form, "The CPS technology that we used was very interesting -- it helped me figure out what chapters I needed to go back and re-read." Since there were no formal exams in this class, without the use of CPS this student might never have become aware of his/her lack of understanding of certain topics, and would not have been motivated to review the appropriate topics.

In the course "Research Methods," a total of 11 questions were recorded in the CPS database. Five out of eleven questions were answered correctly by the majority (at least 50%) of students. For two questions, the largest group of students (45% in both cases) chose the correct answer, but more than half the students chose an incorrect answer. In the case of the remaining four questions, the majority of students (59%-83%) answered incorrectly. These frequencies indicate most students answered most questions incorrectly. Indeed, the percent of correct answers per student varied between 18% and 73% (mean of 47.2%, s.d 15.6%, n=33).

Thus, in the course "Research Methods," the CPS technology was an especially useful tool. Rather than confirming correctly learned material, in the "Research Methods" course the technology provided a threat-free environment to make mistakes and provided timely feedback to the instructor to review pertinent concepts again. Though this cannot be proven through our methodology, it stands to reason that a student who gives an incorrect answer on the review question will be more attentive to the follow-up explanations provided, thus increasing attention and involvement in the class, and potentially increasing learning as otherwise this student would not have received an extra review. As one student said on the semester-end instructor evaluation form, "I liked using the CPS during class to test my knowledge of the material."

We will return to the percent of review questions answered correctly (over the two classes, 56.3%, s.d. 18%, n=55) as one possible predictor of CPS evaluation.

CPS Evaluation

As Table Two shows, participants averaged between "strongly agree" and "agree" on the overall CPS evaluation scale, and the subscales of CPS training, ease of use, and fun. However, concerning the validity subscale, the participants averaged between "agree" and "undecided." Table Two also shows that all but one of the statements about the CPS on the open-ended comments portion of the course evaluation were positive, ranging from the CPS as being one of the best parts of the class, and fun to use, to good for reinforcing learning.

Course Evaluation

While the overall mean course ratings can in no way be linked to the use of the CPS system, the courses did receive high ratings concerning instructional methods and teaching effectiveness. As Table Three shows, the overall ratings for both courses were between "agree" (4) and "strongly agree" (5) and higher than the mean of all the other Master's course that semester on instructional methods and teaching effectiveness.

[Table Three Goes About Here]

In response to the email request three months later for ID numbers and course and CPS evaluations, we received responses from 17 members of the classes. As some students had graduate and moved, some may have changed their email accounts, others were on vacation, and some may have simply not wished to participate, this is of course a small and possibly nonrandom sample of the two courses. However, for exploratory purposes, we will report summary analyses using these data. Table Three provides descriptive statistics for those items. The mean evaluations from these 17, provided three months later, are lower than the mean evaluations for the entire course provided at the next to last week of class, with instructional methods around "agree" and teaching effectiveness midway between "agree and "strongly agree." The single question about learning more by using the CPS received a mean response between "neutral" and "agree."

Influence of Technology Use, Expertise, Fluency and Competency on CPS Evaluation

Correlations. To investigate how computer/web use, expertise, fluency and competency influence CPS evaluation, correlation analysis was conducted, followed by regression analysis. Table Four provides the bivariate correlations between the demographics, Internet and web usage, GT web expertise, CEW fluency subscales and overall scale, CMC competency subscales and overall scale, and CPS exposure group and mean percent of review questions correct, with the four CPS evaluation subscales and overall scale.

[Table Four Goes About Here]

Each of the CPS evaluation subscales was correlated with somewhat different predictors. Positive evaluations of training were predicted by greater exposure to the CPS and more review

questions answered correctly. Ease of use was predicted by more use of the web from public terminals, the CMC competency "medium" factor, and the overall CMC competency scale (excluding contextual factors). Validity of responses using the CPS was predicted by having taken fewer computer classes, and greater use of the web. Perceiving the CPS as fun was not significantly correlated with any of the influences (at $p<.01$). The overall CPS evaluation scale was predicted by greater use of the web from public terminals, and the overall CMC competency scale (excluding contextual factors).

