Concerns Regarding Technology Adoption as Predictors of Instructional Practices

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Introduction

The desired focus for American schools has been debated for decades. Wenglinsky (2004) presents convincing evidence that schools should focus on higher-order thinking skills. Using data from National Assessment of Educational Progress (NAEP) testing of 4th, 8th, and 12 graders in mathematics, science, reading, and civics, Wenglinsky found that although students must learn certain basic facts and skills, when instructional practices encourage advanced reasoning skills, students score higher on the national tests. The question then becomes: How can schools best teach these advanced reasoning skills?

Learner-Centered Education

One philosophy of education that stresses the need for developing these reasoning skills is referred to as learner-centered education. Many educators have been proponents of learner-centered education (Darling-Hammond, 2001; Falk & Darling-Hammond, 1993; Lieberman & Falk, 2006; Smithee, Greenblat, & Eland, 2004; Weimer, 2002). The American Psychological Association (APA) 's Task Force on Psychology in Education (American Psychological Association, 1997; American Psychological Association Task Force on Psychology in Education, 1993) presented research-validated Learner-Centered Principals as a model. The 14 learner-centered principles were organized into four domains important to effective learning: metacognitive and cognitive, affective and emotional, developmental and social, and individual differences (see Appendix A). These principles provide a framework for developing learner-centered environments for all educational levels (Alexander & Murphy, 1997; McCombs, 2002).

Learner-Centered Principles and Constructivism. The Learner-Centered Principles were based on current research and theories of learning, including constructivism (Alexander &

Murphy, 1997). The principles recognize that individuals learn as they construct their own personal understanding of any content or experience (McCombs, 2005). Constructivism is a philosophy of learning that is heavily based on the work of John Dewey (Dewey, 1916) and Jean Piaget (Piaget, 1973) along with Vygotsky's body of work (Vygotsky, 1978). Constructivism encourages meaningful learning through which students process new information by merging the new information with previously constructed knowledge (von Glasersfeld, 1981).

Applefield, Huber, and Moallem (2001) reviewed the constructivism literature and concluded that constructivist learning environments typically have four primary characteristics. First, students construct their own learning. This learning event is dependent on a link between new information and the existing understanding of the student. Social interaction is critical to the learning process. Finally, authentic learning tasks are important for learning.

Constructivism and Technology Use. There is some evidence that they types of instructional tools that are available to teachers and whether and how they use these tools has an effect on whether they use learner-centered practices or not. It is the belief that learning with, not from or about, technology that makes computers important tools in a constructivist learning environment (Boethel & Dimock, 1999).

Technology-based tools appear to provide teachers with learner-centered tools that encourage the use of constructivist instructional practices (Becker & Ravitz, 1999; Dills, 2004; Dwyer, 1994; Rakes, Fields, & Cox, 2006; Rakes, Flowers, Casey, & Santana, 1999; Sandholtz, Ringstaff, & Dwyer, 1997). Other researchers (Kent & McNergney, 1999) described technology in K-12 education as supporting a pedagogical shift in education toward the constructivist paradigm by providing tools for collaboration, higher order thinking, and easier access to information.

However, despite this evidence, some research indicates many teachers do not use technology or do not use it effectively (Rakes, Fields, & Cox, 2006). Increasingly, graduates of teacher education programs possess basic technology skills, but may not truly understand exactly how to apply technology in meaningful ways (Charp, 2003).

Technology Use and the Concerns-based Adoption Model

If technology use can encourage successful learner-centered instructional practices that positively affect student achievement, it is important to identify factors that promote and/or prevent technology adoption. This process can help prescribe meaningful professional development (Hord, Rutherford, Huling-Austin, & Hall, 2005).

One framework for analyzing teachers' willingness to adopt any innovation as an instructional tool is found in the Concerns Based Adoption Model. Despite what teachers know about or can do with technology, affective factors such as concerns may interfere with their effective application of technology in the classroom.

Concern-based theory originated from the work of Frances Fuller and her research with preservice teachers in the 1960s. She proposed that one's feelings towards a change or innovation could be addressed as concerns (Fuller, 1969).

Building on Fuller's work, Hall and Hord (1987) developed the Concerns-Based Adoption Model (CBAM), which "is an empirically based conceptual framework which outlines the developmental process that individuals experience as they implement an innovation and participate in staff development" (Hord & Hall, 1987, p. 12). In other words, it addresses concerns as a developmental trend (Hall & Hord, 2001). The CBAM model consists of three distinct parts: Stages of Concern (SoC), Levels of use (LoU), and Innovation Configuration (IC) (Hall, Wallace, & Dossett, 1973).

In the present study, only the Stages of Concern portion of the CBAM was used. Concerns refer to groups of feelings, perceptions, preoccupations, considerations, motivations, satisfactions, and frustrations that collectively describe an individual's stage in the affective response to an innovation and the change process. These concerns are related to his or her experience with or perception of the innovation. This portion of the model analyzes one's feelings, observations, problems, successes, and failures while progressing through the change process related to adopting an innovation. This information helps to identify an individual's willingness to adopt and use an innovation.

Summary

Research presents evidence that supports the premise that students who are taught to use higher-order thinking skills perform better. There is also evidence that technology use by teachers encourages instructional practices that promote higher order thinking skills in students. However, in spite of the evidence, many teachers do not use technology (Cuban, 2000; Rakes, Fields & Cox, 2006) or simply use computers to support their traditional teaching practices rather than to promote more innovative classroom practices (Cuban, 2001).

Knowledge of requisite technology skills is needed, but such skills alone do not necessarily promote effective use of technology in classrooms. Therefore, it is important to explore affective factors such as teacher concerns that promote or discourage technology use and to further explore the relationship between technology use and learner-centered, authentic instructional practices based in constructivist philosophy. The present further explored whether there is a positive relationship between technology use and the use of such learner-centered instructional practices.

