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IT In the Classroom: Researching the Outcomes of Classroom Response Systems

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ABSTRACT

This research in progress is part of a study being submitted for dissertation. The purpose of this study is to determine what types of students will be impacted by Classroom Response Systems (CRS) technology. Additionally, this research explores the nature of the outcomes experienced by students and their perceptions of leading pedagogy and practices for CRS technology in the classroom. An extensive review of the literature on CRS is included. A theoretical model based on Task-Technology Fit and Kirkpatrick's four-level model of educational outcomes is proposed as a framework to organize the existing CRS technology research and study the impact of CRS technologies.

Keywords

Classroom Response Systems, education, Task-Technology Fit, individual characteristics

INTRODUCTION

Education today is very different than it was 20 years ago. Established teaching practices, based primarily on tradition, do not meet the needs of today's students (Crouch and Mazur 2001). This research seeks to identify the types of today's students affected by Classroom Response Systems (CRS) technology and determine how it does or does not meet their needs.

While there are many methods for providing in-class instruction, the literature suggests that CRS technology allows instructors and students to engage in active learning in ways that may not be possible without this technology (Reay *et al.* 2008). The systems consist of a receiver integrated with a host computer and handheld response devices. These devices, or "clickers", allow students to participate in a presentation/lecture (Figure 1).

Businesses and academic institutions purchase and implement these solutions to achieve two main benefits. First, the systems automate many of the manpower intensive management tasks involved in providing education or training. Second, the systems allow instructors and students to interact and engage in active learning (Crouch and Mazur 2001). These expected benefits are thought to improve the education process. While the success of these systems is often reported, there is simply not enough rigorous research in this area of study to explain the dynamics of how these systems behave (Fies and Marshall 2006; Simpson and Oliver 2007).

These systems likely affect different students in different ways. Who are the students whose performance will either benefit or suffer due to CRS? What are the outcomes from the technology itself? These questions, which have emerged in the current, leading research on CRS, motivate this study.

This research uses an existing Information Systems (IS) theory which explains the impact of technology on performance (Goodhue and Thompson 1995). Task-Technology Fit (TTF) considers the Individual Characteristics of the user and how these differences ultimately impact performance. The study also uses an accepted educational model to define outcomes (Kirkpatrick 1996).

Section 2 presents reviews of literature related to CRS, TTF, and the four-level model. Section 3 develops a theoretical model and discusses research questions. Section 4 offers a preliminary discussion on the expected findings.

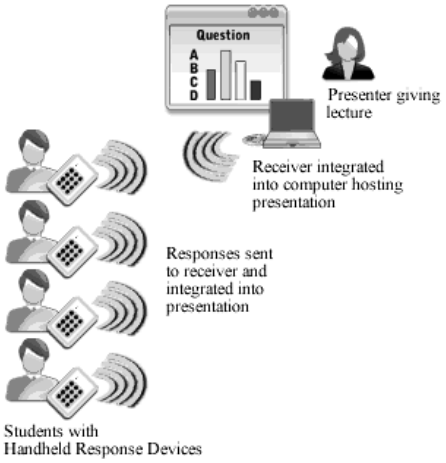

Figure 1. Explanation of Traditional CRS

LITERATURE REVIEW

Technology and Pedagogy

Pedagogy

In the 1970s researchers began to hypothesize that CRS would be used in the future to facilitate active learning environments. The technology quickly became linked to this type of pedagogy in the minds of many researchers. Studies in the 1990s focused on the interactive environment enabled by CRS. Abrahamson (1998, 1999) discusses the benefit of the Socratic Method in teaching physics but explains how this is usually only effective in small classes. His ideas suggest that CRS technology enables this question-answer based pedagogy to work well in large classes.

Dufrense et al. (1996) describe a detailed account of CRS implementation in the physics department of a large university. While many of the technical aspects of the system are discussed, the major focus of the article is to discuss ways to facilitate active learning and help students. (Dufrense et al. 1996).

Poulis et al. (1998) examined outcomes from large physics classes. They analyzed outcomes from classes that used CRS against classes that did not. From the nearly 6,000 students who participated in the study, Poulis et al. found that the pass rate for students in CRS classes was nearly 50% higher than those in the non-CRS classes. Mazur (1997) shows significant gains from pre-test to post-test scores for physics students using CRS over those who did not. Both of these studies attribute gains to the interactive pedagogy rather than the technology itself.

Technology

Elements of CRS research focus on the technology itself. This is different from early works which focused on the basic functionality of rudimentary systems. Researchers who either consider the pedagogy embedded in the technology or make an effort to separate the technology from the pedagogy were included in this section. This technology focused research explores (1) the unique feedback provided by the technology, (2) compares different technologies, or (3) separates/combines the technology from/with the pedagogy.