Table Four also reports correlations between the three post-course items (n=15, so we used $p<.05$ as the significance level) and the CPS evaluation scales. The "instructional methods" course evaluation was significantly correlated with the training, easy, and validity CPS evaluation scales. The "teaching effectiveness of the instructor" was not significantly correlated with any of the evaluation scales. And the "learned more of course material by using the CPS" was significantly correlated with the training, easy, validity, and overall CPS evaluation scales.

Regressions. Because of possible intercorrelations among the significant influences, multiple regressions were run for each evaluation subscale and overall scale, using as predictors those influences that had significant correlations as indicated in Table Four. Table Five shows the results, with each CPS evaluation subscale and the overall scale predicted by a generally different set of influences, including a different CMC competency subscale.

[Table Five Goes About Here]

Evaluation of the CPS training is predicted (37% variance explained) by the better one is acquainted with technology in the first place, the more usage of the CPS system, but less formal courses on computing. Evaluation of how easy the CPS is to use is predicted by being older, more frequent use of the web from a public terminal, and greater overall competency in CMC (35%), showing that exposure to a greater variety of computing settings and greater ability to handle communication via CMC facilitates learning how to use this technology. Evaluation of the validity of one's responses using the CPS is predicted by using the web more from public places, but taking fewer computer classes (51%). Evaluation of the CPS as being fun to use was predicted by being younger, using the web more from public terminals, and greater overall competency in CMC (25%). Finally, the overall CPS evaluation is the best predicted (49% variance explained) by being younger, more frequent use of the web from public terminals, fewer prior computer classes, and overall CMC competency. The more competent one is at using a general computer-mediated communication technology like the web for a range of interactional, applied purposes, the more positive one is likely to be about using this new technology.

The positive influence of more frequent use of the web from public terminals at first seems like a counter-intuitive result. Although the majority of participants in this study rarely access the web from public terminals, if ever, those who do seem to gain special skills. For example, when using public terminals one must deal with a different set-up than at home, potentially a different operating system or web browser, different log-on and log-off procedures, possibly a more stressful or interrupted social context, and more. Thus, the simple process of accessing the web turns into a learning experience – in both technological and social skills -- each time a user attempts this process from a public terminal. These users may become more open-minded toward technology and are better able to draw connections between what they already know, and what the new technology provides, ultimately predicting a more positive CPS evaluation.

Finally, it is interesting to note that neither web expertise as measured by the Georgia Tech scale, nor CEW fluency, predict CPS evaluation. In order to understand this result, one

must recall the actual items measured by these two scales. The CEW fluency scale is a more skills-oriented instrument, and asks mostly about fairly simple tasks (i.e., using the "save as" function, opening an attachment, etc.). Similarly, the Georgia Tech web use scale asks about very specific tasks completed or not. By contrast, the CMC competency scale looks more at interacting with technology, the application of underlying skills, one's self-efficacy in using a variety of current and new technologies, and one's confidence in knowing which medium to use. Nowadays, having basic computer and Internet technology skills has become ubiquitous. A person is no longer differentiated from another because he or she knows how to check their email account. However, the application of such skills to other contexts has many levels, most of which are measured by CMC competency, a more applied measure, and not by CEW fluency, a baseline measure.

Finally, we consider the very exploratory analysis of predictors of the three post-course evaluation variables, by means of final stepwise regressions (n=11 each). More positive evaluation of "instructional methods" was predicted by less use of the web from work, and greater competency in effective CMC use (84% of variance explained). More positive evaluations of "teacher effectiveness" was predicted by less efficacy in CMC use (53%). And a sense of learning more of the course material by using the CPS was predicted by a more positive evaluation of the validity of responses provided through the CPS (68%).

