Expectancy Theory and Behavioral Intentions to Use Computer Applications

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Abstract

A theoretically sound model linking antecedents of an organizationally new software implementation to behavioral intentions to use this software is presented and empirically tested. The organization is a university in the United States and the users are primarily faculty. The antecedents of previous computer experience, ease of system use, and administrator support for the software are linked to behavioral intentions to use the software through self-efficacy and outcome expectancy/usefulness and then attitudes toward the software. The software context examined is an implementation of Digital Measures that is used to develop a repository of faculty activities and to generate a variety of faculty-oriented reports. The empirical study used 154 responses by faculty. The model was estimated using structural equations modeling. The results found that ease of system use impacts both self-efficacy and outcome expectancy/usefulness, which both then impact attitudes towards Digital Measures, which in turn influences behavioral intentions to use Digital Measures. Discussion and conclusion sections are also presented.

Keywords: IS success, data retrieval system, self-efficacy, outcome expectancy

Introduction

Rapid technological developments have increased society's dependence on information technology. As a result, employers expect employees to use computers and the Internet effectively in their daily work; however, implementing a new technology does not mean the employees will consider it beneficial. Typically, organizations implement new computer technology to automate routine and repetitive tasks, allowing employees time for more analytical, decision-making tasks. Such technology succeeds at automating tasks only if the employee actually uses it appropriately. Many factors influence employees' perceptions of successful acceptance of technology (R. A. Davis, 2001). For example, the following can influence an employee's intention to use the technology: whether an employee believes that he or she can competently use the technology to enhance his or her work performance, whether the employee perceives the ease of use and usefulness of the technology, and the employee's perceived degree of satisfaction with the technology.

A better understanding of these factors and their interrelationships can provide insights improving the development and implementation of information technology. The purpose of the research presented below is to better understand these factors and their interrelationships based on a theoretically sound model.

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The model links antecedents of information technology experiences, use, and support to attitudes regarding the technology and behavioral intentions to use it. Furthermore, because these antecedents are at least partially controllable, meaningful managerial implications are possible. The research's presentation begins with the theoretical foundation and resulting model. Next, the empirical study is presented. The manuscript ends with a discussion of the empirical findings and conclusions.

The Theoretical Foundation

Accepting a technology depends on whether employees believe that the technology will benefit them. Predicting and perceiving employee's beliefs for future computing use can be based on self-efficacy theory (Bandura, 1986; Bates & Khasawneh, 2007). The model used in this research is rooted in self-efficacy theory or social cognitive theory (Bandura, 1977, 1982; Martinko, Henry, & Zmud, 1996). The theory (Bandura, 1982, 1986) links an individual's cognitive state to a variety of affective and behavioral outcomes (Staples, Hulland, & Higgins, 1998). According to self-efficacy theory, expectations (e.g., motivation, performance, and feelings of frustration associated with repeated failure) determine affective and behavioral reactions in numerous situations. If the system is perceived to be useful, an employee is more likely to adopt and use the technology in the future (Henry & Stone, 2001; Martinko et al., 1996). The extensive use of technology and information systems in the workplace requires many systems to be non-volitional. A system that is mandatory may inflate the system use but the perception of usefulness will still be present (Iivari, 2005). Rai, Lang, and Welker (2002) defined "quasi-volitional IT use" as un-mandated use of the system but not completely volitional because of social pressure and subjective norms in the environment. This means that an employee may not be required to use the system but the influences in the workplace suggest the employee should use it.

In the past, self-efficacy theory has helped explain individuals' reactions in a variety of contexts including reactions to information technologies (Bandura, 1986; Baronas & Louis, 1988; Hasan, 2003; Havelka, 2003; Martinko et al., 1996; Meier, 1985; Potosky, 2002). Bandura (1986) separated the affective and behavioral outcomes into two distinct types: self-efficacy and outcome expectancy. An individual's belief that he or she possesses the skills and abilities to successfully accomplish a specific task represents self-efficacy. Outcome expectancy is an individual's belief that by accomplishing a task, a desired outcome is attained. Self-efficacy and outcome expectancy have separate impacts on behavior and effect. However, self-efficacy typically has a larger effect than outcome expectancy (Bandura, 1986). Generally, self-efficacy has a direct impact on outcome expectancy (Stone & Henry, 2003).

In self-efficacy theory, four groups of constructs are proposed to directly impact self-efficacy and outcome expectancy. These constructs are past experience or mastery with the task, vicarious experience performing the task, emotional or physiological arousal regarding the task, and social persuasion to perform the task. These constructs impact attitudes toward the task, behavioral intentions to perform the task and ultimately task performance through self-efficacy and outcome expectancy.

