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Emotional Responses to Computer-Based Training Materials in Education

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ABSTRACT

This paper discusses the results of an experiment that examines how emotional responses influence student satisfaction ratings with computer-based training materials. A comparison between tutorial-based and a simulation-based training showed significant differences in student emotional responses, satisfaction and continuance. The authors caution educators to consider the benefits and limitations of more automated assessment and learning simulation tools versus traditional application-embedded tutorials, as additional layers of training automation may lower student ease-of-use and satisfaction ratings, and ultimately, their interest in the subject.

Keywords

Computer-based tutorials, emotions, satisfaction, continuance, assessment and training software, higher education

INTRODUCTION

Computer-based training materials have been popular for years as classroom tools. Tutorials that accompany software have migrated from hard copy to online formats, found either in accompanying media (CD ROMs) or delivered over the Internet. In these tools, students use the actual software application and follow instructions in a book or using online media. There are many advantages to this approach, but there are also drawbacks, particularly in terms of providing immediate conceptual and contextual feedback. Often that delayed feedback comes to the student only after the instructor has manually graded their assignments. Evaluating a completed assignment does not reveal difficulties a student may have had with a particular task. Instructors may also not be able to check every detail of a student's work when grading a software assignment, often due to the amount of detail in an assignment or because of the number of assignments to be graded in a short period of time. In those instances the instructor may resort to "spot checking," which again gives the student inadequate feedback (Kay, 1998).

To increase feedback to students, publishers have been offering assessment and training software that uses simulation-based training.. The assessment and training software is delivered online to students who can complete them at times and locations more convenient to them. It is also self-grading, so that students can complete training components and then apply those components in online exam modules. Reporting facilities are available to show students what tasks were completed successfully. Online self-study and virtual classroom training continues to increase as a percentage of overall training every year (Hall, 2006), with online self-study more than doubling as a training method during 2005-2006 alone. Spending on online education has also been increasing for the past few years, and is expected to continue to increase in the next few years (Sarker and Nicholson, 2005).

Computer-based self study, which often employs simulation-based training, is increasingly favored not only in the classroom, but also in business. Information technology, systems, and desktop application programs account for roughly 34% of all formal corporate training (Hall, 2006). Professional and technology-related certifications are also often delivered using self-

study mechanisms. Therefore, the argument could be made that using similar training mechanisms with students prepares them for similar experiences in corporate training.

The impact of these automated materials must be evaluated. Not only must educators consider the performance of students, but their satisfaction with these training methods and their desire to continue using these materials has an impact on how well they actually learn the application being studied. Too often, these materials are less well developed than traditional tutorials and may be quite rigid in regard to how the simulated product can be used. Students wind up learning how to navigate the automated software rather than learning about the application being simulated. Frustrations leading from this experience could influence their intent to continue using automated software in future settings. Using these tools also elicits emotional responses that could influence satisfaction and continuance. In fact, Layne and Porch (2002) found that using computer-based tools can have a negative impact on the learning experience, leading to decreased satisfaction with the course in which the tools are used and even in continued interest in information technology or related disciplines as a course of study. The use of simulation-based training imposes both a different method of learning and an inherently less structured and less mature application (i.e., the simulation software).

The impact of emotional responses has been gaining momentum in the world of computer-human interaction (Marcus, 2003) but studies related to computer-based training tools have focused less on the emotional component. Students anecdotally report having strong emotional responses that influence their level of satisfaction and ultimate interest in the subject. This paper formalizes their anecdotal reporting by presenting the results of a survey conducted to examine how emotional responses play a role in student satisfaction using computer-based training materials. A comparison between a tutorial-based training for a software application and a simulation-based training application showed significant distinctions in student satisfaction and continuance.

BACKGROUND

Computer based training and tutorial products have been used in business classes for years. Early products tended to be books or other hard-copy training materials; these were in time supplemented by online tutorials, and, more recently, with automated assessment and grading tools, and with the growth of distance education, online courses. Researchers have looked at student satisfaction and performance, as well as learning outcomes. For example, a study by Marks (1998) found that using computerized learning tools in a graduate finance course improved student test performance. Lane and Porch (2002) found in their study of computer aided learning that performance was the same whether the tool was used or not; however, as noted earlier, they found that the tool was not an aid in improving computer literacy, and had a negative impact on attitudes and perceptions.