Research Questions

The present study further explored the relationship between teachers' willingness to adopt technology as indicated by their concerns about the use of technology in their classrooms and specific classroom instructional practices. The study addressed two specific research questions:

Research Question 1. What are teachers' concerns about the use of instructional technology in the classroom?

Research Question 2: Is there a relationship among stages of concern regarding the use of technology in the classroom and the use of constructivist teaching practices?

Sample

The purposive sample for this study consisted of 102 graduate students enrolled in one of three masters program in education at the University of Tennessee at Martin that is accredited by the National Council for the Accreditation of Teacher Education. One program is for currently licensed teachers; one program is for initial licensure; one program is designed to lead to licensure as a school principal. All subjects were employed as PK-12 teachers. Sample demographics are reflected in Table 1.

Table 1

Respondent Demographics

Variable	*n*	percent
Sex		
Male	23	22.5
Female	79	77.5
Grade Taught		
PK-K	5	4.9
1-3	10	9.8
4-6	19	18.6
7-9	27	26.5
7-12	5	4.9
10-12	36	35.3
Highest Degree Earned		
Bachelors	59	57.9
Masters	29	28.4
Specialist	8	7.8
+30 hours	4	3.9
Doctorate	2	2.0
School Location		
Urban	17	16.7
Rural	71	69.6
Suburban	14	13.7
Technology Coordinator in Your Building		
Yes	91	89.2
No	11	10.8
Years Teaching Experience		
1 year	18	17.6
2 years	12	11.8
3 years	6	5.9
4 years	9	8.8
5 years	5	4.9

(*table continues*)

Variable	*n*	percent
6 - 10 years	13	12.7
11 - 15 years	23	22.5
16 - 20 years	8	7.8
21 - 25 years	3	3.0
over 25 years	5	5.0

Note: N=102.

Methodology

Instrumentation

In order to measure their concerns about the use of technology and their use of current constructivist-related teaching practices, subjects completed the Stages of Concern Questionnaire (SoCQ), the Constructivist Behavior Questionnaire (CBQ). Participants also provided basic demographic information. In addition, subjects were asked to voluntarily answer one open-ended question regarding their concerns about the use of technology in the classroom. All questions were placed on the Internet using Dragon, survey software that is a companion to the FileMaker Pro database software. This software will not allow participants to submit incomplete data, directing them to missing responses before allowing submission. No personal information was collected. All responses were voluntary and anonymous. Participants were invited to participate via email, provided with the URL for the survey, and asked to complete the instruments

Stages of Concern Questionnaire. By identifying teachers' stage of concern with regard to technology implementation, one may better promote and facilitate teachers' adoption of technology in the classroom (Hord, 2005; Negrete, 2004). To assess these concerns, this study

used the Stages of Concern Questionnaire (SoCQ) (George, Hall, & Stiegelbauer, 2006; Hall, George, Rutherford, 1979, 1986). The SoCQ identifies the intensity of the seven Stages of concern related to the adoption of an innovation ((George, Hall, & Stiegelbauer, 2006; Hall, George, & Rutherford, 1979, 1986). The questionnaire is a 35-item Likert scale developed using K-12 and university instructors. Each of the seven stages has five statements (see Appendix B) to which the respondents indicate their degree of concern based on an 8-point scale. The statements were selected to represent varying types of concerns that teachers have when they are initially introduced to an educational innovation, begin to use it, and then move to more seasoned and mature perspectives along with increased confidence in the use of the innovation (Negrete, 2004). A summary of the seven stages of concern is presented in Table 2 below.

Table 2

Stages of Concern Summary

Stage of Concern			Expression of Concern
IMPACT	6	Refocusing	The individual focuses on exploring ways to reap more universal benefits from the innovation.
	5	Collaboration	The individual focuses on coordinating and cooperating with others regarding the use of the innovation.
	4	Consequence	The individual focuses on the innovation's impact on students.

TASK	3	Management	The individual focuses on the processes and tasks of using the innovation and the best use of information and resources. Issues related to efficiency, organizing, managing, and scheduling dominate.
	2	Personal	The individual is uncertain about the demands of the innovation, his or her adequacy to meet those demands, and/or his or her role with the innovation. The individual is analyzing his or her relationship to the reward structure of the organization.
SELF	1	Informational	The individual indicates a general awareness of the innovation and interest in learning more details about it. The individual does not seem to be worried about him/herself in relation to the innovation.
	0	Unconcerned	The individual indicates little concern about or involvement with the innovation.

Source: George, Hall, & Stiegelbauer, 2006, p. 8

The SoCQ was originally validated in 1979 on a group of teachers involved in team teaching and professors concerned about innovation (n=830) and a sub sample (n=132) of this group that participated in a test-retest of the instrument over a two-week period (Hall, George, & Rutherford, 1979). Cronbach's alpha was used to establish internal validity, alpha coefficients ranged from .64 to .83. The test-retest sub sample correlation ranged from .65 to .84, indicating the internal consistency and stability for each of the seven Stages (Hall et al, 1979). The SoCQ has been further validated in numerous studies over the course of the last two decades (see George, Hall, and Stiegelbauer (2006) for a detailed presentation of over two dozen of the best studies using the SoCQ).

Constructivist Behavior Questionnaire. Teacher use of constructivist teaching practices was measured using the Constructivist Behavior Questionnaire (see Appendix C). The questionnaire is based on a review of literature describing constructivist behaviors in teachers by Brooks and Brooks (1999) in which they provided a summary of teachers' perceptions of their classroom constructivist behaviors. Behaviors in the survey items represent those most frequently described in the relevant literature.

Fourteen items ask participants to describe their classroom behavior in constructivist terms. Teachers reported their use of each behavior as used frequently (daily 5), often (weekly 4), fairly often (monthly 3), sometimes (during each semester 2), or never (1). Responses were summed to produce the individual's constructivist score. Reliability alpha for the original questionnaire (N=435) was .88 (Rakes, et al., 1999). Reliability alpha for the present sample was .93.