The Model

Based on the literature and the context of this investigation, a model was developed. The context explored the introduction of a new software system for university faculty using, storing, and retrieving data regarding their research, teaching, and service. The software, Digital Measures, was adopted by the University administration to create a repository of faculty activity and to standardize various reports based on this data (e.g., annual performance reports). At the time of this study, the faculty and staff were strongly encouraged to use Digital Measures, but it was not a requirement. As a result, the use of Digital Measures can be viewed as volitional. Quasi-volitional may

be a more realistic definition (Rai, Lang, & Welker, 2002) as the system was not mandated to be used individually. Some faculty may have had an authorized staff person enter the information into Digital Measures.

The developed model includes the antecedents of previous computer experience (mastery), ease of system (i.e., Digital Measures) use (emotion or physiological arousal), and administrator support for using Digital Measures (social norm or persuasion). The literature regarding these specific antecedents is presented below.

Recent research on computer self-efficacy investigates the construct of previous computer experience with a variety of demographic predictors (Barbeite & Weiss, 2004; Havelka, 2003; Potosky & Bobko, 1998). Although this research does not involve students, inference can be taken from previous research to provide insights in the university environment. From Havelka's research (2003) significant differences in self-efficacy ratings regarding computer use resulted for information systems and economics majors compared to management majors. This study does involve faculty and staff who cross all the different academic fields in a typical university campus and thus the significance of academic field may play a role. Some research has looked at the effect of individual experiences and its effect on self-efficacy. Previous computer experience has shown to be influential to computer self-efficacy. If a person has more computer experience, particularly in certain areas of computer programming and graphic applications, he or she tends to report higher self-efficacy (Busch, 1995; Hasan, 2003; Havelka, 2003; Wilson & Shrock, 2001). Furthermore, prior experience leads to expectations of the usefulness of outcomes from completing the task.

Emotional or physiological arousal regarding a system influences self-efficacy relating the perception of task completion. Intellectual interest in a task or perceptions of how easy the task is to complete improves an individual's perception of self-efficacy and the value of completing the task (i.e., outcome expectancy/usefulness). Negative judgments of one's efficacy and the task outcome can be produced from anxiety regarding performing a specific task (Bandura, 1977, 1986). Thus, emotional or physiological arousal impacts perceptions of self-efficacy and outcome expectancy/usefulness. One such aspect of arousal is ease of system use. The ease in using the system influences completion of the task (Compeau & Higgins, 1995). The easier a system is to use, the more likely an individual will be to use it, as suggested by the technology acceptance model (F. D. Davis, 1989; Venkatesh & Davis, 2000; Venkatesh, Morris, Davis, & Davis, 2003).

The final antecedent in the model, administrator support (social norm or persuasion), occurs when individuals are led by a superior or peer or when management suggest they have the capability to complete the expected task. One intended outcome of implementing an information system is to have the individual use the system. In many organizations, users don't see the value of the system and, therefore, don't or won't use it if use is volitional. Supportive encouragement and feedback can make the difference in the successful implementation and adoption of systems through impacting users' self-efficacy for completing the task and perceived value from completion (Henry & Stone, 1995). Some research argues that management support succeeds when the tasks are interdependent (Sharma & Yetton, 2003), and others suggest credibility to be a key issue (Luarn & Lin, 2005). Regardless of the root, rising cost of implementing and developing systems becomes a concern of administrators if systems are underutilized (Doll & Torkzadeh, 1998).

Vicarious experience is gained by observing and modeling other people's behavior. By observing others who have previously completed the intended task, individuals can improve their performance (Eastin & LaRose, 2000). For this study, vicarious experience was not included because faculty and staff are dispersed across multiple units. As a result, it was unclear how much, if any, vicarious experience occurred. Therefore, this construct was not added to the developing model.

Within the context of the study using Digital Measures, the literature implies a context specific model. The foundation for this model is summarized immediately below. For an organization to receive a return on their investment with an information system, individuals must use the system (Yi & Hwang, 2003). Acceptance of the system therefore is reliant on the individual's belief that the technology is beneficial, provides capabilities to complete tasks, is easy to use, and management will provide support to use the system. The hypothesized model relates the antecedents of self-efficacy and outcome expectancy/usefulness to faculty perceptions of ability in completing tasks related to using Digital Measures. Specifically, the theoretical model links the antecedents of previous computer experience, administrator support for Digital Measures, and ease of Digital Measures use to both outcome expectancy/usefulness and self-efficacy. Self-efficacy is also predicted by the model to impact outcome expectancy/usefulness and both expectancies are hypothesized to impact behavioral intentions to use Digital Measures in the future through attitudes towards Digital Measures. The theoretical model is shown in Figure 1.