Feedback

One of the unique contributions of CRS technology is the immediate feedback it offers. Boyle and Nicol (2003) describe an initiative called, "New Approaches to Teaching and Learning in Engineering," (NATALIE) in the engineering department of a large university. The department used NATALIE to see if CRS could address three major concerns, "weak conceptual

understanding, insufficient interaction and discussion, and low levels of motivation" (Boyle and Nicol 2003). They used two different pedagogic methods, PI (Mazur 1997) and class-wide discussion (Dufrense et al. 1996). The study ran for two 12-week semesters. One hundred seventeen student participants were assigned to three or four person peer teams within their perspective class. Student perceptions were captured through surveys, questionnaires and group discussions. Boyle and Nicol (2003) found that the unique contribution of the technology lies in the feedback it enables. Students reported feeling most engaged either when they were discussing topics with their peers or when the feedback (histogram slide) was presented.

Comparisons

Other research considers the effects of CRS compared to other technologies. Considering less technically advanced solutions, Stowell and Nelson (2007) compared CRS to standard lecture, hand-raising, and a paper flashcard system. They conducted a controlled experiment and randomly assigned 140 undergraduate students enrolled in introductory psychology courses to each of the four conditions. Each group received the same lecture which served to simulate a psychology class. Questions were presented in each lecture and answers were obtained through different methods. Standard lecture presented open ended questions which students could choose to answer by hand-raising and being called upon. The other three sections presented multiple choice type questions and asked the students to raise their hand, hold up a flashcard, or click for the appropriate choice. Students were given the Academic Emotions Questionnaire (AEQ) before, during and after the lecture. This battery captures student emotions. The researchers also gathered formal and informal measures of participation in each condition. They found that students participate most in the CRS condition, less when using flashcards, even less when hand-raising, and the least in standard lecture (Stowell and Nelson 2007).

Performance and Fit

The outcomes that researchers have looked for can be categorized as either pertaining to performance or fit. Studies which test to see if CRS use leads to improved learning outcomes, affects attendance or motivation, or changes student behavior are considered "performance" oriented. Studies which gather and analyze student perceptions are considered "fit" oriented..

Performance

Reay et al. (2008) conducted research to test for the affect of CRS on conceptual learning. Approximately 50% of the classes used clickers. In sections where CRS were not used, the same concepts were covered in traditional lecture. They found a 10% increase in post test scores for students who used CRS during the course of the year. They also found that students were generally enthusiastic about using the CRS, except when used for grading or to present too many questions.

Lasry (2008) conducted a study of learning outcomes on students randomly assigned to two sections of an algebra class. Both sections were taught with the PI pedagogy (Mazur 1997) for one full semester. The treatment group (n=42) used a CRS technology. The control group (n=41) used paper flashcards. All other elements constant, Lasry found no significant difference in scores between groups and concluded that CRS do not yield learning outcomes by themselves; the pedagogy works without the technology. The real benefit to both instructor and student in using CRS lies in making the teaching process more efficient (Lasry 2008).

While most of the performance oriented research focuses on cognitive learning outcomes, other performance outcomes have also been explored. Len (2007) used different reward structures to see if student behavior would change. Thirty six undergraduate astronomy students participated in the study. These students identified themselves as either the type of student who would answer a question on his own, "self-testers" or as the type of student who would rather confer with a peer, "collaborators". Len doubled the participation points awarded to if the class reached an 80% success rate on clicker questions. He found that this motivated the self-testers to collaborate to achieve this high success rate (Len 2007).

Fit

In addition to performance outcomes, researchers have been interested in how instructors and students feel about CRS. The perception of how well a technology will help an individual complete a task or set of tasks is defined as fit (Goodhue and Thompson 1995).

Most studies that consider fit also look for specific performance outcomes. A study that does not separate the effects of the technology from the pedagogy shows that students like using CRS and achieve higher scores when using them (Sharma et al. 2005). One hundred thirty eight physics students provided survey responses about their comfort using CRS to cover specific physics principles during a 2002 semester. The questions presented were based on questions and answers gathered from non-CRS users in 1999. Overall, the 2002 students reported being comfortable and liking CRS.

Preszler et al. (2007) conducted a combined study of student attitudes and performance. Five hundred fifty students enrolled in six biology courses of varying levels participated over the course of a semester. The number of clicker questions was systematically varied. Participants provided survey responses about their perceptions from using CRS. The study found that while the majority of participants were positive about CRS, students from lower-division courses reported significantly more positive feelings about CRS (Preszler et al. 2007).

Individual Characteristics

Not much research has been conducted on the effects of the individual characteristics of student users, although CRS researchers have highlighted this as an area of interest for future research (Fies and Marshall 2006; Simpson and Oliver 2007). Technology, in general, affects different people in different ways. The studies included in this section consider the individual differences of: gender, age, ethnicity, experience with technology, time, course level, willingness to participate, and major course of study.