Educators and IT researchers are also concerned about whether their students are satisfied with and will continue to use software products after they have completed their training. There is a vast amount of research in the area of adoption and diffusion using the Technology Assessment Model (TAM) to measure satisfaction and continuance. While this paper is not testing that model per se, we are interested in the dependent variables (ease of use, satisfaction, and continuance) of the model in terms of the impact of emotional responses on IT usage outcomes. Some researchers have examined the role that positive emotions play within the TAM model. Zhang and Li (2005) found that emotional reactions to IT helped form evaluations in terms of both perceived usefulness and perceived ease of use. Khong and Song (2003) also used the TAM and found that perceived ease of use, perceived usefulness (relative advantage), and enjoyment all affect satisfaction. They defined enjoyment as the pleasure experienced in using the product without consideration of its impact on usefulness, etc. Saade and Kira (2006) found that emotions indirectly affected usefulness through perceived ease of use.

Negative emotions can have a profound and long-lasting impact on student intentions to continue using software for which they have completed the training. Thuring and Mahlke (2007) found that technology which performs poorly affected perceived ease of use and elicited negative emotions, which may have had a lasting impact on attitude. Research by Wang (2003) found a positive relationship between satisfaction and continuance and a negative relationship between satisfaction and complaining behavior with students using an asynchronous e-learning system. However, Saade and Kira (2006) found that the more anxious students felt about using an online learning system, the more useful they perceived it to be.

Researchers have also analyzed cognitive factors such as consumer expectations and emotional states, and found that positive emotions are associated with confirmation of expected performance and satisfaction, while negative emotions are linked to disconfirmation and dissatisfaction (Oliver, 1993). Assessing the influence of emotions on consumer satisfaction has proven to be difficult, with emotions sometimes acting as a separate independent variable on satisfaction, and other times as a

mediated influence between cognition and satisfaction. Service researchers have found that customers report positive emotions when the provider pays extra attention to them, and negative emotions when the provider fails to meet a minimum service standard (Liljander and Strandvik, 1997). In comparison, some services that are difficult to judge (e.g., doctors, dentists) may be primarily evaluated by the generalized affect of the service provider (Yi, 1991). Together, these studies confirm that emotions influence customer satisfaction ratings within products and services; however, the presence and strength of emotional influence may vary with the service situation, amount of customer involvement and service context. As a first step in examining emotional influence on the satisfaction and TAM process, we measure positive and negative emotions in a student IT training experiment, and assess emotional influence on the TAM as experimental covariates. In the next section, we describe and explicate our experimental hypotheses.

HYPOTHESES

Our first three hypotheses reflect previous research in IT based on both the TAM model and Expectation-Confirmation Theory (ECT). TAM research explains satisfaction through both Perceived Ease of Use and Perceived Usefulness. IT user decisions to continue using a product or service are driven by initial beliefs and experiences. Many of the initial expectations are cognitive beliefs about the software and information technology system (Davis et al., 1989). In a learning environment, most students begin their studies with eagerness, anticipation and some expectation that they will learn new skills and techniques (Marks, 1998). Training users expect IT systems to enhance their software understanding and, hopefully accelerate the learning process. Software that fails to meet baseline consumer expectations with slow access, complex instructions, poor help menus and incomplete or missing service support will be viewed as difficult to use. IT tutorial software that is well-structured is likely to enhance the learning experience, and be evaluated as easy to use. Thus:

> H1: Users of tutorial-based training are more likely to report software as easier to use than users of simulation-based training.

A vast body of literature has found linkages between perceived usefulness and usage intentions (e.g., Bhattacherjee, 2001; Davis et al., 1989). Systems that are perceived to be both useful (measured by job effectiveness, control over quality of work) and easy to use (measured by learning curves, ability to manipulate the system easily, and clear, understandable interfaces) have a positive effect on attitudes (e.g., satisfaction) toward a system and its actual use (Davis, Bagozzi, and Warshaw, 1989). Consumer researchers have also shown that prior beliefs are correlated with outcome evaluations such as satisfaction (Oliver, 1991). IT software users who ease-through or struggle with training programs will form beliefs that serve as cues for summary evaluations such as satisfaction (Solomon, 2008). Positive and negative cues such as clear software structure or complex instructions influence an IT user's product beliefs and attitudes. We therefore expect that IT tutorial software will generate more satisfied users, and less-structured, simulation software dissatisfied users. Therefore:

> H2: Users of tutorial-based training will be more satisfied than users of simulation-based training.