Limitations

The following limitations should influence the interpretation of the results of this study.

1. The sample is restricted to a sample of 102 teachers enrolled in a masters program in education at one university.
2. All information is self-reported data. The information provided was based solely on the subjects' perceptions.
3. Relationships among variables were analyzed; such an analysis does not establish cause and effect relationships.
4. Factors that affect the relationship between technology use by teachers and their instructional practices may not be accounted for in the methodology of this study.

Results and Discussion

Research Question 1

What are teachers' concerns about the use of instructional technology in the classroom?

Results of the Stages of Concern Questionnaire

One way of analyzing group concerns is to aggregate individual data by developing a profile that provides the average scores for each stage of the individuals in a group. Group averages reflect the dominant high and low Stages of Concern of the entire group. Mean scores were converted to percentiles and plotted following the procedures outlined by George, Hall, and Stiegelbauer (2006) using the SoCQ Quick Scoring Device. The first and the second highest stages of concern for all respondents are typically analyzed along with the lowest stage of concern. Identification of the second highest stage of concerns along with the peak stage makes possible a more in-depth interpretation of the concerns of the group.

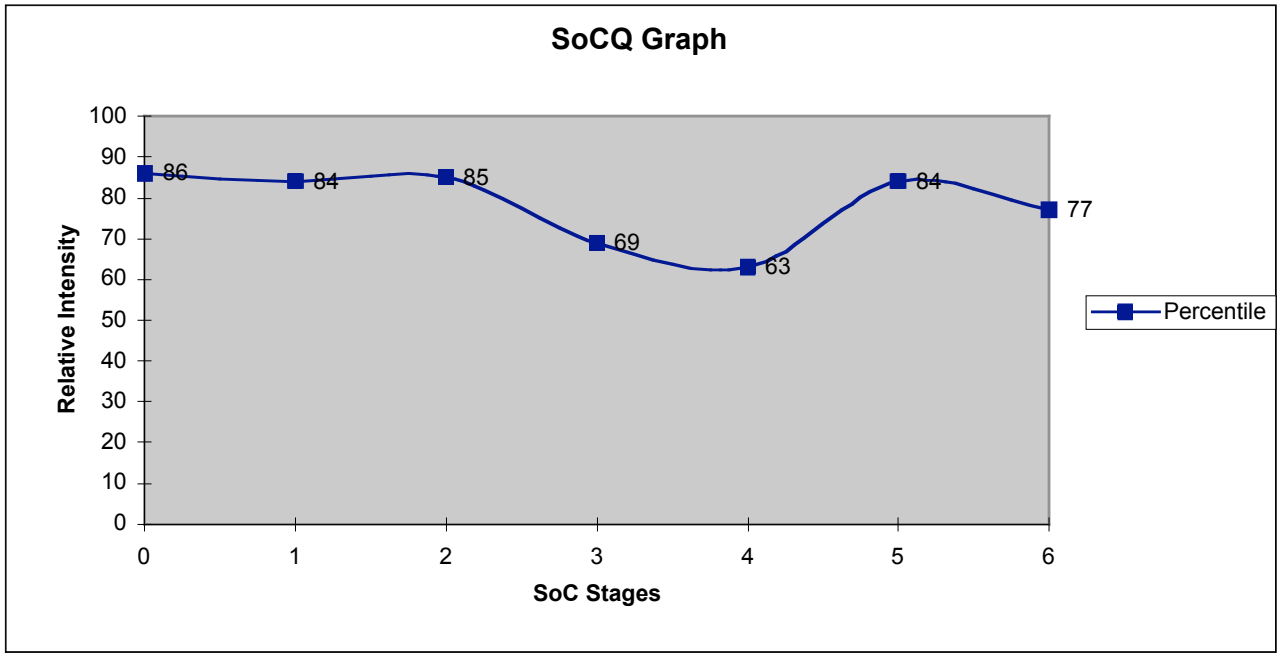

Figure 1. *Stages of Concern Questionnaire Results*.

In this sample, Stages 0, 1, 2 and 5 were all within one or two percentile points. All four were, therefore, interpreted as the highest concerns. It is not unusual for Stages 1 and 2 to be similar in a nonuser profile such as this. Although distinct stages, Stages 1 and 2 (Informational and Personal) concerns frequently occur at the same time.

The raw score for each of the seven scales is the sum of the responses to the five statements on that scale (see Appendix B). The mean scores were determined for each item. The mean scores were then converted to percentile scores. The percentiles are not absolute, but should be viewed as relative to other scores that an individual or group. The percentiles are represented in Table 3 below.

Table 3

Percentiles for Each of the Stages of Concern

Stage	0	1	2	3	4	5	6
Percentile	86	84	85	69	63	84	77

Discussion of SoCQ Results

This profile is that of what the CBAM model (George, Hall, & Stiegelbauer, 2006) refers to as a nonuser. Typically, for such nonusers, either Stage 0, 1, or 2 is the highest score. Scores are considered high when they are in the 75th percentile or above. In this case, the three scores are virtually identical. A high score on Stage 0 for nonusers indicates the degree of priority respondents place on the innovation. Stage 0 provides information about the degree of interest in or engagement with an innovation as compared to other activities and efforts in which the

respondents may be engaged. As in this sample, a higher Stage 0 score indicates there are a number of other activities that are of concern to the respondent.

As seen in Figure 1 above, nonusers who are high on Stage 0 are typically also high on Stages 1 and 2. A high Stage 1 score reflects interest in additional information about the innovation. They simply want information that is more fundamental rather than details. These concerns focus on the structure and function of the innovation.