In the first study which directly considered the individual characteristics, Rice and Bunz (2003) analyzed student evaluations of CRS based on student demographics and existing expertise, fluency, competency and usage of technology. A total of 61 students in two Master courses participated in the study over the course of a semester. They received questionnaires that measured a number of items related to demographics, expertise, fluency, competency and usage of technology. The authors hypothesized that those students with less of a "digital divide" to technology in general would have an easier time (Rice and Bunz 2003). Their findings showed that gender, age, prior computer usage, experience, and fluency do not affect how students evaluate CRS. Exposure to a diversity of technology, prior computer classes, and greater overall efficacy and comfort with technology do positively influence the overall perception.

MacGeorge (2007) is highly critical of much of the existing research for not considering important elements, such as individual characteristics. She points out several limitations in the existing research and provides methods to correct them. Her study states that most of the existing research focuses on students, classes or implementations that do not represent the typical undergraduate using CRS in a large class. To correct for these limitations, MacGeorge conducted a robust empirical study. She created and validated a multi-dimensional evaluation tool: the Audience Response Technology Questionnaire (ART-Q), which captures nearly 15 dimensions of user perceptions about CRS. She also gathered data on the diversity of the student users (gender, year in school, ethnicity, prior use, major course of study, and age) and tested to see if these individual factors affect students' perceptions. The study consisted of three separate classes, representing different disciplines, where the instructors used CRS in different ways. A total of 854 student users participated in the study. Students completed the ART-Q at three separate times during the 17 week semester. The ART-Q captured the student perceptions about CRS affects on: appraisal/learning, enjoyment, preparation/motivation, attendance, negative grade and ease of use. MacGeorge (2007) found that students reported CRS easy to use, enjoyable, beneficial to learning, and that the systems encourage attendance. These finding generalize to the typical student and seem stable over time. MacGeorge concludes that these individual characteristics do not effect student perceptions of CRS, but suggests the future research employ different statistical methods to explore them. In any case, the preponderance of literature suggests that while individual characteristics of students remain an area of research interest, no recognizable pattern of differences has emerged.

THEORETICAL MODEL

This study makes a case for TTF as a theoretical framework with which to better understand the dynamics of CRS. This section is organized in terms the TTF model (Goodhue and Thompson 1995). TTF shows how the elements of pedagogy, technology, individual characteristics, and the fit work together to predict performance outcomes. While previous CRS research has considered many of these elements, this is the first study to contain them all.

The TTF theoretical model is most often used to assess overall fit of technology, in general, for a business or when evaluating large information systems or phenomena (D'Ambra and Wilson 2004; Zigurs and Buckland 1998). Goodhue defines this specific type of fit as the extent to which the technology matches task requirements and individual abilities and leads to higher performance (Goodhue 1997).

The TTF model shows that for technology to have positive impacts on performance, it must be utilized, and it must be a good fit with both the people who use it and the tasks it supports (Goodhue and Thompson 1995). Figure 2 shows the chain of technology to performance. The figure breaks down into two major sections, (1) theories of fit and (2) theories of attitudes and behavior.

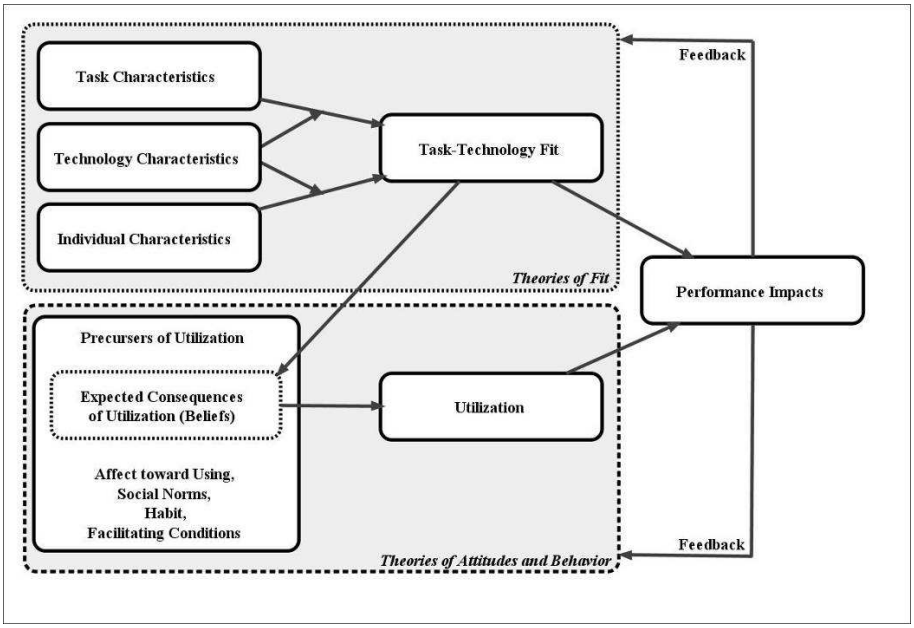

Figure 2. The Technology-to-Performance Chain (Goodhue and Thompson 1995)

Figure 2 shows that task characteristics and individual characteristics directly affect fit. Technology characteristics moderate the relations between task characteristics and fit, and between individual characteristics and fit. Fit then directly affects performance. Theories of attitudes and behavior show that individual factors affect whether a person will actually use a specific technology. Utilization then directly affects performance. Throughout the process, performance provides feedback which affects the antecedents of both fit and utilization.