<div align="center">Conclusion</div>

A wireless classroom feedback system was used multiple times in two Master's classes to foster in-class review and discussion, cognitive and physical interaction, and discussion about topics and answers. Evaluation of the classroom performance system (a wireless student response system) in two courses showed that the students generally rated the system highly (between "strongly agree" and "agree") on the dimensions of training, fun and ease of use, though were less positive about the question of whether the system interfered with the validity of their answers. Overall instructional course ratings were high in both courses.

The primary measures were multi-item, multi-dimensional constructs developed and validated in prior studies, which again showed excellent reliability in this study. Fluency involved three dimensions (computer, email, web), competency involved eight dimensions (comfort, contextual factors, efficiency, interaction management, medium factors, general usage, effectiveness, and rapport), and evaluation of the system included four dimensions (training, ease of use, perceived validity, fun). Different evaluation dimensions were predicted (from 18% to 49%) by different combinations of prior web use, computer classes, exposure to the system, and different dimensions of computer-mediated competency. The system was apparently easy to learn and assess quickly, as there were no changes in over-time evaluation subscales. The predictors of the overall evaluation scale were more use of the web from public terminals, more computer classes, and greater CMC competency.

These results seem to indicate that gender, age, prior computer usage, experience, and computer-email-web fluency do not affect how students evaluate this wireless course feedback system. However, use of the web from public terminals (indicating greater diversity of exposure to technical and social situations), more prior computer classes, and greater overall efficacy and comfort with computer-mediated communication, do positively influence students' overall evaluation of the system. Positive evaluation of the CPS training in particular is influenced by greater exposure to the system, and overall CMC competency. *Ease of use* is positively influenced by familiarity with media differences, *perceived validi*ty of the system by more

computer classes and better ability to manage computer-mediated communication interactions, and *fun* by younger age and greater sense of efficacy with computer-mediated communication.

Referring back to the recent use of self-diagnostic surveys for students to see if they are well-matched to online courses (Hiltz & Shea, 2004; Wang & Newlin, 2000), it does seem that a diagnostic survey using the CMC competency scale could be used to help students understand areas that might positively or negatively influence their evaluation of a wireless class response system. The traditional divides of age, gender, web expertise and overall fluency with computers, email or the web, do not represent opportunities for the use of such a system in a class to favor or hinder any particular students. However, one's level of computer-mediated communication competency, something not yet widely understood, studied, or acquired, does seem to be a possible influence on differential system evaluations.

A rigorous understanding of how computer-mediated instructional technology in general might improve classroom satisfaction and learning would require measurement of the intervening processes of improved social and informational interaction. Few instructional technology studies have done so, though use of the Study Process Questionnaire has been able to show deeper learning in groups supported by learning technology (Biggs, 1991; Kwok & Ma, 1999; both cited in Alavi & Dufner, 2004), and would be a useful addition to future studies of classroom performance systems. Specific applications, and specific intervening learning processes, could then be linked to specific evaluation dimensions. This greater understanding could be used to better implement and understand how such new instructional technologies can improve convergent, collaborative, and participative learning in classrooms, without furthering digital divides between students with different competencies.

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Table One.
Descriptive Statistics for GT Web Expertise, CEW Fluency and CMC Competency

Computer/Web	Mean	S.D.	Alpha
GaTech Web expertise (novice – 0%, intermediate – 13%, experienced – 49%, expert – 38%)	8.5 activities	2.0	
CEW Fluency	4.69	.34	.94
Computer	4.88	.21	.77
Email	4.69	.46	.92
Web	4.49	.50	.88
CMC Competency, excluding contextual factors	3.83	.48	.90
Comfort	3.94	.59	.72
Medium factors	3.93	.71	.81
General usage	3.86	1.04	.87
Effectiveness	3.94	.74	.63
Rapport	3.50	.71	.80
Efficacy	3.94	.70	.85
Interaction management	3.74	.72	.52
Contextual factors	2.90	.45	.11

Table Two.
Reliabilities, Correlations, Means and Standard Deviations for CPS Evaluation Scale and Subscales, Across the Two Measurement Periods, with Open-Ended Comments Concerning CPS