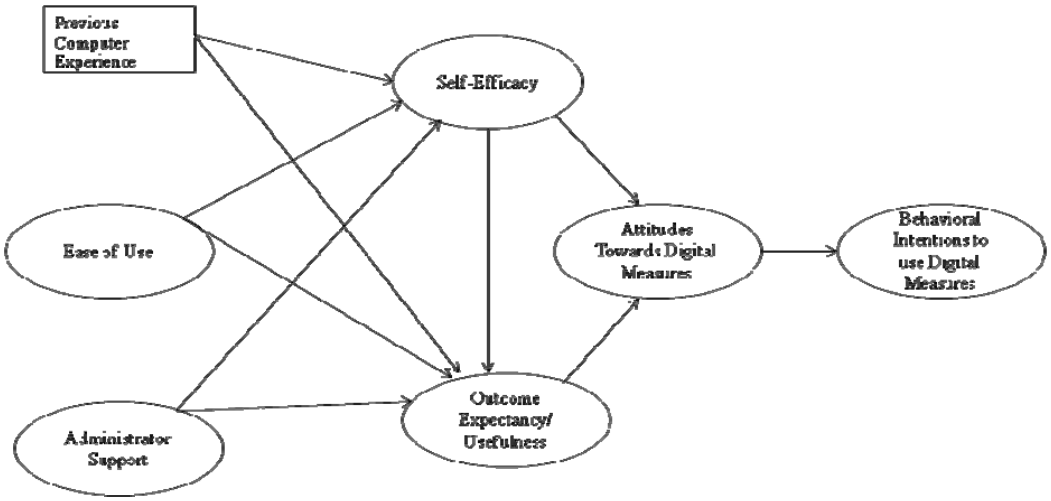

Figure 1. The Theoretical Model

The Empirical Study

The collected data for the empirical study used faculty at a western university that had adopted Digital Measures. The purpose of Digital Measures is to collect and present a variety of faculty performance data, including vitae and annual performance reports. A questionnaire was developed presenting a series of items used to measure the constructs in the model. Respondents were presented a five point Likert-type scale upon which to respond. The scale and weights used were: Strongly Agree-5; Agree-4; Neutral-3; Disagree-2; and Strongly Disagree-1. A questionnaire was distributed to faculty and administrators on the Internet using a survey tool called WebSurveyor. The URL for the web site containing the questionnaire was emailed to faculty through a university list serve. A total of 866 individuals received this email and were asked to participate. The number of usable responses was 154, producing a response rate of 17.78%.

The Sample

Several demographic variables were collected on this sample of 154 respondents. Twenty-seven percent of the respondents in the sample were female and seventy-three percent male. Fifty-one percent of the sample respondents reported an age in the 50-59 years old range. The vast majority

of the respondents, 86%, held tenure-track faculty positions at the university. The College of Letters, Arts, and Social Sciences represented the largest group of respondents at 26% of the sample while the second largest group was from the College of Agriculture and Life Sciences at 16%. The respondents were evenly divided on the receipt of training to use Digital Measures with 58% reporting that they received no training while 42% reported receiving training. The details regarding these demographics are shown in Table 1.

Table 1. The Demographics of the Respondents

Gender

Gender Category	Frequency	Percentage
Female	41	27%
Male	109	73%
Total	150	100%

Age

Age Category	Frequency	Percentage
25-29 years	2	1%
30-34 years	5	3%
35-39 years	14	9%
40-44 years	19	13%
45-49 years	19	13%
50-54 years	46	31%
55-59 years	30	20%
60 years and older	15	10%
Total	150	100%

Job Classification

Job Category	Frequency	Percentage
Tenure-Track Faculty	132	86%
Non-Tenure-Track Faculty	6	4%
Instructor	4	3%
Administrator	11	7%
Total	153	100%

Received Training in the use of Digital Measures

Category	Frequency	Percentage
No Training Received	86	58%
Training Received	64	42%
Total	150	100%

College Affiliation

College Affiliation Category	Frequency	Percentage
Agriculture and Life Sciences	25	16%
Business and Economics	16	10%
Education	10	6%
Engineering	17	11%
Law	2	1%
Letters, Arts, and Social Sciences	40	26%
Natural Resources	11	7%
Sciences	16	10%
Library	10	6%
Art and Architecture	5	3%
Other	2	1%
Total	154	97%

Details may not sum to totals due to rounding or omitted responses.