Defining Outcomes

Kirkpatrick's view of the possible outcomes from education has been used in education and training research since its inception in 1959. Table 2 presents the four-level model and explains that students experience reaction, learning, behavior, and results outcomes.

Level	Outcome	Definition
Level I	Reaction	Did the student like or enjoy it? Did they find it easy to learn?
Level II	Learning	Did the student gain knowledge or deeper understanding of new concepts?
Level III	Behavior	Did the student actually change their behavior due to the learning process?
Level IV	Results	Were there actual measured performance results?

Table 2. Four-Level Model of Outcomes from Education (Kirkpatrick 1996)

This research augments the model by using it to define the range of possible impact potential outcomes within the TTF theoretical framework. Quantitative measures associated with the four-level model, coupled with qualitative measures from student feedback make the four-level model appropriate for framing a more complete definition of possible impacts of CRS.

MODEL

The original TTF framework considers only the boxes and straight line arrows in Figure 3. This version contains the basic elements of the original TTF model, but it has been modified in three major ways. First, a direct relation between *Individual Characteristics* and *Outcomes* has been added (the curved line). Second, the current project does not explore or address the relation between *Individual Characteristics* and *Perceived Fit*, or the moderating effect of *Technology Characteristics* on this relation (the grey lines). Third, *Individual Characteristics, Perceived Fit,* and *Outcomes* are specifically defined in this research. These variables are expanded throughout this section to show where they fit into the overall constructs.

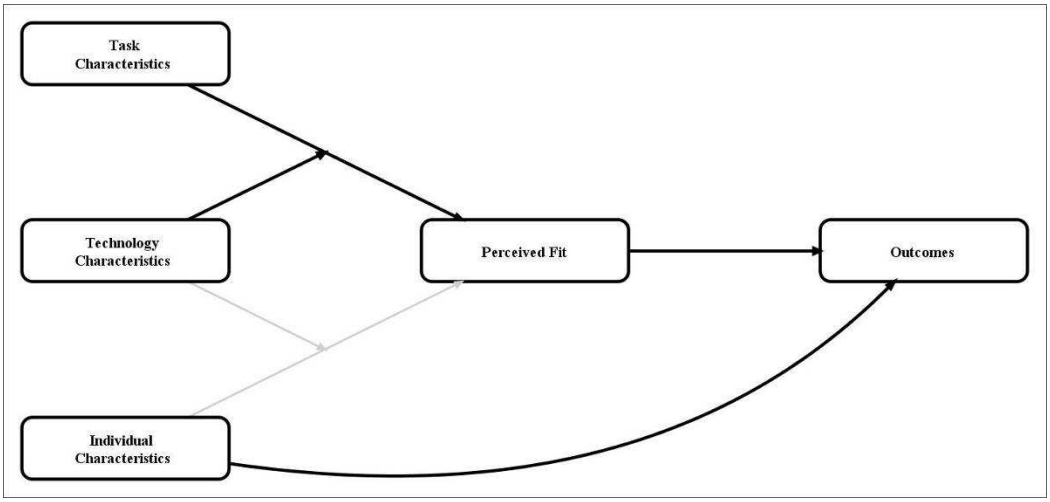

Figure 3. Modified TTF Model

The modification suggests that *Individual Characteristics* have a direct relation to *Outcomes*. Figure 3 also suggests that *Perceived Fit* has a direct relation to *Outcomes* and that *Task Characteristics*, moderated by *Technology Characteristics*, affect *Perceived Fit*.

Model Development

Individual Characteristics (Personality)

Although CRS technology researchers have evaluated how users' *Individual Characteristics* affect *Outcomes*, none have conducted a purposeful analysis of basic, stable, and complete *Individual Characteristics*. *Personality* is defined as a set of characteristics unique to an individual (McCrae and Costa 1997). These characteristics influence an individual's perceptions, attitudes, motivations and actions (McCrae and Costa 1997). Since *Personality* factors differentiate individuals, are stable over time and across cultures (Gough and Heilbrun 1983; McCrae and Costa 1997), and provide useful dynamics with which to profile student users, these characteristics are used as a surrogate measure of the TTF construct *Individual Characteristics*. Specifically, the *Personality* factors of the Five-Factor Model (FFM) will be used.

The FFM identifies an individual's *Personality* through a mix of factors (McCrae and John 1992).It shows that *Personality* can be described with five basic dimensions (Table 3). These dimensions, coupled with a wide range of scales and indices to interpret them, provide robust measures of *Individual Characteristics* which can be derived from a short, valid, and highly reliable survey, the Adjective Check List (ACL) (Gough and Heilbrun 1983). Data from the ACL will be used to create profiles of students based on their *Personality* factors and their experienced *Outcomes.*

Personality Factor	Definition
Openness	Sometimes called intellect/imagination, openness includes having wide interests, and being imaginative.
Conscientiousness	Defined as a tendency to show self-discipline, act dutifully, and achieve.
Extraversion	Sometimes referred to as assurgency, extraversion encompasses more specific traits like being talkative, energetic, and assertive.
Agreeableness	Defined as a tendency for compassionate attitude and behavior towards others.
Neuroticism	Sometimes reversed and called emotional stability, neuroticism is characterized by being tense, moody, or anxious.