Evaluation	Alpha		Mean/ S.D.		T-test	Correlation
	7 weeks	14 weeks	7 weeks	14 weeks		
Overall CPS Evaluation	.88	.89	1.77 / .47	1.74 / .48	n.s.	.67 ***
Training	.91	.92	1.55 / .56	1.47 / .59	n.s.	.58 ***
Ease of use	.73	.75	1.41 / .47	1.41 / .48	n.s.	.99 ***
Validity	.75	.80	2.36 / .82	2.36 / .82	n.s.	.99 ***
Fun	.87	.85	1.76 / .68	1.77 / .73	n.s.	.44 ***

Items scored from 1=strongly agree to 5=strongly disagree; n=39 to 45, 39 in common; pairwise correlations.
*** $p<.001$
Open-ended comments from student instructional evaluation forms relating to CPS
The CPS system. I really liked the CPS system. I liked using the CPS during class to test my knowledge of the material. The CPS technology that we used was very interesting -- it helped me figure out what chapters I needed to go back and re-read. Lecture style and use of CPS for reinforcing learning. CPS and course lecture. CPS. Fun use of teaching technology in class. The CPS was a great complement to the lectures. Using the eInstruction system is not appropriate in a graduate class and took time away from meaningful discussions. CPS was fun.

Table Three.
Summary Course Ratings from End-of-Semester Instructional Rating Survey

Questions	Overall Course Mean Evaluations, Reported by Course Evaluation Office			Three Questions Three Months Later – Mean and S.D. of Individual Responses		
	Research Methods	Mediated Commun-ication	Mean of All Master's Level Courses that Semester	Research Methods	Mediated Commun-ication	Mean across the Two Courses
Instructional methods encouraged student learning (a)	4.38	4.52	4.32	3.6 (sd=1.2)	4.4 (sd=.5)	4.1 (sd=1.0)
Teaching effectiveness of the instructor (b)	4.75	4.83	4.46	4.6 (sd=.5)	4.6 (sd=.5)	4.6 (sd=.5)
I learned more course material by using the CPS (a)	---	---	---	3.4 (sd=1.4)	3.8 (sd=.7)	3.5 (sd=1.1)

a. 1= strongly disagree to 5 = strongly agree; b. 1=poor to 5=excellent

Table Four.

Correlations between Independent Variables and CPS Evaluation Scale and Subscales

Independent Variables	Training	Easy	Validity	Fun	Overall CPS Evaluation
Gender (1=M)	.01	-.03	-.11	.15	.00
Age	.06	.17	-.22	.37**	.10
Years using Internet	-.08	-.02	.14	-.05	-.02
Computer classes	.24*	.25*	.34*	.04	.30*
Web use from home	-.04	-.18	-.25*	-.04	-.18
Web use from work	.06	.29*	.09	.15	.19
Web use from school	-.19	-.20	-.35*	.15	-.20
Web use from public terminal	-.34**	-.38**	-.38**	-.10	-.40**
Web use from other	-.29*	-.30*	-.25	-.11	-.31*
GaTech web expertise	.19	.16	.23	.01	.20
Low, medium, high exposure to CPS	-.36**	-.08	.04	.09	-.07
Percent of review questions correct	-.37**	-.20*	-.08	.07	-.18
CEW: Computer	-.16	-.01	.09	.03	-.00
CEW: Email	-.01	-.01	-.08	-.03	-.05
CEW: Web	-.21	-.09	-.04	-.12	-.15
CEW: Overall	-.13	-.05	-.04	-.06	-.09
CMC: Comfort	-.31*	-.30*	-.14	-.22	-.31*
CMC: Medium	-.24	-.36**	-.15	-.24	-.31*
CMC: General	-.14	-.30*	-.12	-.09	-.21
CMC: Effectiveness	-.30*	-.33*	-.18	.04	-.23
CMC: Rapport	-.12	-.23	-.11	-.26*	-.24
CMC: Efficacy	-.14	-.13	-.07	-.29*	-.21
CMC: Interaction	-.21	-.14	-.31*	.02	-.23
CMC: Contextual	.09	-.03	.10	-.23	-.02
CMC: Overall, without contextual	-.34*	-.38**	-.32*	-.29*	-.45**
Instructional effectiveness	-.46*	-.51*	-.46*	.14	-.41
Teacher effectiveness	-.24	-.26	.14	.10	-.03
Learn more course material by using CPS	-.44*	-.53*	-.64**	.05	-.52*