The ECT model, often used in consumer behavior research, examines continuance as well as satisfaction (Bhattacherjee, 2001). If a purchased product meets or exceeds consumer expectations through its perceived performance, users are more likely to be satisfied and would tend to continue to use the product. Satisfaction, measured through positive, negative, or indifferent attitudes, is a predictor of intention to use a system. Using the ECT model, Bhattacherjee (2001) found that satisfied users are indeed more apt to continue their usage of IT products and services. In a follow-up longitudinal study, Bhattacherjee and Premkumar (2004) confirmed that user expectancies and satisfaction are important factors in attitudinal changes toward IT products over time. They also noted that usefulness and attitudinal change is more pronounced when IT products were negatively perceived. For IT training software, we would expect positive (negative) evaluation of tutorial (simulation) software leads directly to higher (lower) software continuance intentions. Thus:

> H3: Users of tutorial-based training are more likely to continue to use the software than users of simulation-based training.

Emotions may be a fundamental element of all consumer product and service experiences. Service researchers believe that emotions may complement cognitive appraisals in predicting satisfaction and other consumer service outcomes (Mano and Oliver, 1993). A wide range of service studies point to a positive link between pleasant surprise or positive feelings and customer satisfaction (McQuitty Finn, and Wiley, 2000), and a negative link between disappointment and switching or complaint behavior (Babin and Babin, 2001). However, positive and negative emotions may asymmetrically influence IT

user outcomes. Inman et al. (1997) found that negative emotions produced stronger and longer-lasting post-choice evaluations of products compared to positive emotions. Emotions and emotions associated with services can be linked to many service outcomes including satisfaction, word-of-mouth communications and repurchase intentions (Oliver, 1993). We anecdotally noted students' frustration and irritation with poorly written training software in prior classes. In addition, there is preliminary evidence that emotions influence some elements of the TAM (Saade and Kira, 2006). Because earlier consumer studies have found linkages between emotions and many service outcomes, and the impact of positive and negative emotions may be asymmetric, we will posit that both positive and negative emotion will have a significant influence on the overall TAM. Thus:

> H4: Positive emotions will significantly covary with technology adoption outcomes of ease of use, continuance and satisfaction.
>
> H5: Negative emotions will significantly covary with technology adoption outcomes of ease of use, continuance and satisfaction.

METHOD

We identified two different implementations of application training used at a major New England university -- specifically, one class using instructor-led tutorial-based training and another using simulation-based training. The two programs were qualitatively described in prior 2005 and 2006 year-end class evaluations as either as frustrating and poorly structured, or rewarding and competently-structured training programs by students in multiple class sections. We used these two software tutorial applications used in four different Spring 2007 undergraduate classes to examine emotional and TAM outcomes toward the software products. A cross-sectional survey of students was conducted during week 14 of a 16 week semester. Two sections of one business class with 57 undergraduate students used a tutorial program that accompanies SPSS, and used the actual application to complete the assignments. The SPSS tutorial was a web-based tutorial that guided students through basic statistical software configuration, and introductory and advanced statistical analysis. This well-structured tutorial was designed to be a "hands on" step-by-step guide toward using SPSS software. All tutorial examples used files that were available with the SPSS program, allowing students to independently replicate the tutorial procedures and analyses on their computers. After students completed the training, they were required to apply their learning by opening new SPSS files; analyzing the data and answering multiple choice and short answer essay questions with a timed online quiz.

The other application, Skills Assessment Manager (SAM), was a product that provided a simulated experience in using a software application. In this instance, SAM 2003 for Access was used in two sections with 81 students of a Spring MIS class. Students did not manipulate Access, but instead interacted with the simulation. There were two major components: a training module, and an exam module. In the training modules, students were presented with online reading material to prepare them for completing the task, an automated step that let students observe how the task should be performed, a practice session, where students were guided through the task using tool tips, and finally, an apply step where students were asked to perform the tasks. Instructors could combine sets of these tasks to form training modules, and students could repeat the tasks as often as desired. Once the students believed they had mastered the training, they were then tested on their knowledge by completing an exam. When the exam launched, students were given directions on each task. Instructors could specify how many times an exam could be retaken. For both types of modules, instructors could provide starting and ending dates and times that they are available. Students were able to generate reports showing training progress and exam results. All student work was saved at a remote server controlled via the publisher. Technical support was available six days a week for both students and instructors.

