A contingency model of computer and Internet self-efficacy

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Abstract

Information system researchers have recently devoted considerable attention to the concept of computer self-efficacy in order to understand computer user behavior and system use. This article reports on the development and examination of a contingency model of computer and Internet self-efficacy. User attitude and computer anxiety were assumed to influence the development of computer and Internet self-efficacy. Measures of user attitude, computer anxiety, computer self-efficacy, and Internet self-efficacy were used in a university environment to collect 347 responses at both the beginning and end of an introductory computer course. Results suggested that training significantly improved computer and Internet self-efficacy. Respondents with ‘favorable’ attitudes toward computers improved their self-efficacy significantly more than respondents with ‘unfavorable’ attitudes. Respondents with ‘low’ computer anxiety improved their self-efficacy significantly more than respondents with ‘high’ computer anxiety. The interaction effect between attitude and anxiety was significant for computer self-efficacy scores but not for Internet self-efficacy scores. The implications of these findings are discussed.

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Keywords: Computer self-efficacy; Internet self-efficacy; Computer anxiety; Computer user attitude; Computer user training; Gender; Contingency model

1. Introduction

The ultimate question about information technology effectiveness relates to its impact on the individual and organizations. The effective use of an IS is influenced by not only system design features but also by the user’s ability to use the system effectively in making decisions, plan work, service customers, or control events. Self-efficacy reflects the belief that individuals have about their ability to use systems effectively. Research studies suggest that the higher the induced level of self-efficacy, the greater is performance achievement [1]. Individuals with high self-efficacy work harder and longer than individuals with low self-efficacy [44].

Computer self-efficacy is defined as an individual’s belief regarding their ability to use a computer [10]. Research suggests that it plays a significant role in an individual’s decision to use computers and how comfortable users are in learning skills related to effective use [26,32]. MIS researchers have, in recent years, devoted much effort in studying computer user training, user attitude, and computer anxiety as they relate to computer self-efficacy. Marakas et al. provided a comprehensive review of related literature and the path that research on computer self-efficacy has traveled.

Although computer self-efficacy constructs have been the subject of research studies, contingency models that examined the influencing effect of user attitude and computer anxiety on computer self-efficacy
have not been considered. User attitude and computer anxiety are important variables and are expected to influence the outcome of self-efficacy development efforts [27,39]. Improving our understanding about influence on training programs should help in making better decisions regarding technology implementation, acceptance, and use.

In our study, the pattern of change in computer and Internet self-efficacy was examined as individuals learned about computers and interacted with them. Survey responses were collected from 347 students at the beginning and end of an introductory computer course. Data were analyzed to examine the relationship between training and self-efficacy and how this relationship was influenced by user attitude and computer anxiety. Our specific goals were to examine the relationships between training and (a) computer self-efficacy, (b) Internet self-efficacy, (c) computer self-efficacy controlling for user attitude, (d) Internet self-efficacy controlling for user attitude, (e) computer self-efficacy controlling for computer anxiety, (f) Internet self-efficacy controlling for computer anxiety, (g) computer self-efficacy controlling for the interaction effect between attitude and anxiety, and (h) Internet self-efficacy controlling for the interaction effect between attitude and anxiety.

2. Self-efficacy construct

Research on self-efficacy concept has a long tradition in social sciences with notable works by Bandura [2,4,5], Schunk [36,37], Gist [14,15], and others. Self-efficacy arises from the gradual acquisition of complex cognitive, social, linguistic and/or physical skills through experience [3]. It is expected to affect task effort, persistence, expressed interest, and the level of goal difficulty selected for performance. Individuals appear to evaluate information about their own effectiveness is likely to influence whether they will try to cope with a given situation. Our specific goals were to examine the relationships between training and (a) computer self-efficacy, (b) Internet self-efficacy, (c) computer self-efficacy controlling for user attitude, (d) Internet self-efficacy controlling for user attitude, (e) computer self-efficacy controlling for computer anxiety, (f) Internet self-efficacy controlling for computer anxiety, (g) computer self-efficacy controlling for the interaction effect between attitude and anxiety, and (h) Internet self-efficacy controlling for the interaction effect between attitude and anxiety.

3. Research model and hypotheses

In our contingency model, user attitude and computer anxiety were the conditional variables that moderated the outcome of computer training. Here, we measured training outcome in terms of pattern of change in computer and Internet self-efficacy as trainees went through a semester long computer course. Part (a) in Fig. 1 shows our assumed moderating effect of computer anxiety and user attitude on computer and Internet self-efficacy. Part (b) shows the assumed moderating effect of the interaction between computer anxiety and user attitude on computer and Internet self-efficacy.

Research studies in cognitive modeling, behavioral modeling, and self-management suggest that training programs enhance self-efficacy [12,13,16]. MIS research has focused on computer self-efficacy as a special case of general self-efficacy. MIS researchers, similarly, have illustrated the importance of training for computer self-efficacy. Training is also suggested to enhance Internet self-efficacy, considered an extension of computer self-efficacy construct in the domain of World Wide Web [31]. Thus we proposed:

Hypothesis 1. Computer training improves computer self-efficacy.
Hypothesis 2. Computer training improves Internet self-efficacy.