p<.05; ** *p*<.01; one-tailed, pairwise tests
For all but last three variables, N = 42 – 44; for last three variables, N=15
Note: The items for the CPS evaluation scale and subscales are scored from 1=strongly agree to 5=strongly disagree, so negative correlations mean more positive evaluation.

Table Five.
Final Stepwise Regressions Predicting CPS Evaluation Subscales and Overall Scale (Excluding Contextual Factors)

Independent Variables	Training	Easy	Validity	Fun	Overall CPS
Age		.28*		.44***	.26*
Web from public terminal	-.27*	-.44***	-.34***		-.41***
Web from work					
Computer classes	.15*		.37**		.30**
CPS Exposure	-.40***				
CMC: Medium factors					
CMC: Interaction management					
CMC: Efficacy				-.40**	
CMC: Overall scale (excluding contextual factors)	-.33*	-.41***			-.53***
Adjusted R-square	.37	.35	.51	.25	.49
F-ratio	6.8***	7.9***	14.4***	7.4***	10.4***
N	39	39	39	42	40

Note: The items in the CPS evaluation scale and subscales are scored from 1=strongly agree to 5=strongly disagree, so lower values mean more positive evaluation. Values are standardized beta coefficients.
* *p*<.05; ** *p*<.01; *** *p*<.005

Table Six.
Final Stepwise Regressions Predicting Post-Course Instructional Evaluations

Independent Variables	Instructional Effectiveness	Teacher Effectiveness	Learned More Course Content from Using CPS
Web from work	-.44**		
CMC: Effectiveness	.67***		
CMC: Efficacy		-.76***	
CPS: Validity			-.84***
Adjusted R-square	.84	.53	.68
F-ratio	29.1***	13.3***	24.6***
N	11	11	11

Note: The items in the CPS evaluation scale and subscales are scored from 1=strongly agree to 5=strongly disagree, so lower values mean more positive evaluation. Values are standardized beta coefficients.
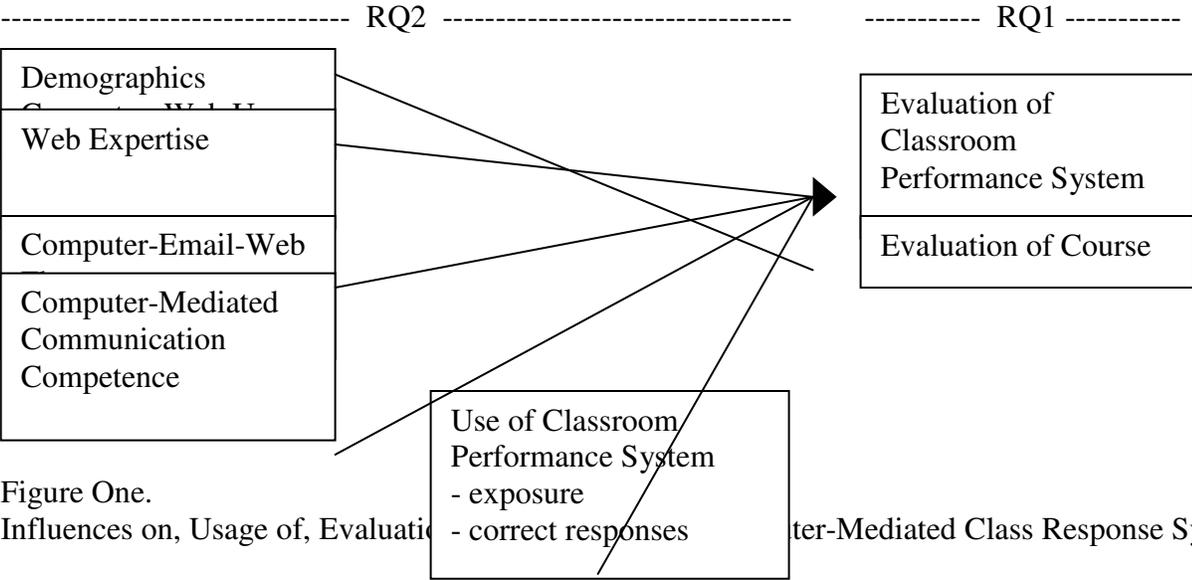* *p*<.05; ** *p*<.01; *** *p*<.005