For our experiment, we utilized existing measurements for all variables including positive emotions, negative emotions, ease of use, continuance and satisfaction. The positive and negative emotions were measured with the PANAS (Watson and Tellegen, 1988) scale. Each emotion contained ten single item emotions measured from "very slightly or not at all" through "extremely." The continuance and ease-of-use dependent variable scales were measured on a seven-point Likert scale ranging from "strongly agree" to "strongly disagree." Continuance was measured with the three-item scale from Bhattacherjee (2001) and ease-of-use by the eight-item scale from Moore and Benbaset (1991). Satisfaction utilized a seven-point semantic differential scale from Laroche, Bergeron, and Barbaro-Forleo (2001). The final sample size was 138 students. The mean age of respondents was twenty-two (SD=2.26), and males (65%) outnumbered females. Whites (82%), Hispanics (10%), and Asians (4%) were the main ethnic groups studied. Seniors (58%) and juniors (40%) dominated the sample.

RESULTS

To validate the two software treatment conditions in the experiment, a manipulation check question, "My interaction with the training program is clear" anchored by (1) strongly agree to (7) strongly disagree was used. Using an independent sample t-test, a significant difference between the mean scores was found (SAM: M=4.34, SPSS: M=3.28, t(147)=4.14, P<0.001). Hence, the two training tutorial packages yielded different student reactions. For our experimental measurements, factor structure and reliability results were sufficient: e.g., no significant cross loadings, item loadings >0.60, and alpha levels >0.70), for all standardized multi-item scales including positive and negative emotions, perceived ease of use and satisfaction, (see Tables 1-5). The Bhattacherjeee (2001) continuance scale contained one item that did not load on the continuance factor and was removed from the analysis.

Table 1

Factor Analysis for Covariates and Dependent Variables
Positive Emotions

Variable and Measurement Items	***Type of Variable***	***Number of Items***	***Factor Loading***	***Alpha***
Positive emotions (Watson and Tellegen, 1988)	Covariate	10	0.56	0.912
Determined			.549	
Active			.719	
Interested			.807	
Attentive			.751	
Enthusiastic			.819	
Concentrating			.476	
Strong			.682	
Inspired			.856	
Excited			.833	
Proud			.605	

Table 2

Factor Analysis for Covariates and Dependent Variables
Negative Emotions

Variable and Measurement Items	***Type of Variable***	***Number of Items***	***Factor Loading***	***Alpha***
Negative emotions (Watson and Tellegen, 1988)	Covariate	10	0.70	0.946
Afraid			.644	
Upset			.537	
Nervous			.742	
Jittery			.843	
Scared			.832	
Distressed			.612	
Guilty			.632	
Ashamed			.638	
Irritable			.479	
Hostile			.576	

Table 3
Factor Analysis for Covariates and Dependent Variables
Ease of Use

Variable and Measurement Items	*Type of Variable*	*Number of Items*	*Factor Loading*	*Alpha*
Ease of use (Moore and Benbaset, 1991)	DV	8	0.63	0.899
I believe the training material was cumbersome to use.			.592	
It is easy for me to remember how to perform tasks using the training material.			.789	
My using the training software requires a lot of mental effort.			.621	
Using the training material was often frustrating.			.739	
My interaction with this training material is clear and understandable.			.760	
I believe it is easy to get the training program to do what I want it to do.			.718	
Learning to operate the training program is easy for me.			.597	
Overall, I believe that the training software is easy to use.			.811	

Table 4

Factor Analysis for Covariates and Dependent Variables
Continuance

Variable and Measurement Items	*Type of Variable*	*Number of Items*	*Factor Loading*	*Alpha*
Continuance (Bhattacherjee, 2001)	DV	2	0.76	0.681
I intend to continue using the training material after the class ends			0.74	
I'd rather continue using my current training product rather than use the other one. *			0.23*	
If I could, I would like to discontinue my use of the training product.			0.69	

Table 5

Factor Analysis for Covariates and Dependent Variables
Satisfaction

Variable and Measurement Items	*Type of Variable*	*Number of Items*	*Factor Loading*	*Alpha*
Satisfaction (Laroche, Bergeron and Barbaro-Forleo, 2001)	DV	4	0.87	0.950
Very Satisfied/Very Dissatisfied			.901	
Very Please/Very Displeased			.848	
Contented/Frustrated			.843	
Delighted/Terrible			.706	