Stage 2 (Personal) concerns are considered self concerns (Fuller, 1969). When Stage 2 concerns are equal to or more intense than the Stage 1 concerns, the personal concerns (Stage 2) override concerns about learning more about the innovation, which in this case is the use of technology. Individuals are personal status. A high Stage 2 concern indicates questions and uncertainties that are ego-oriented. Even when general, non-threatening attempts are made to discuss the innovation with someone with this profile, the high Stage 2 concerns are intensified and the Stage 1 concerns are reduced. For this situation, Stage 2 concerns normally have to be reduced before one can look at the innovation objectively.

A high Stage 2 indicates an intense personal concern about instructional technology and its consequences for the respondents on a personal level. Though these concerns reflect uneasiness regarding technology, they do not necessarily indicate resistance to technology. Individuals at this stage reflect high concerns about the status, reward, and potential or real effects of technology. Individuals with intense personal concerns may, in effect, block out more substantive concerns.

Management concerns are not particularly strong (Stage 3) for this sample. Stage 3 score represents concern about management, time, and logistical aspects of using an innovation. The profile does not reflect intense concern about consequences for students (Stage 4). Stage 6

shows a focus on exploring ways to gain more universal benefits from technology use. The low, tailing down of Stage 6 is positive; it generally means that respondents do not have ideas that would potentially compete with the use of technology, how to change the innovation, or replace the innovation with something else (George, Hall, & Stiegelbauer, 2006; Hall, George, & Rutherford, 1998).

The lowest stage of concern for the aggregate data was Stage 4. A low Stage 4 indicates that the respondents have low to no concerns about the effect the use of technology may have on students.

A high stage 5 typically demonstrates strong concerns about collaborating with colleagues in the use of technology. Since Stage 1 is also high for this sample, it is likely that these respondents have more concerns about looking for ideas from others, demonstrating more interest in learning from other teachers, instead of concern for actual collaboration (Hall, George, & Rutherford, 1998).

In summary, the aggregate data for this sample presents an overall profile of a group of teachers who are not currently making real use of technology. High levels of "self" concerns are preventing most in the group from moving to higher-level concerns that leave them more open to the effective use of technology. The self concerns are preventing group members from concentrating on the effects of technology use on their students and preventing them from moving forward and using technology in more cooperative, advanced ways. In essence, the intense self concerns have paralyzed their progress.

Results of the Open-Ended Question.

Respondents were provided with the opportunity to respond to a question that asked, "What specific concerns do you have about the use of technology in your classroom?" About

one-third of the respondents chose to answer this open-ended question (n=35). Responses provided the respondents an opportunity to provide additional information regarding their use of technology beyond the items in the questionnaire.

Content analysis was used to analyze the text provided in the open-ended responses. Four categories of comments emerged. Each comment was coded and assigned to the appropriate category. Respondent comments are summarized in Table 4 below.

Table 4

Summary of open-ended comments

Category	n	percent
Lack of access to resources	9	25
Lack of technical support / Technical problems	14	38
Lack of time	6	17
Lack of effective training	6	17

Note. Individual respondents may have included multiple statements that fit into more than one category.

Discussion of the Open-Ended Question Results

Lack of Access to Resources

Lack of access to adequate technology resources is a continuing theme in the literature (Cuban, Kirkpatrick, & Peck, 2001; Ertmer, et al., 1999; Hadley & Sheingold, 1993). One fourth of the teachers who volunteered information regarding their concerns about technology use

described a lack of access to technology as a major problem. Several teachers made comments about the mismatch between available computers and class size. “With only one computer lab it seems teachers are always trying to use the computer lab when someone else has reserved it. Our computer lab has 20 computers and only 20 chairs. Most of my classes have at least 30 students.” Another commented, “With one computer lab for a school with about 900 students the teachers are fighting to sign up for the computer lab first. When we have gone to the computer lab the students seem to be on task, better behaved, remember more about the lesson, and enjoy it.”

Two other teachers expressed typical frustration with inadequate resources. “It seems that there is a big push to teach us how to use technology with our students without the resources to back it up. I have been to several great workshops that showed us how to use the computers in the classroom. But with one computer, and no way to display the screen to students, nearly all of the information is useless. “ “By the time resources catch up with training, the resources that we have are outdated.”

This perception may be as much a matter of organization of resources (computers only available in labs vs. in classrooms) as the number of computers in a school (Fabry, & Higgs, 1997; Smerdon & Cronen, 2000).

> Virtually every public school has access to the Internet. Yet in most schools, it is business as usual. Computers are enclosed in computer rooms rather than being a central part of the learning experience (Office of Educational Technology, 2005, p. 22).

Lack of Technical Support/Technical Problems

Nearly one-fifth of the teachers responding to the open ended question expressed frustration over lack of technical support for the use of technology. This response is particularly interesting in light of the fact that the majority of the respondents (89%) stated that there was a technology coordinator housed in their building. This expression of frustration continues in part

because the perception is that there is either not enough assistance or the assistance they receive is not of the type they feel is helpful (Fabry, & Higgs, 1997; Office of Educational Technology, 2005; Smerdon & Cronen, 2000)

Even from those who stated they had such assistance available, comments included "Need more help in organizing and getting started with this in the classroom more often." From those who did not have such assistance readily available, comments included, "We do not have a technology person in the building, which makes it hard for me to become comfortable with different types of technology." "We do not have adequate technical support in our school or district to assist us with these issues." Using technology would be great if there was someone to keep it up and running.

Even though the majority of teachers in this sample reported having some kind of technology support in their building, about one-fifth of the respondents named technical problems as something that interferes with their use of technology. One teacher explained, "My main concern is the time lost to technology problems when trying to complete a lesson" Another summarized the frustration expressed by several others. "I use technology daily but have frequent problems with the computers not working, the server being down, etc. What I have is extremely out of date and needs repairing."