Table 3. Definitions of Factors in the Five-Factor Model.(McCrae and Costa 1997)

The *Personality* factors represented in Table 3 are separate and distinct elements which, when taken together, describe an individual's *Personality*. Each person's *Personality* will contain a value for each factor. Each factor's score exists along a continuum.

Perceived Fit

Fit, as defined by Goodhue includes many sub-elements. Some of these sub-elements are only appropriate for evaluating technology in general not for evaluating specific systems. The sub-elements which are appropriate for evaluating a specific technology are listed and defined in Table 4.

Element	Definition
Currency	The data used is current enough to meet a user's needs.
Right Data	The system maintains the necessary fields or elements of data.
Right Level of Detail	The CRS maintains the data at the right level or levels of detail.
Meaning	It is easy to determine what a reported data element means, or what is excluded or included in calculating it.
System Reliability	The system is dependable and there is a consistency of access and uptime.
Ease of Use	It is easy to do what the user wants to do using the system hardware and software.
Training	The user can get the kind of quality training on the system when they need it.
Task Equivocality	The frequency of dealing with ill-defined problems in the course.
Performance Impact	The system has a large, positive impact on the user's effectiveness and productivity in this class.

Table 4. Task-Technology Fit Elements and Definitions. (Goodhue and Thompson 1995)

If a user perceives: the data presented by the response system is current, is the right type and level of data, understands the meaning of the data, perceives the systems as working and reliable, easy to use, is well trained to use the system, can use the system for ambiguous tasks, and feels that the system positively impacts him, the user will have a high Perceived Fit.

Outcomes

Kirkpatrick has defined outcomes from education or training in terms of *Reaction*, *Learning*, *Behavior*, and *Results* (Kirkpatrick 1996). Researchers have accepted this model as a simple, yet complete, set of outcomes which result from education. These behave in the same manner as the Personality factors: they are separate outcomes, a person will have a value for each, and values for each exist along separate continuums. A high *Reactive Outcome* score means the student enjoyed the class. *Learning* identifies if a person gained new concepts or deeper understanding of existing concepts from the course. A high *Learning Outcome* means the individual gained many new concepts. *Behavior* is defined as a change in behavior as a result of the course. Those who change many behaviors will have high *Behavior Outcomes.* And *Results* are defined through test scores. An individual with high gains from pre to post test has a high *Results Outcome.*

Research Questions and Hypotheses

Research Question and Hypothesis 1

The first question involves *Personality* and *Outcomes*. TTF holds that, in general, *Individual Characteristics* are moderated by *Technology Characteristics* and affect *Perceived Fit*. *Perceived Fit* then affects *Outcomes*. Using a more specific and robust set of *Individual Characteristics*, such as *Personality*, may show direct effects between *Individual Characteristics* and *Outcomes*. Research Question 1 asks if an individual's *Personality* directly affects *Outcomes* from a course when using a response system (Figure 5):

RQ1: Is there a relation between Personality and Outcome, following a class using a response system?

While no existing study provides background information with which to determine which *Personality* factors will contribute most to the hypothesized relations, assumptions about *Personality* factors provide some possible intuitive directions.

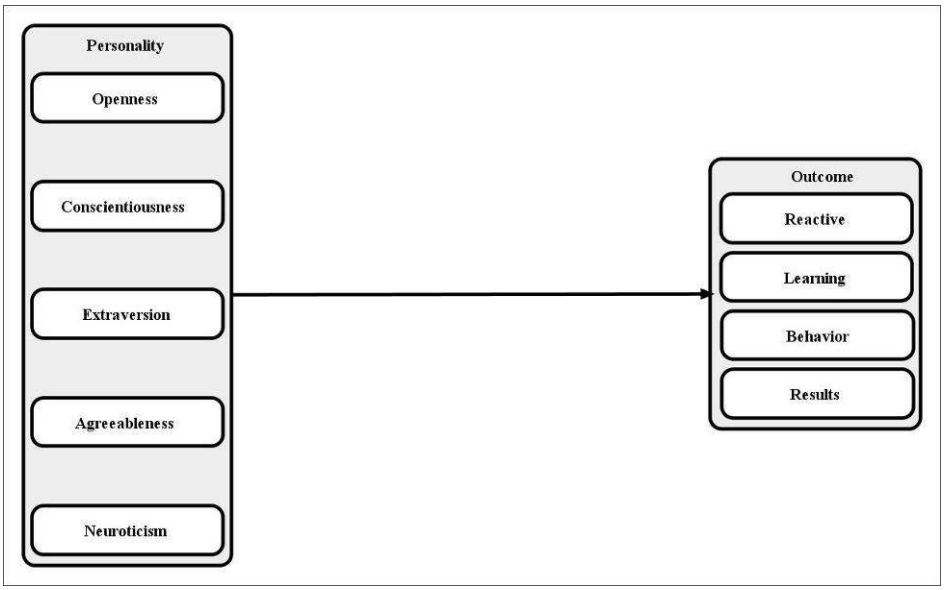

Figure 5. Personality's Effect on Outcomes.