-------------------------------- RQ2 ---------------------------------   ----------- RQ1 -----------

Demographics
Web Expertise
Computer-Email-Web
Computer-Mediated Communication Competence

Evaluation of Classroom Performance System
Evaluation of Course

Use of Classroom Performance System
- exposure
- correct responses

Figure One.
Influences on, Usage of, Evaluation... ...ter-Mediated Class Response System

Appendix A. Questionnaire 1: Demographics, Computer Use, Web Expertise, Computer-Email-Web Fluency, Computer-Mediated Communication Competency

Computer-Email-Web Fluency & CMC Competency

1. **Are you male or female?**
   a. Male
   b. Female

2. **How old were you on your last birthday?**
   a. Under 19
   b. 20-24
   c. 25-29
   d. 30-35
   e. 36 or older

3. **How long have you been using Internet (including using email, web, chat, etc.)?**
   a. 6 to 12 months
   b. 1 to 3 years
   c. 4 to 6 years
   d. 7 to 9 years
   e. More than 9 years

4. **How many computer classes, courses, or seminars have you attended throughout your lifetime?**
   a. 0
   b. 1-2
   c. 3-5
   d. 6-8
   e. 9 or more

How frequently do you access the World Wide Web (WWW) from the following locations?

[Choices on form were a=daily, b=weekly, c=monthly, d=less than conce a month, e=never]

1.	**From home?**
2.	**From work?**
3.	**From school?**
4.	**From public terminals?**
5.	**From other locations?**

Which of the following have you done?

[Choices on form were a=I have done or b=I have never done]

6.	**Ordered a product/service by filling out an online form**
7.	**Made a purchase online for more than $100**
8.	**Created a web page**
9.	**Customized a web page for yourself (e.g. MyYahoo, CNN Custom News)**
10.	**Changed your browser's "startup" or "home" page**
11.	**Changed your "cookie" preferences**
12.	**Participated in an online chat or discussion (not including email)**
13.	**Listened to a radio broadcast online**
14.	**Made a telephone call online**
15.	**Used a nationwide online directory to find an address or telephone number**
16.	**Taken a seminar or class about the Web or Internet**
17.	**Bought a book to learn more about the Web or Internet**

[Choices on form, for the following sections on computer, email and web tasks, were a=very difficult, b=somewhat difficult, c=neutral, d=somewhat easy, and e=very easy, with a=1 up to e=5 for data analysis]

The following questions are about <u>computer tasks</u>. Please read each question carefully and fill in the appropriate letter on the scantron sheet.

18.   Switching a computer on is

19.   Restarting a computer is

20.   Opening a new document is

21.   Beginning a new document based on a template is

22.   Opening a previously saved file from any drive/directory is

23.   Saving a file is

24.   Saving a document as a template is

25.   Saving a file in a specified drive/directory is

26.   Using "save as" when appropriate is

27.   Saving on a floppy disk is

28.   Using the hard drive is

29.   Creating folders/directories is

30.   Moving files between drives and directories is

31.   Switching between currently open applications is

32.   Renaming files is

33.   Deleting unwanted files is

34.   Printing a document is

The following questions are about <u>email tasks</u>. Please read each question carefully and fill in the appropriate letter on the scantron sheet.