Lack of Time

A continuing complaint (Cuban, 2001; Ertmer, et al., 1999; Rogers, 2000) involves the lack of time to add any new to the classroom with technology. "Time is very limited here at my school. I have a 25 minute break for 3 days and 2 days without a break! I do not have much planning time and the requirements for me to do my job are multiplying without time to do them!" Teachers perceive a lack of time to learn existing and new technology, time to practice

what they have learned, and time to plan lessons that use technology, a problem that could be solved with increased release time during the school day (Smerdon & Cronen, 2000).

Simply providing teachers with more time to use technology can produce positive effects on their concerns. For example, Dooley (1999), found that low users of technology had a higher percentage of self concerns, middle users shifted demonstrated more task or management concerns, and frequent users were more concerned about the impact of the innovation had on their students.

Lack of Effective Training

Six teachers spoke of a lack of training that keeps them abreast of the changes that occur related to the use of technology. One teacher's response was typical of these statements. "So many things change and change so quickly and we do not get enough inservice to keep us up to date for technology." Again, this expression of concern about the use of technology persists in the literature (Casey & Rakes, 2002; Fabry, & Higgs, 1997; Office of Educational Technology, 2005). Research indicates that teachers need continuous professional development in order to integrate technology fully into the curriculum (Wetzel, 2001a, 2001b).

Unfortunately, these concerns have changed little in over a decade (see OTA, 1995). It appears evident that these concerns have not been adequately addressed by school leaders. The concerns expressed by teachers in this sample and in the literature in general are what George, Hall, and Stiegelbauer (2006) would label self and management concerns. Such lower-level concerns, according to the Concerns-Based Adoption Model, continue to prevent teachers from moving forward to concerns that allow them to fully integrate technology into their instructional practices.

Research Question 2

Is there a relationship among teacher concerns regarding the use of technology in the classroom and their use of constructivist instructional practices?

Results

In order to examine the relationship between the Stages of Concern levels and the total score on the Constructivist Behavior Questionnaire, the data were analyzed using multiple regression with Constructivist Behavior Questionnaire scores entered as the dependent variable and the Stages of Concern subscales as the independent or predictor variables.

Responses to the Constructivist Behavior Questionnaire (CBQ) are summarized in Table 5 below. Percentages of responses for each item along with a mean score for each item are presented.

Table 5

Summary of Responses to Constructivist Behavior Questionnaire

Item Number and Mean Response		Frequently (Daily)	Often (Weekly)	Fairly Often (Monthly)	Sometimes (During Each Semester)	Never
Scale		5	4	3	2	1
1	(3.96)	37.3%	36.3%	13.7%	9.7%	1.8%
2	(3.15)	12.7%	27.5%	28.4%	24.5%	6.9%
3	(3.77)	26.5%	40.2%	20.6%	9.8%	2.9%
4	(3.85)	32.4%	35.3%	20.6%	7.8%	3.9%
5	(3.71)	31.4%	27.5%	27.5%	7.8%	5.9%
6	(3.95)	32.4%	41.2%	18.6%	4.9%	2.9%
7	(4.33)	56.9%	28.4%	06.9%	5.9%	2.0%
8	(4.41)	60.8%	25.5%	09.8%	2.0%	2.0%

Item Number and Mean Response		Frequently (Daily)	Often (Weekly)	Fairly Often (Monthly)	Sometimes (During Each Semester)	Never
Scale		5	4	3	2	1
9	(4.18)	50.0%	30.4%	11.8%	2.9%	4.9%
10	(4.30)	51.0%	35.3%	08.8%	2.0%	2.9%
11	(3.67)	19.6%	44.1%	23.5%	8.8%	3.9%
12	(4.55)	68.6%	21.6%	07.8%	0.0%	2.0%
13	(4.07)	37.3%	42.2%	12.7%	5.9%	2.0%
14	(4.23)	45.1%	37.3%	14.7%	1.0%	2.0%

Results of standard multiple regression, in which all variables were entered into the predictive equation, revealed an R^2 of .169, $F(7,94) = 2.73$, $p < .013$. Results revealed that R^2 was weak; however, the Coefficients table reveals that it was interpretable. Beta weights, part correlations, and partial correlations are presented in Table 6. Means and standard deviations for the SoCQ subscales are presented in Table 7. Regardless of whether the Beta weights, part correlations, or partial correlations were interpreted, results shown in Table 6 indicate that the Collaboration (Stage 5, ß = .408, pr = .259, t = 2.601, $p < .01$) and Refocusing (Stage 6, ß = .499, pr = .210, t = 2.085, $p < .04$) stages were the most strongly predict the Constructivist Behavior Questionnaire score.

Table 6

Multiple Regression Analysis

Variable	*ß*	*Beta*	*Part Cor*	*Partial*	*t*
Collaboration	.50	.28	.20	.21	2.09*
Informational	.41	.29	.24	.26	2.60**
Awareness	-.09	-.06	-.04	-.04	-.41
Management	-.13	-.08	-.06	-.07	-.64
Refocusing	-.07	-.05	-.03	-.03	-.34
Consequence	-.16	-.11	-.07	-.07	-.73
Personal	.07	.03	.02	.03	.27

Note. Results revealed that R^2 was weak(R^2=.169), but interpretable. N=102.

**p < .04, **p < .01*

Table 7

Table of Means by Variables

CBQ Total	*SoCQ Subscales*	*M*	*SD*
	Awareness	12.37	4.24
	Informational	23.94	7.08
	Personal	25.36	7.74
	Management	18.34	6.58
	Consequence	27.75	6.40

Collaboration	29.19	7.31
Refocusing	23.79	5.82

Discussion

Higher concerns toward the use of technology predicted higher scores on the Constructivist Behavior Questionnaire, indicating a positive relationship between these factors. Teachers who reach a level of technology adoption in which they express interest in what other teachers are doing with technology and express interest in making better use of technology tools describe more use of constructivist teaching practices in their classroom than teachers with lower-level concerns.