Research Question and Hypothesis 2

The second research question explores the relation between *Perceived Fit* and *Outcomes*. TTF theory proposes that an individual's *Perceived Fit* of technology-to-task affects their performance *Outcome*. This research question tests to see if this applies to response system use (Figure 6):

RQ2: Is there a relation between Perceived Fit and Outcome, following a class using a response system?

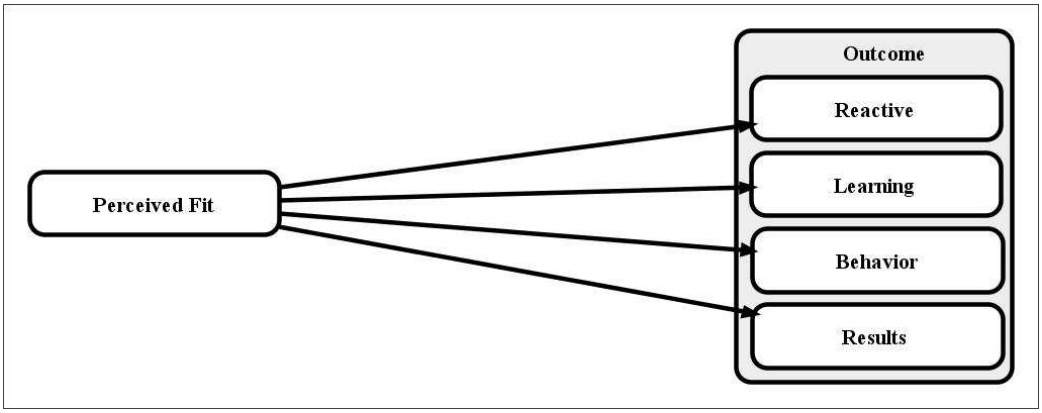

Figure 6. Perceived Fit's Effect on Outcomes.

This also tests a proven theory, TTF, in a different environment. Results from the quantitative analysis part of this study will either show that TTF works, in part or as a whole, for predicting the impact of CRS technology or it will provide an example where a proven theory does not work as expected. This will highlight either the power or the limitations in the TTF model when used to evaluate a specific technology. This could generate alternate explanations that TTF only measures certain types of performance, that it measures something other than performance, or that *Personality* alone has more predictive power than the entire model.

PRELIMINARY FINDINGS AND CONCLUSION

This project began at a major southwestern university, using two sections of an introductory information systems class. These sections meet over the Spring 2009 semester, from January to May. Over 100 students are assigned to each section. The students enrolled in these sections are demographically diverse and range in age from 19 to over 50.

The data to be collected during this study are both quantitative and qualitative in nature. Students self select which section of the course they will attend and each section is randomly assigned as either control (non-CRS technology condition) or treatment (CRS technology condition). Initially, a variety of personality related quantitative data was collected from both conditions using the ACL. A pre-test for existing knowledge was also be administered to each section. The same PI-based curriculum will be employed for both the control and treatment groups. The treatment group will use the TurningPoint™ response system (TurningTechnologies 2008), while the control group will use a paper-based flashcard system. At the end of the semester, Perception of Fit data (Appendix 1), Outcome data (Appendix 2), and post-test data will be collected and measured. Once these quantitative data have been collected, they will be mined for patterns that explain Outcomes.

Specifically, Multivariate Adaptive Regression Splines (MARS) will be used to classify and predict *Outcomes* from patterns in the *Personality* and *Perceived Fit* data. MARS is a non-parametric regression technique. It finds patterns based on linear combinations, non-linearity and interactions. MARS is especially suited for large data sets, output is easy to understand and interpret, and it requires little to no data preparation.

Qualitative focus group discussions will be conducted at the end of the course. The discussions will use a semi structured format (Appendix 3). Responses from these discussions will be analyzed for trends in responses that offer explanation as to "why" the patterns discovered in the quantitative analysis might exist.

So far, the only data that has been analyzed are the pre-test scores for each section. Each section performed similarly and showed low levels of pre existing knowledge (mean = 45, standard deviation = 10 for each section).

The research site and sample, forms of data to be collected, operationalization of the constructs of interest, and data collection procedures are unique and appropriate. This is the first study to frame CRS technology in terms of the TTF model and define potential outcomes with the four-level model. It blends education and IS disciplines and has potential to contribute to the body of knowledge for each discipline.