The Measures and Their Psychometric Properties

The constructs in the theoretical model were measured by a series of questionnaire items. These items were developed from previously published scales based on the work of Henry and Stone (Henry & Stone, 1995, 1999a, 1999b; Stone & Henry, 1998, 2003). These items were grouped into the measures used in the study. A confirmatory factor analysis was performed using a structural equations approach (i.e., Calis in PC SAS version 9.1) on these measures in order to evaluate their psychometric properties. The fit of the confirmatory factor analysis to the data was acceptable as indicated by several summary statistics. The goodness of fit index was 0.83 while adjusted for degrees of freedom this index had a value of 0.77. The root mean square residual was 0.22 and the chi-square statistic was significant at 1% and had a value of 283.98 with 154 degrees of freedom. The normed chi-square statistic was 1.84. Bentler's comparative fit index was 0.94 and the incremental fit indexes (i.e., Bentler and Bonett's and Bollen's normed and non-normed indexes) ranged from 0.85 to 0.94. These values indicate an acceptable fit between the model and the data for the confirmatory factor analysis. Using the standardized path coefficients from the confirmatory factor analysis, a reliability coefficient and the percentage of shared variance value for each measure were calculated. These values are shown in Table 2 along with the estimated standardized path coefficients for each indicant in each measure. All the standardized path coefficients except those used to scale the measure were statistically significant at a 1% level.

Table 2. The Constructs, Questionnaire Items, Indicant Estimates, Reliability, and Shared Variance

Constructs and Questionnaire Items	Indicant Estimate	Reliability	Shared Variance
Self-Efficacy		0.75	62%
1. It would be easy for me to become skillful at using Digital Measures.	0.95^		
2. I have the knowledge necessary to use Digital Measures.	0.58**		

Ease of Use		0.82	70%
3. My interaction with Digital Measures is clear and understandable.	0.80**		
4. I find Digital Measures easy to use.	0.87**		
Attitudes Towards Digital Measures		0.79	55%
5. Interacting with Digital Measures is often frustrating.	0.81^		
6. Digital Measures is rigid and inflexible.	0.72**		
7. I find Digital Measures cumbersome to use.	0.69**		
Outcome Expectancy/Usefulness		0.98	86%
Using Digital Measures……..			
8. Would enable me to accomplish tasks (vita, annual evaluations) more quickly.	0.86^		
9. Saves me time in my job.	0.92**		
10. Enhances my effectiveness on performing these tasks.	0.96**		
11. Improves the quality of the work I do on tasks.	0.93**		
12. Increases my productivity.	0.95**		
13. Makes it easier to do my job.	0.96**		
14. Overall, I find Digital Measures useful in my job.	0.91**		
Administrator Support		0.66	50%
15. In general, the University has supported the use of Digital Measures.	0.53**		
16. The administrators at the University have been helpful in the use of Digital Measures.	0.85**		
Behavioral Intentions to use Digital Measures		0.91	77%
In the future I intend to…..			
17. Use Digital Measures in more ways.	0.90^		
18. Say positive things about Digital Measures.	0.91**		
19. Find other uses for Digital Measures.	0.82**		

^ Used to scale the latent construct.

** Denotes statistical significance at a 1% level.

Self-efficacy was measured by two indicants with an estimated reliability coefficient of 0.75 with a percentage of shared variance of 62%. The ease of use construct was also measured by two indicants. Its reliability coefficient was 0.82 and the shared variance was 70%. Three indicants were used to measure the users' attitudes towards Digital Measures. The resulting measure had a reliability coefficient of 0.79 and a shared variance of 55%. A total of seven questionnaire items formed the measure of outcome expectancy/usefulness. The computed reliability coefficient for the resulting measure was 0.98 while the percentage of shared variance was 86%. The final two measures of administrative support and behavioral intentions to use Digital Measures were developed from two and three indicants, respectively. For the measure of administrative support the

calculated reliability coefficient was 0.66 and the shared variance 50% while for behavioral intentions these values were 0.91 and 77%.