The experiment contained the covariates of positive and negative emotions and several dependent outcome variables including perceived ease of use, continuance and satisfaction. The descriptive statistics revealed large changes in the means for all outcome variables between the two software treatment conditions (see Table 6). Because the software outcome variables were interrelated through the TAM model, a MANCOVA was performed to test software supplier differences on the variables collectively (i.e., H1-H3). As a first step, homogeneity was examined for the outcome variables, and these tests confirmed homogeneous data for all outcomes variables. Students who used the SPSS training program yielded more positive responses toward all outcome constructs. The MANCOVA exhibited a moderate overall effect, with Hotelling's T2=2.56, F(3, 139)=11.09, P<0.001, Wilks' λ= 0.79, F(3, 139)=11.10, P<0.001, η2=0.24, and statistically significant effects for all dependent variables (see Table 7). Both positive and negative covariates generated significant effects on the dependent variables, F(3, 135)>12, P<.001, but nonsignificant effects with independent software variable (p>.15). Participants who learned SPSS via the software tutorial (M=3.36, SD=0.94) generated more favorable ease of use ratings than the participants who trained on SAM (M=4.30, SD=1.32), F(1, 137)=8.10, P=0.005, η2=0.06, more favorable continuance intentions (SPSS: M=3.36, SD=1.36, SAM: M=5.20, SD=1.40), F(1, 137)=22.95, P<0.001, η2=0.15), and more favorable satisfaction ratings (SPSS: M=3.16, SD=0.97, SAM: M=4.44, SD=1.40), F(1, 137)=19.43, P<0.001, η2=0.13). Hence, H1-H5 are strongly supported.

Table 6

Experimental Descriptive Statistics

Factor	*Software Training Tutorial*	*Mean*	*Std. Deviation*
Ease of Use	SPSS	3.36	0.94
	SAM	4.30	1.32
Continuance	SPSS	3.36	1.36
	SAM	5.20	1.40
Satisfaction	SPSS	3.16	0.97
	SAM	4.44	1.40

Table 7

Experimental MANCOVA Results
(SAM vs. SPSS Tutorials)

Variable COV/DV	*Degrees of Freedom*	*F-value*	*Significance Level*
Positive Emotion	3, 135	20.13	P<0.001
Negative Emotion	3, 135	12.90	P<0.001
Ease of Use	1, 137	8.10	P=0.005
Continuance	1, 137	22.95	P<0.001
Satisfaction	1, 137	19.43	P<0.001

DISCUSSION AND CONCLUSION

The results of the experiment showed that, as expected, tutorials that are well-structured are indeed perceived as being easier to use, and therefore users are more likely to be satisfied with the product, enough to intend to continue using it. Additionally, if tutorials are well-structured, they can be expected to engender positive emotions from the users, whereas less well-developed applications, simulation-based training in this case, elicit negative emotions. These results enforce our anecdotal observations of student groups using both kinds of training. Furthermore, these results support the power of the TAM model in relating emotional responses to the model's dependent variables.

Training simulations provide many benefits to learning in that they can be web based; contain consistent data sets, scenarios, and solutions; provide instant grading/feedback to the trainee and trainer; and manage the learning environment. These

benefits may come at a price. As we discovered, using a simulated application instead of an actual application can create a different emotional response. Many of the simulation-based applications used in the educational markets have been created by publishing companies over the past five years, in part, to provide value added to textbooks and as an additional source for revenue in a highly competitive industry with declining margins. The organizational expertise in software development at these publishing companies could be considered somewhat different from the expertise and knowledge that is more common at a software company. The organizational knowledge in application development at a company such as, for example, Microsoft, should be vastly superior to that found at a publishing company. In addition to this, the simulation software does not benefit from the many years of debugging and product development that has taken place in the more established software market. Finally, the simulation application itself provides an added veneer of rigidity and additional points of failure over the base application on which it is providing training. When a simulation of an application is being used for training, there is an expectation by the user that the simulation will perform the same way that the actual application would. If this expectation is not met, there is an opportunity for a negative emotional response. The concept that applications can help to cause an affective state in users is not a new one and the most prevalent example is that of an application does not function as expected (Hollnagel, 2002).

Educators implementing these simulation-based training applications should be aware that there is a much higher potential from negative emotional response and develop strategies to manage this process. Repeated acknowledgement of the issue prior to dealing with student frustration may help to manage expectations and have the effect of mitigating potential negative responses. Developing these course management strategies would be an opportunity for future research.

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