35.   Opening an email program is

36.   Opening new mail messages is

37.   Opening an attached file is

38.   Saving an attached file is

39.   Deleting old or unwanted mail is

40.   Sending an email message is

41.   Attaching and sending a file with a message is

42.   Using the reply and forward features for mail is

43.   Blocking unwanted email senders is

44.   Creating folders for saving mail is

45.   Using message settings such as "important" is

46.   Setting preferences such as "save sent emails" is

47.   Creating a signature file is

48.   Explaining the difference between Address Book & Distribution List is

49.   Creating an address in the address book is

50.   Using the address book to find an address is

51.   Creating my own distribution list is

52.   Using a distribution list to send mail is

The following questions are about <u>web tasks</u>. Please read each question carefully and fill in the appropriate letter on the scantron sheet.

53. Using a browser such as Netscape or Explorer to navigate the World Wide Web is

54. Entering a web address to go there directly is

55. Identifying the host server from the web address is

56. Using hypertext links on World Wide Web pages is

57. Using "back" and "forward" to return to pages is

58. Adding bookmarks of useful sites is

59. Editing bookmarks is

60. Using search engines such as Yahoo and Alta Vista is

61. Using advanced search techniques in search engines is

62. Saving text contents of web pages to a disk is

63. Saving images off web pages to a disk is

64. Turning on/off auto load images is

65. Using a dial-in account to log on to the Internet is

66. Creating a website is

67. Using Internet email such as Yahoo, Hotmail, etc. is

For the following questions, please consider CMC to include all forms of e-mail and computer-based networks (e.g., world-wide-web, chat rooms, personal data assistant, electronic bulletin boards, terminal-based video-telephony, etc.) for sending and receiving written messages with other people. For the following items, indicate the degree to which you agree or disagree with each statement regarding your use of various CMC media. Please read each question carefully and fill in the appropriate letter on the scantron sheet.

[Choices on form were a=strongly disagree, b=disagree, c =undecided, d=agree, e=strongly agree, with a=1 to e=5 for data analysis.]

[Reverse coded items are indicated by the letter "(R)". Abbreviations indicate subscale: CT-Comfort, MF-Medium Factors, GU-General Usage, ES-Effectivness, RT-Rapport, EY-Efficacy, IM-Interaction Management, CF-Contextual Factors.]