These findings extend those of other researchers (Becker & Ravitz, 1999; Dills, 2004; Dwyer, 1994; Kent & McNergney, 1999; Sandholtz, Ringstaff, & Dwyer, 1997; Rakes, Fields, & Cox, 2006; Rakes, Flowers, Casey, & Santana, 1999) who have found a positive relationship between teachers who have positive attitudes toward and who use technology and those teachers who also use constructivist instructional practices in their classrooms.

Implications for Practice and Future Research

The present study provided additional support for the idea that there is a relationship between technology use and the use of learner-centered instructional practices. These types of teaching strategies have been shown to increase student performance (Wenglinsky, 2004). Despite this evidence, many teachers still do put technology to its best use in their classrooms.

Implications for Practice

This study provided further evidence that concerns can provide useful insight into reasons for the continuing resistance to changes involving technology. "Teacher resistance to change is primarily due to their concerns regarding the influence of instructional technology integration on their preparation, beliefs, and values (Wetzel, 2002, p. 43). Within the Concerns-Based Adoption Model, school leaders can identify teachers' concerns and use the data to design professional development that will lead them forward.

Teachers who expressed higher-level concerns toward technology also described their classroom practices as being more constructivist in nature. Teachers' classroom behaviors reflect their beliefs about the nature of teaching and learning (Pajares, 1992). Professional development opportunities that encourage teachers to reflect on the relationship between their own beliefs about successful instructional practices and the theoretical benefits of an innovation such as the use of technology can reduce the perception of incompatibility and increase the likelihood of effective use of technology (Koszalka, 2003).

Implications for Future Research

One challenge for future research is to explore more fully specific teacher beliefs that underlie their classroom behavior and their relationship to technology use by teachers. There may be a basic conflict between what teachers believe about teaching and learning (e.g., learner-centered vs. teacher-centered) and how they choose to use or ignore technology in their classrooms.

For example, Becker and Ravitz (2001) found that

> teachers who avoid computers are also the ones who seem to be most "traditional" in their teaching philosophy; teachers who believe that their role is to transmit to students an externally mandated curriculum by means of a highly controlled pedagogy. In contrast, teachers who value students doing group projects and working on topics of personal

> interest–an approach compatible with belief in constructivist learning principles–are among the most frequent computer-using teachers (pp. 9-10).

Resolution of such a conflict may prove to be one of the most important requirements for successful technology implementation (Zhao et al, 2002).

References

Alexander, P.A., & Murphy, K.P. (1998). The research base for APA's learner-entered psychological principles. In N.M. Lambert & B. L. McCombs (Eds.), *How students learn: Reforming schools through learner-centered education* (pp. 25-60). Alexandria, VA: Association for Supervision and Curriculum Development.

American Psychological Association (APA) (1997). *Learner-centered psychological principles: A framework for school reform and redesign (Rev. Ed.).* Washington, DC: American Psychological Association. Retrieved February 1, 2007, from www.apa.org/ed/lcp2/lcp14.html

American Psychological Association Task Force on Psychology in Education (1993). *The learner-centered psychological principles: Guidelines for school redesign and reform.* Washington, D.C.: American Psychological Association and the Mid-continent Regional Educational Laboratory.

Applefield, J.M., Huber, R., & Moallem, M. (2001). Constructivism in theory and practice: Toward a better understanding. *The High School Journal, 84*, 35-53.

Becker, H.J., & Ravitz, J.L. (March, 2001). *Computer use by teachers: Are Cuban's predictions correct?* Paper presented at the annual meeting of the American Educational Research Association, Seattle, Washington.

Becker, H.J., & Ravitz, J. (1999). The influence of computer and Internet use on teachers' pedagogical practices and perceptions. *Journal of Research on Technology in Education. 31*(4), 356-379.

Brooks, J. G. & Brooks, M. G. (1999). *The case for constructivist classrooms*. Alexandria, VA: Association for Supervision and Curriculum Development.

Casey, H. B., & Rakes, G. C., (2002). An analysis of the influences of technology training on teacher stages of concern regarding the use of instructional technology in schools. *Journal of Computing in Teacher Education*, 18, 124-132.

Charp, S., (2003). Technology integration in teaching and learning. *T.H.E. Journal, 30*, 8.

Cuban, L. (2001). *Oversold and underused: Reforming Schools through technology, 1980-2000*. Cambridge MA: Harvard University Press.

Cuban, L. (2000, January). So much high-tech money invested, so little use and change In practice: How come? Paper prepared for the Council of Chief State School Officers' Annual Technology Leadership Conference, Washington, D.C.

Cuban, L., Kirkpatrick, H., & Peck, C. (2001). High access and low use of technologies in high school classrooms: Explaining an apparent paradox. *American Educational Research Journal*, 38(4), 813-834.

Darling-Hammond, L. (2001). *The right to learn: A blueprint for creating schools that work*. San Francisco, CA: Jossey-Bass

Dewey, J. (1916). *Democracy and education: An introduction to the philosophy of education.* New York: Free Press.

Dils, A. K. (2004). The use of metaphor and technology to enhance the instructional planning of constructivist lessons. *Contemporary Issues in Technology and Teacher Education, 4*(2), 214-224.

Dooley, K.E. (1999). Towards a holistic model for the diffusion of educational technologies: An integrative review of educational innovation studies. *Educational Technology and Society 2*(4), 1-15.

Ertmer, P. A., Addison, P., Lane, M., Ross, E., & Woods, D. (1999). Examining teachers' beliefs

about the role of technology in the elementary classroom. *Journal of Research on Computing in Education,* 32(1), 54-71.

Fabry, D., & Higgs, J. (1997). Barriers to the effective use of technology in education. *Journal of Educational Computing, 17*(4), 385-395.

Falk, B., & Darling-Hammond, L. (1993). Building learner-centered schools. *School Voices, 3*(1), 12, 13, 18.

Fuller, F. F. (1969). Concerns of teachers: A developmental conceptualization. *American Educational Research Journal, 6*(2), 207-226.