Based on the reliability coefficients, composite reliability was satisfied, with some concern for the reliability of administrative support (Nunnally, 1978). A reliability coefficient of 0.66 is low and the measure of administrative support needs refinement if it is to be used in future research. The average percentages of shared variance were all 50% or greater, demonstrating satisfactory levels of this trait (Rivard & Huff, 1988). From these values, it can be concluded that convergent validity was satisfied for each measure (Igbaria & Greenhaus, 1992; Rainer & Harrison, 1993).

Discriminant validity was also examined using the standardized path coefficients from the confirmatory factor analysis. The examination compared the squared correlation between each pair of measures (computed from the correlations estimated in the confirmatory factor analysis) to their average percentage of shared variances. Discriminant validity is satisfied if, for each measure pair, the average percentages of shared variance are greater than the corresponding squared correlation (Fornell & Larcker, 1981). These squared correlations ranged from 0.00 to 0.67. All but one of the pairs of squared correlations were smaller than the corresponding average percentages of shared variances. The squared correlation between ease of use and attitudes towards Digital Measures was 0.62 while their shared variances were 70% for ease of use and 55% for attitudes towards using Digital Measures. This result implies that the indicants for ease of use and attitudes towards using Digital Measures could not discriminate between their own measure and the other. For all the other pairs of measures, discriminant validity was satisfied (Fornell & Larcker, 1981).

The Estimation Results

The theoretical model was estimated using a structural equations approach (i.e., Calis) in PC SAS version 9.1. The estimation method used was maximum likelihood with all the indicants being defined as reflective in the measures of the constructs. The overall fit of the theoretical model to the data is summarized by several statistics that are displayed in Table 3. The goodness of fit index was 0.82 while adjusted for degrees of freedom it was 0.76. The root mean square residual was 0.07. The chi-square statistic was 308.77 and had 158 degrees of freedom and was statistically significant from zero at a 1%. The normed chi-square was 1.95. Bentler's comparative fit index was 0.93 and the incremental fit indices ranged from 0.84 to 0.93. While these statistics produce mixed results regarding the quality of the fit between the model and the data, they indicate an acceptable fit given the number of observations and the complexity of the model (Hair, Anderson, Tatham, & Black, 1992).

Table 3. Summary Statistics of the Fit of the Model

Summary Statistic	Value
Goodness of Fit Index	0.82
Adjusted Goodness of Fit	0.76
Root Mean Square Residual	0.07
Chi-Square Statistic (df=158)	308.77**
Normed Chi-Square	1.95
Bentler Comparative Fit Index	0.93
Bentler and Bonett's Non-normed Index	0.92
Bentler and Bonett's Normed Index	0.87
Bollen Normed Index	0.84
Bollen Non-normed Index	0.93

** Significant at 1% level

The estimated path model is shown in Figure 2. All the reported estimates are standardized path coefficients. Before discussing these estimated coefficients, it is important to remember the items composing the Attitudes Towards Digital Measures variable are phrased in a negative direction. This means that high levels of self-efficacy and outcome expectancy/usefulness are expected to occur with low levels of attitudes towards Digital Measures or, in other words, that the path coefficients are expected to be negative. The significant path coefficients show that ease of Digital Measures' use impact the respondents' behavioral intentions to use Digital Measures through two paths. The first path is ease of use to self-efficacy to attitudes towards Digital Measures to behavioral intentions. This path indicates that high perceptions of ease of use lead to high levels of self-efficacy that lead to low levels of negative attitudes towards Digital Measures that lead to high behavioral intentions to use Digital Measures. The second path is ease of use to outcome expectancy/usefulness to attitudes towards Digital Measures to behavioral intentions. The interpretation of this path is that high perceptions of ease of use lead to high perceptions of outcome expectancy/usefulness to low levels of negative attitudes towards Digital Measures to high behavioral intentions to use Digital Measures. It should be noted that previous computer experience and administrator support were found to have no empirical impact in the model.