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Appendix 1. Task-Technology Fit Survey

Task-Technology Fit

Instructions

This survey is one of three you will complete as part of the semester long research study. Please take your time and provide responses to the best of your ability. Please remember to provide your class assigned ID (not your UTSA student ID). This will be the only tracked identification method for these surveys and will be destroyed after the data have been analyzed. Thank you for your help.

1. Please provide your class assigned ID:

Task-Technology Fit

The system we have been using in class to gather responses from students, provide feedback, and spark discussion is interesting to researchers in the Information Systems and Education fields. Researchers want to know how students who use the system feel about it and whether or not it is appropriate to use in the classroom environment. Your honest feedback is important for researchers to better understand the overall effects of these types of systems.

*** 1. I can't get data from the response system that is current enough to meet my needs during class.**

	Agree	1	2	3	4	No Opinion	6	7	8	9	Disagree
Rating	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

*** 2. The response system is an important and valuable aid to me in taking this course.**

	Agree	1	2	3	4	No Opinion	6	7	8	9	Disagree
Rating	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

*** 3. I get the training I need to be able to use the response system effectively.**

	Agree	1	2	3	4	No Opinion	6	7	8	9	Disagree
Rating	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

*** 4. The response system is subject to frequent problems.**

	Agree	1	2	3	4	No Opinion	6	7	8	9	Disagree
Rating	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

*** 5. Frequently the problems I face in class involve answering questions that have never been asked in quite that form before.**

	Agree	1	2	3	4	No Opinion	6	7	8	9	Disagree
Rating	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

*** 6. The response system maintains data at an appropriate level of detail for my tasks.**

	Agree	1	2	3	4	No Opinion	6	7	8	9	Disagree
Rating	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

Task-Technology Fit

	Agree	1	2	3	4	No Opinion	6	7	8	9	Disagree
Rating	○	○	○	○	○	○	○	○	○	○	○

*** 7. The response system is subject to unexpected or inconvenient times where it is unavailable for use which makes it harder to use in class.**

	Agree	1	2	3	4	No Opinion	6	7	8	9	Disagree
Rating	○	○	○	○	○	○	○	○	○	○	○

*** 8. The feedback data is up to date enough for my purposes.**

	Agree	1	2	3	4	No Opinion	6	7	8	9	Disagree
Rating	○	○	○	○	○	○	○	○	○	○	○

*** 9. I frequently deal with ad-hoc, non-routine problems in this course.**

	Agree	1	2	3	4	No Opinion	6	7	8	9	Disagree
Rating	○	○	○	○	○	○	○	○	○	○	○

*** 10. The response system has a large, positive impact on my effectiveness and productivity in this class.**

	Agree	1	2	3	4	No Opinion	6	7	8	9	Disagree
Rating	○	○	○	○	○	○	○	○	○	○	○

*** 11. There is not enough training for me or my fellow students on how to find, understand, access or use the response system.**

	Agree	1	2	3	4	No Opinion	6	7	8	9	Disagree
Rating	○	○	○	○	○	○	○	○	○	○	○

*** 12. The response system is missing critical data that would be very useful to me for this class.**

	Agree	1	2	3	4	No Opinion	6	7	8	9	Disagree
Rating	○	○	○	○	○	○	○	○	○	○	○

*** 13. On slides or feedback presented in class, the exact meaning of the data elements is either obvious, or easy to find out.**

	Agree	1	2	3	4	No Opinion	6	7	8	9	Disagree
Rating	○	○	○	○	○	○	○	○	○	○	○

*** 14. The data maintained and presented by the response system is pretty much what I need to carry out my tasks for the course.**

	Agree	1	2	3	4	No Opinion	6	7	8	9	Disagree
Rating	○	○	○	○	○	○	○	○	○	○	○

Task-Technology Fit

*** 15. Frequently the problems I work on involve answering questions that have never been asked in quite that form before.**

	Agree	1	2	3	4	No Opinion	6	7	8	9	Disagree
Rating	○	○	○	○	○	○	○	○	○	○	○

*** 16. I can count on the response system to be working and available when I need it.**

	Agree	1	2	3	4	No Opinion	6	7	8	9	Disagree
Rating	○	○	○	○	○	○	○	○	○	○	○

*** 17. The exact definition of data presented by the response system is easy to determine.**

	Agree	1	2	3	4	No Opinion	6	7	8	9	Disagree
Rating	○	○	○	○	○	○	○	○	○	○	○

*** 18. The response system is convenient and easy to use.**

	Agree	1	2	3	4	No Opinion	6	7	8	9	Disagree
Rating	○	○	○	○	○	○	○	○	○	○	○

*** 19. I frequently deal with ill-defined problems in this course.**

	Agree	1	2	3	4	No Opinion	6	7	8	9	Disagree
Rating	○	○	○	○	○	○	○	○	○	○	○

*** 20. It is easy to learn how to use the response system.**

	Agree	1	2	3	4	No Opinion	6	7	8	9	Disagree
Rating	○	○	○	○	○	○	○	○	○	○	○

*** 21. Sufficiently detailed data is maintained by the response system.**

	Agree	1	2	3	4	No Opinion	6	7	8	9	Disagree
Rating	○	○	○	○	○	○	○	○	○	○	○

Thank You

Thank you for completing this survey.