George, A.A., Hall, G.E., & Stiegelbauer, S.M. (2006). *Measuring implementation in schools: The Stages of Concern Questionnaire*. Austin, TX: Southeast Educational Development Laboratory.

Hadley, M., & Sheingold, K. (1993). Commonalities and distinctive patterns in teachers' integration of computers. *American Journal of Education,* 261-315.

Hall, G. E., & Hord, S. M. (1987). *Change in schools: Facilitating the process*. New York: State University of New York Press.

Hall, G., & Hord, S. (2001). *Implementing change: Patterns, principles, and potholes*. Needham Heights, MA: Allyn and Bacon.

Hall, G. E., George, A. A., & Rutherford, W. L. (1979). *Measuring stages of concerns about the innovation: A manual for use of the SoC Questionnaire*. Austin: University of Texas.

Hall, G. E., George, A. A., & Rutherford, W. L. (1986). *Measuring the Stages of Concern about the innovation: A manual for use of the SoC Questionnaire*. Austin: University of Texas.

Hall, G.E., Wallace, R.C., & Dossett, W.A. (1973). *A developmental conceptualization of the adoption process within educational institutions*. Austin, TX: Research and Development Center for Teacher Education, The University of Texas.

Hord, S.M., Rutherford, W.L., Huling-Austin, L., & Hall, G.E. (2005). *Taking charge of change*. Austin, TX: Southeast Educational Development Laboratory.

Kent, T., & McNergney, R. (1999). Will technology really change education? Thousand Oaks, CA: Corwin Press, Inc.

Koszalka, T.A. (2003). *Reflection as a critical component of the technology adoption process*. (ERIC Document Reproduction Services ED 480 237)

Lieberman, A., & Falk, B. (2006). Leadership in learner-centered schools. In A.B. Danzig, K. Borman, B. Jones, & B. Wright (Eds.), Professional *development for learner centered leadership: Policy, research, and practice*. Mahway, New Jersey: Lawrence Erlbaum Associates.

McCombs, B.L. (2002, April). *How can we define teacher quality? The learner-centered framework.* Paper presented at the American Educational Research Association, New Orleans, LA.

McCombs, B.L. (2005). The Learner-centered framework on teaching and learning as a foundation for electronically networked communities and cultures. *Preparing Tomorrow's Teachers to Use Technology: Reflections on Teaching and Learning*. Retrieved May 14, 2005, from http://pt3.altec.org/VQ/teach_learn.php3

Negrete, E.G. (2004). *Faculty concerns and perceptions of mandated educational change: An exploratory study*. (Doctoral dissertation, University of Texas at Austin, 2004). *Dissertation Abstracts International, 11A*, 4127.

Office of Technology Assessment. (1995). *Teachers and technology: Making the connection* (Report No. OTA-HER-616). Washington, DC: U.S. Government Printing Office.

Piaget, J. (1973). *To understand is to invent.* New York: Grossman.

Pajares, M. F. (1992). Teacher's beliefs and educational research: Cleaning up a messy construct. *Review of Educational Research, 62*(3), 307-332.

Rakes, G.C., Fields, V.S., & Cox, K.E. (2006). The influence of teachers' technology use on instructional practices. *Journal of Research on Technology in Education, 38*(4), 411-426.

Rakes, G.C., Flowers, B.F., Casey, H.B., Santana, R. (1999). An analysis of instructional technology use and constructivist behaviors in k-12 teachers. *International Journal of Educational Technology, 1*(2). Retrieved May 14, 2007 from http://smi.curtin.edu.au/ijet/v1n2/rakes/index.html

Rogers, P. L. (2000). Barriers to adopting emerging technologies in education. *Journal of Educational Computing Research,* 22(4), 455-472.

Sandholtz, J. H., Ringstaff, C., & Dwyer, D. C. (1997). *Teaching with technology: Creating student-centered classrooms*. New York, NY: Teachers College Press.

Smerdon, B., & Cronen, S. (2000). *Teachers' tools for the 21st century: A report on teachers' use of technology* (Report No. NCES 2000102). U.S. Department of Education. Washington, D.C.: National Center for Education Statistics. Retrieved May 16, 2007 from http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2000102

Smithee, M., Greenblatt, S. L., & Eland, A. (2004). *U.S. culture series: U.S. classroom culture*. Washington, D.C.: NAFSA: Association of International Educators. Retrieved May 20, 2006, from http://www.nafsa.org/publication.sec/international_students/u.s._culture_series_1

Office of Educational Technology (2005). *Toward A new golden age In American education: How the Internet, the law and today's students are revolutionizing expectations.* Washington, D.C.: U.S. Department of Education. (ERIC Document Reproduction Services ED 484 046)

von Glasersfeld, E. (1981). The concepts of adoption and viability in a radical constructivist theory of knowledge. In I.E. Sigel D.M. Broinsky and R.M. Golinkoff (Eds.), *New directions in Piagetian theory and practice.* Hillsdale, NJ: Lawrence Erlbaum.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes.* Cambridge, MA: Harvard University Press.

Weimer, M. (2002). *Learner centered teaching: Five key changes to practice.* San Francisco: Jossey-Bass.

Wenglinsky, H. (2004). Facts or critical thinking skills? What NAEP results say. Educational Leadership, 62(1), 32-35.

Wetzel, D. (2002). A model for pedagogical and curricular transformation with technology. *Journal of Computing in Teacher Education, 18*(2), 43-49.

Wetzel, K. (2001a). Preparing teacher leaders. *Learning and Leading with Technology, 29*(3), 50–53.

Wetzel, K. (2001b). Reaching students with emotional disabilities: A partnership that works. *Learning and Leading with Technology, 29*(2), 22–24, 26–27.

Zhao, Y., Pugh, K., Sheldon, S., & Byers, J. L. (2002). Conditions for classroom technology innovations. *Teachers College Record, 104*(3), 482-515.