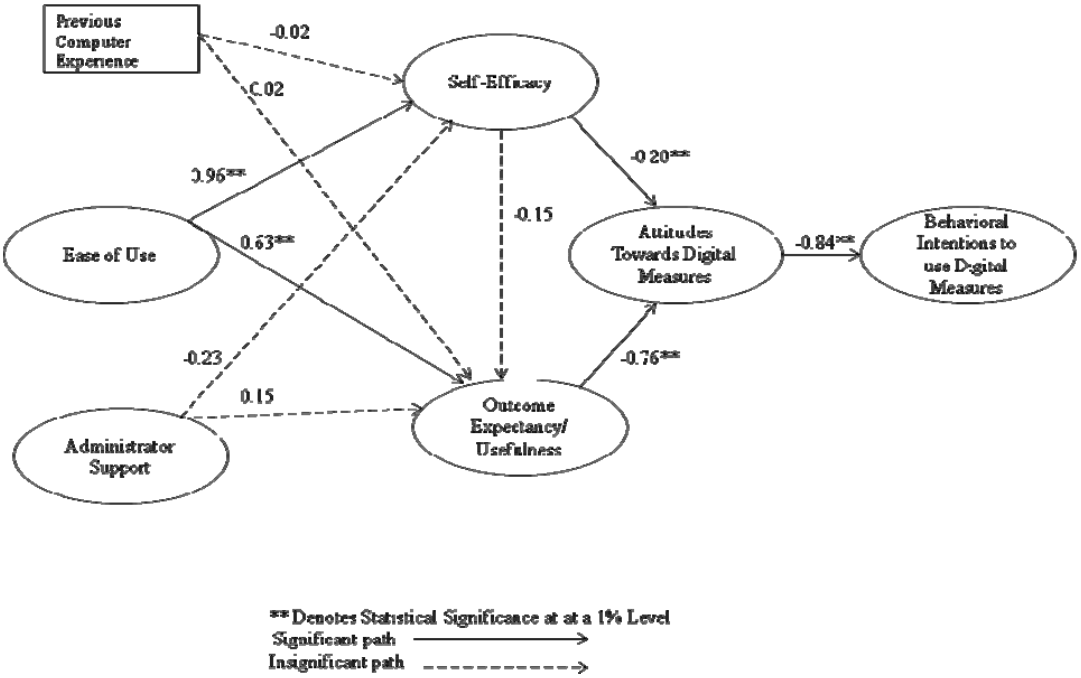

Figure 2. The Estimated Path Model Using Standardized Coefficients

Discussion

The empirical results indicate that ease of use is significant in encouraging the behavioral intentions of faculty to use Digital Measures. The transmission mechanism is ease of system use to behavioral intentions through self-efficacy and outcome expectancy/usefulness to attitudes toward Digital Measures. Specifically, ease of use positively impacts self-efficacy and outcome expectancy/usefulness and both directly influence users' positive attitudes towards Digital Measures. Users' attitudes towards Digital Measures have significant influences on users' behavioral intentions to use Digital Measures. These results may be interpreted as indicating the critical importance of easy to use software to gain users' behavioral intentions to use the software. If the software is perceived easy to use, it increases a faculty's confidence and perception of abilities

using the software as well as increasing the faculty's perceptions of the systems' value or usefulness. Better perceptions of self-efficacy and usefulness lead to better attitudes regarding the software, in this case Digital Measures. A more positive attitude leads to greater behavioral intentions to use Digital Measures.

The lack of significant paths from previous computer experience and administrator support to self-efficacy and outcome expectancy/usefulness has interesting interpretations. Prior experience with computers had no impact on the expectancies with regard to the use of Digital Measures. Similarly, the support from administrators to use Digital Measures had no impact on faculty expectations. Potential explanations of the faculty responding are based on the uniqueness of Digital Measures. If Digital Measures is truly a unique software application, no prior experience would match well to its use by responding faculty. As a result, no previous computer experience would impact self-efficacy and outcome expectancy/usefulness of Digital Measures. Furthermore, possibly the uniqueness of Digital Measures would make any support from administrators insignificant. This is even more likely when considering that the use of Digital Measures was soon to be non-volitional for faculty or at least perceived to be quasi-volitional. If the responding faculty were frustrated by the departments' expectations to use Digital Measures instead of a more familiar procedure to complete required administrative tasks, faculty might attribute the Digital Measures mandate to the administrator providing support. This might well lead to a perception that the support of these administrators as being insignificant or not meaningful.

Conclusions

The results indicated perceptions regarding the ease of system use as key to encouraging faculty behavioral intentions to make greater use of the new software application (i.e., Digital Measures). The impacts of ease of use are transmitted through positive impacts on self-efficacy and outcome expectancy/usefulness and these expectancies on the users' attitudes concerning Digital Measures. These results have implications for software developers as well as administrators. In the software development process, attention needs to be paid to the potential user groups. These groups can be used to make sure the software is easy to use within their contexts of use. In similar spirit, managers and administrators can provide training for users in order to facilitate the system's ease of use and thereby encouraging intentions to use Digital Measures. Additional training could also improve the mandate perception to use the system if the faculty perceives the usefulness of the system.

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Biographies

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