Appendix 2. Outcomes Survey

Outcomes

Instructions

This survey is one of three you will complete as part of the semester long research study. Please take your time and provide responses to the best of your ability. Please remember to provide your class assigned ID (not your UTSA student ID). This will be the only tracked identification method for these surveys and will be destroyed after the data have been analyzed. Thank you for your help.

1. Please provide your class assigned ID:

Outcomes

The system we have been using in class to gather responses from students, provide feedback, and spark discussion is interesting to researchers within the Information Systems and Education fields. Researchers want to know how students who use the system feel about it and what type of benefit students perceive. Your honest feedback is important for researchers to better understand the overall effects of these types of systems.

*** 1. I learned concepts in this class that I did not know prior to taking it.**

	Agree	1	2	3	4	No Opinion	6	7	8	9	Disagree
Rating	○	○	○	○	○	○	○	○	○	○	○

*** 2. I enjoyed using the response system in class more than using traditional in-class methods (e.g. lecture)?**

	Agree	1	2	3	4	No Opinion	6	7	8	9	Disagree
Rating	○	○	○	○	○	○	○	○	○	○	○

*** 3. My habits (e.g. study, attendance, note taking...) changed due to this course.**

	Agree	1	2	3	4	No Opinion	6	7	8	9	Disagree
Rating	○	○	○	○	○	○	○	○	○	○	○

*** 4. I found myself behaving differently in this class than in others.**

	Agree	1	2	3	4	No Opinion	6	7	8	9	Disagree
Rating	○	○	○	○	○	○	○	○	○	○	○

*** 5. I found the response system made it easier for me to participate in class and learn.**

	Agree	1	2	3	4	No Opinion	6	7	8	9	Disagree
Rating	○	○	○	○	○	○	○	○	○	○	○

*** 6. I developed a deeper understanding of certain concepts from taking this course.**

	Agree	1	2	3	4	No Opinion	6	7	8	9	Disagree
Rating	○	○	○	○	○	○	○	○	○	○	○

Outcomes

*** 7. I learned many new things in this course.**

	Agree	1	2	3	4	No Opinion	6	7	8	9	Disagree
Rating	○	○	○	○	○	○	○	○	○	○	○

*** 8. I can think of behaviors I personally changed due to this course.**

	Agree	1	2	3	4	No Opinion	6	7	8	9	Disagree
Rating	○	○	○	○	○	○	○	○	○	○	○

*** 9. Using the response system made attending class more fun and interesting.**

	Agree	1	2	3	4	No Opinion	6	7	8	9	Disagree
Rating	○	○	○	○	○	○	○	○	○	○	○

*** 10. Using the response system made me do things differently in this course.**

	Agree	1	2	3	4	No Opinion	6	7	8	9	Disagree
Rating	○	○	○	○	○	○	○	○	○	○	○

*** 11. Using the response system helped me check my own understanding of concepts and learn more.**

	Agree	1	2	3	4	No Opinion	6	7	8	9	Disagree
Rating	○	○	○	○	○	○	○	○	○	○	○

*** 12. Using the response system broke the monotony of this course and made it easier or more interesting.**

	Agree	1	2	3	4	No Opinion	6	7	8	9	Disagree
Rating	○	○	○	○	○	○	○	○	○	○	○

Thank You

Thank you for completing this survey.

Appendix 3. Base Questions for Focus Group Discussion

Focus Group Discussion Questions

Instructions

You have been selected to participate in a focus group discussion based on your performance in this semester's Information Systems Course. The questions provided here will guide the discussion. The Master Teaching Assistant facilitating the discussion will ask these and follow on discussion questions. Be honest and candid in your responses.

1. Please provide your class assigned ID:

Base Questions

These are the basic questions for discussion. Follow on questions will develop based on your responses.

1. Describe the task of "In-Class Education". Include what you believe YOU, as a student, are required to do during a college course. Identify any issues or challenges resulting from your position as a student in a large course communicating with your instructor.

2. Describe the response system technology used during class. Be sure to explain your understanding of what it does and how you used it.

3. Describe how you believe the response system technology "Fit" the task of "In-Class Education". Was it an appropriate solution? What worked well for you and what did not work? Explain why you believe the instructor chose to use the system and what he hoped to accomplish with it. Was there a need for it? Was it successful?

4. Describe how you feel about the "Outcomes" you should expect from a college course? What is important to you to get out of the task of "In-Class Education"? Is it important for you to enjoy the experience? Is learning important? Should your behaviors change? Is the grade in the course important?

Thank You

Thank you for participating in this focus group discussion. You will receive a $15 gift card to the Campus Bookstore as compensation for your time and effort, and as our way of saying "Thank You".