APPENDIX A

Learner-Centered Psychological Principles[1]

COGNITIVE AND METACOGNITIVE FACTORS

Principle 1: Nature of the learning process.
The learning of complex subject matter is most effective when it is an intentional process of constructing meaning from information and experience.
Principle 2: Goals of the learning process.
The successful learner, over time and with support and instructional guidance, can create meaningful, coherent representations of knowledge.
Principle 3: Construction of knowledge.
The successful learner can link new information with existing knowledge in meaningful ways.
Principle 4: Strategic thinking
The successful learner can create and use a repertoire of thinking and reasoning strategies to achieve complex learning goals.
Principle 5: Thinking about thinking
Higher order strategies for selecting and monitoring mental operations facilitate creative and critical thinking.
Principle 6: Context of learning
Learning is influenced by environmental factors, including culture, technology, and instructional practices.

MOTIVATIONAL AND AFFECTIVE FACTORS

Principle 7: Motivational and emotional influences on learning
What and how much is learned is influenced by the learner's motivation. Motivation to learn, in turn, is influenced by the individual's emotional states, beliefs, interests and goals, and habits of thinking.
Principle 8: Intrinsic motivation to learn
The learner's creativity, higher order thinking, and natural curiosity all contribute to motivation to learn. Intrinsic motivation is stimulated by tasks of optimal novelty and difficulty, relevant to personal interests, and providing for personal choice and control.
Principle 9: Effects of motivation on effort
Acquisition of complex knowledge and skills requires extended learner effort and guided practice. Without learners' motivation to learn, the willingness to exert this effort is unlikely without coercion.

Learner-Centered Psychological Principles[1]

DEVELOPMENTAL AND SOCIAL FACTORS

Principle 10: Developmental influence on learning
As individuals develop, they encounter different opportunities and experience different constraints for learning. Learning is most effective when differential development within and across physical, intellectual, emotional, and social domains is taken into account.
Principle 11: Social influences on learning
Learning is influenced by social interactions, interpersonal relations, and communication with others.

INDIVIDUAL DIFFERENCES FACTORS

Principle 12: Individual differences in learning
Learners have different strategies, approaches, and capabilities for learning that are a function of prior experience and heredity.
Principle 13: Learning and diversity
Learning is most effective when differences in learners' linguistic, cultural, and social backgrounds are taken into account.
Principle 14: Standards and assessment
Setting appropriately high and challenging standards and assessing the learner and learning progress—including diagnostic, process, and outcome assessment—are integral parts of the learning process.

Source: APA Work Group of the Board of Educational Affairs (1997, November). *Learner-centered psychological principles: A Framework for school reform and redesign.* Washington, DC: American Psychological Association.

APPENDIX B

Constructivist Behavior Questionnaire

How often do you as a classroom teacher (bold = lowest mean responses)

1. encourage and support student autonomy and initiative (students working independently and helping to direct their own learning)?
2. use raw data and primary sources?
3. use maniulative, interactive, and physical materials?
4. when explaining tasks, use cognitive terminology such as "classify," analyze," "predict," and "create?"
5. allow student responses to drive lessons, shift instructional strategies, and alter content accordingly?
6. inquire about students' understanding of concepts before sharing my own understanding of those concepts?
7. encourage students to engage in dialogue, both with the teacher and one another?
8. encourage student inquiry by asking thoughtful, open-ended questions?
9. encourage students to ask questions of each other?
10. seek elaboration of students' initial responses?
11. engage students in experiences that might result in contradictions to their initial ideas?
12. allow wait time after posing questions?
13. provide time for students to construct relationships between/among concepts?
14. nurture students' natural curiosity?

APPDENDIX C

Stages of Concern Questionnaire Statements Grouped by Stage

Item #	Statement
Stage 0 - Awareness	
3	I don't even know what is.
12	I am not concerned about this innovation.
21	I am completely occupied with other things.
23	Although I don't know about this innovation, I am concerned about things in the area.
30	At this time, I am not interested in learning about this innovation.
Stage 1 - Informational	
6	I have a very limited knowledge about the innovation.
14	I would like to discuss the possibility of using the innovation.
15	I would like to know what resources are available if we decide to adopt this innovation.
26	I would like to know what the use of the innovation will require in the immediate future.
35	I would like to know how this innovation is better than what we have now.
Stage 2 - Personal	
7	I would like to know the effect of reorganization on my professional status.
13	I would like to know who will make the decisions in the new system.
17	I would like to know how my teaching or administration is supposed to change.
28	I would like to have more information on time and energy commitments required by this innovation.
33	I would like to know how my role will change when I am using the innovation.
Stage 3 - Management	
4	I am concerned about not having enough time to organize myself each day.
8	I am concerned about conflict between my interests and my responsibilities.
16	I am concerned about my inability to manage all the innovation requires.
25	I am concerned about time spent working with nonacademic problems related to this innovation.
34	Coordination of tasks and people is taking too much of my time.

Stages of Concern Questionnaire Statements Grouped by Stage

Item #	Statement
Stage 4 - Consequence	
1	I am concerned about students' attitudes toward this innovation.
11	I am concerned about how the innovation affects students.
19	I am concerned about evaluating my impact on students.
24	I would like to excite my students about their part in this approach.
32	I would like to use feedback from students to change the program.
Stage 5 - Collaboration	
5	I would like to help other faculty in their use of the innovation.
10	I would like to develop working relationships with both our faculty and outside faculty using this innovation.
18	I would like to familiarize other departments or persons with the progress of this new approach.
27	I would like to coordinate my effort with others to maximize the innovation's effects.
29	I would like to know what other faculty are doing in this area.
Stage 6 - Refocusing	
2	I now know of some other approaches that might work better.
9	I am concerned about revising my use of the innovation.
20	I would like to revise the innovation's instructional approach.
22	I would like to modify our use of the innovation based on the experiences of our students.
31	I would like to determine how to supplement, enhance, or replace the innovation.