68. CT   I get nervous using CMC. (R)

69. CT   I am not very motivated to use computers to communicate with others. (R)

70. CT   Communicating with higher-ups through computers relieves some of my tension.

71. CT   I look forward to sitting down at my computer to compose messages.

72. CT   I like tinkering with options to make my CMC messages more effective.

73. CT   I am very knowledgeable about computer-based communication techniques.

74. CT   I simply don't understand CMC hardware or software very well. (R)

75. CF   I never seem to have enough time to compose my CMC messages as well as I'd like.

76. CF   I like CMC because it gives me time to prepare drafts of my messages. (R)

77. CF   Most of my CMC messages are to people who are geographically far away.

78. EY   I can almost always figure out quickly how to use a new CMC.

79. EY   Having to learn new technologies makes me very anxious. (R)

80. IM   I am good at managing the timing of my CMC conversations with others.

81. IM	Sometimes I don't know when or how to close down a topic of conversation. (R)
82. CT	I am very familiar with e-mail and communication networks.
83. CF	Most of my messages I send to persons "above me" (i.e., of higher status) in the organization.
84. CF	Most of my messages I send to persons of the same status as me. (R)
85. CF	In my work my CMC messages are "all business" and only about the task at hand. (R)
86. CF	I treat my CMC messages as opportunities to work on relationships as well as tasks.
87. EY	I don't feel very competent in learning and using communication media technology. (R)
88. EY	I feel completely capable of using almost all currently available CMCs.
89. EY	I am confident that I will learn how to use any new CMCs that are due to come out.
90. EY	I am nervous when I find I have to learn how to use a new communication technology. (R)
91. EY	I am generally the last person of friends and colleagues to adopt or purchase a new CMC. (R)
92. EY	I find changes in technologies very frustrating. (R)
93. IM	I manage CMC interactions skillfully.
94. MF	I choose which medium to send some messages by (i.e., CMC, mail, phone, or face-to-face), based on how much access the person I need to communicate with has to each channel or medium.
95. MF	I choose which medium to send some messages by (i.e., CMC, mail, phone, or face-to-face), based on how quickly I need to get a message out to people.
96. MF	I choose which medium to send some messages by (i.e., CMC, mail, phone, or face-to-face), based on how immediate I need the feedback to be.
97. MF	I choose which medium to send some messages by (i.e., CMC, mail, phone, or face-to-face), based on how much benefit there would be to having the other(s) present.
98. MF	I choose which medium to send some messages by (i.e., CMC, mail, phone, or face-to-face), based on how lively the interaction and feedback need to be.
99. GU	I rely heavily upon my CMCs for getting me through each day.
100. GU	I use computer-mediated means of communication almost constantly.
101. GU	I can easily go a week without any CMC interactions. (R)
102. GU	I am a heavy user of computer-mediated communication.
103. ES	I generally get what I want out of my CMC interactions.
104. ES	I find most of my CMC conversations frustrating. (R)
105. RT	My colleagues/friends look to me frequently for help with their CMC questions or needs.
106. RT	I spend a lot of time just exploring CMCs just to see what I can do with them.
107. RT	I am excited by the prospect of getting and learning new CMCs.
108. RT	I usually master a new CMC before most of my friends or colleagues.
109. RT	I am rarely far away from a computer with which I can communicate with others.
110. RT	I have access to computer communication media both at home and at a place of work.

This concludes our survey. Thank you for participating.

Appendix B. Questionnaire 2, 3:
Evaluation of the CPS – Training, Ease of Use, Perceived Validity, Fun.

Your Experience with Using the CPS Technology

On the Scantron sheet, your I.D. NUMBER has three digits, placed to the right.

- **In the 1st row and the 8th column, enter a "1" if you are in the CMC class, and a "2" if you are in the Research class.**
- **In the same 1st row but columns 9 and 10, enter your two-digit remote control number – that is, 01 up to 32.**
- **Then fill in/darken the ovals for the corresponding three numbers.**

Please tell us about your experience using this new technology. When answering the following questions, please think about your experience <u>with using the remote control technology</u>, not any other CMC technology you might be familiar with.

For each question, please choose the appropriate letter based on the scale: (a=Strongly Agree; b=Agree; c=Neither Agree nor Disagree (Undecided); d=Disagree; e=Strongly Disagree). *[where a is entered as 1, up to e as 5, for data analysis.]*

Then fill in/darken that letter for that question on your Scantron sheet.

[Note: Reverse coded items are indicated by the letter "(R)". Abbreviations indicate subscale:T-Training, F-Fun, V-Perceived Validity, E-Easy.]

1.	T	The introductory explanations on how to use the technology were sufficient.
2.	T	The introductory explanations on how to use the technology were clear.
3.	T	The introduction didn't provide enough explanation on how to use the technology. (R)
4.	T	After the introduction, I still wasn't sure how to use this technology. (R)
5.	T	Listening to the introductory explanations, I understood quickly how this technology works.
6.	E	Using the technology was easy.
7.	E	Using the remote controls was easy.
8.	E	Using CPS is pretty hard. (R)
9.	E	I don't really understand how this technology works. (R)
10.	E	I had no problems with the technology.
11.	V	Having to use the technology influenced the way I answered questions. (R)
12.	V	I never thought about the technology while answering questions.
13.	V	I'm not sure my answers were accurate. (R)
14.	V	Having to use CPS had no effect on how I answered the questions.
15.	V	I wasn't always able to answer the way I wanted to because of the technology. (R)
16.	F	Using the remote controls was fun.
17.	F	I always enjoy using a new technology.
18.	F	Using CPS as a way of completing a questionnaire is exciting.
19.	F	The technology was annoying. (R)
20.	F	I really enjoyed using CPS.

THANK YOU!