Studies in the field of psychology suggest that people experience anxiety when performing behaviors that they do not feel they can perform competently. When trainees experience anxiety, they cannot concentrate on learning; they focus on inner feelings and thoughts [9,38]. Studies have suggested that computer anxiety reduces the effectiveness of computer-based training [17,22]. We, therefore, expected computer anxiety to adversely affect training outcome measured in terms of improvement in computer or Internet self-efficacy. Thus, we proposed:

Hypothesis 3. Computer anxiety negatively influences computer training outcome measured in terms of pattern of change in computer self-efficacy.

Hypothesis 4. Computer anxiety negatively influences computer training outcome measured in terms of pattern of change in Internet self-efficacy.

User attitude also plays an important role in training and learning. Studies have suggested that user attitude toward computer influenced the outcome of training programs [7,41,45]. A positive user attitude toward computer is expected to positively influence the outcome of training programs and the level of self-efficacy improvement. Thus, we proposed:

Hypothesis 5. User attitude influences computer training outcome measured in terms of pattern of change in computer self-efficacy.

Hypothesis 6. User attitude influences computer training outcome measured in terms of pattern of change in Internet self-efficacy.

We have argued that anxiety and attitude, separately, influence the outcome of computer training. Research also suggested a significant relationship between computer anxiety and user attitude [6,18,23]. For example, Harris suggested that computer anxiety had negative influence on attitude toward end-user-computing. However, this relationship has not been widely tested and there is thus a need to examine the interaction effects between computer anxiety and user attitude on computer training. We expected the interaction between anxiety and attitude to influence the computer training outcome and thus constructed the following hypotheses:

Hypothesis 7. The interaction between computer anxiety and user attitude influences computer training outcome measured in terms of pattern of change in computer self-efficacy.

Hypothesis 8. The interaction between computer anxiety and user attitude influences computer training outcome measured in terms of pattern of change in Internet self-efficacy.

These hypotheses are summarized in Table 1, which also provides literature support for each.

4. The instruments

Arguably the most important aspect of computer self-efficacy to MIS research is the development of
valid and reliable measures that can be used with confidence to accumulate findings and facilitate substantive hypotheses testing. We have not developed a sufficient pool of research instruments in this domain and this has hampered research on computer self-efficacy.

Two broad perspectives have emerged for measures of computer self-efficacy. One encourages developing task specific measures, while another encourages developing general measures. Works of Murphy et al. [29] and Compeau et al. [11] are examples of general and task specific measures, respectively. Marakas et al. suggested the need for specific computer self-efficacy measures while Torkzadeh et al. validated and used general measures.

The argument for use of specific measures of computer self-efficacy suggested that it was important to align computer self-efficacy with the particular task domain. Such a strong alignment would be likely to improve the exploratory power of the instruments. This perspective served to motivate the development of measures that assessed the individual’s level of self-efficacy with specific task such as the use of a spreadsheet, suggesting that a new measure is needed every time a new area is explored.

The argument for general measures of computer self-efficacy is that it is difficult to establish a research tradition if new measures are to be developed every time research is attempted: task specific measures may not be stable over time for use in longitudinal or follow up studies. This perspective has served to motivate the development of general measures that are likely to be stable over time and applicable for longitudinal studies.

The inherent nature of computer technology involves constant and often rapid change, most of which is not accurately predicted. This unpredictable nature has posed challenges for research in IS in general and instrument development in particular. This does not mean that existing measures should not be used, but that they must be used with caution and their reliability must be reported each time they are used.

4.1. Computer self-efficacy

We used an instrument developed by Murphy et al. based on the work of Bandura, in which he conceptualized self-efficacy as individualized self-perception varying across activities and situational circumstances, rather than as a goal disposition that can be assessed by an omnibus test. Domain specific measures, such as computer self-efficacy, allow researchers to be more accurate in evaluating computer training outcome than general instruments. Owen [33] also suggested that self-efficacy could be reliably measured and that such measures might be used to assess a composite of affect, cognition, and performance in the attainment of program and course objectives. Murphy et al. suggested that their instrument could be used to evaluate skill attainment at both pre- and post-training. Later, Harrison and Rainer [19] used this instrument to measure the respondent’s perceptions regarding specific computer-related knowledge and skills and reported an overall reliability coefficient of 0.95 for the instrument. In a more recent study, Torkzadeh et al. used it in a study of training and computer self-efficacy and also reported a reliability of 0.95. Our study used 25 of the original 32-item instrument developed by Murphy et al. (see Appendix A). Items related to mainframe system were deemed irrelevant here, and were dropped.

4.2. Internet self-efficacy

The computer self-efficacy instrument pre-dated the rise and importance of Internet related skills. In a more recent study, Torkzadeh and Van Dyke [40] developed a 17-item instrument for measuring the individual’s self-perception and self-competency in interacting with the Internet. They based their measurement development on Bandura’s conceptualization of self-efficacy and other studies of social and cognitive psychology. Later, they used this 17-item instrument in a study of training and Internet self-
efficacy and reported a reliability of 0.96. We used 15 items of the instrument developed by Torkzadeh and Van Dyke for measuring Internet self-efficacy. Two items in the original instrument were deemed redundant and were dropped. Both computer self-efficacy and Internet self-efficacy instruments used a five point Likert-type scale where 1 = strongly disagree and 5 = strongly agree.

4.3. Computer anxiety and user attitude

Our study used measures of computer anxiety developed by Heinssen et al. [21] and used by Compeau et al. to study computer self-efficacy and system use. It also used measures of user attitude developed by Loyd and Gressard [25] and used by Compeau et al. In their study, Compeau et al. used five items for measuring user attitude or “affective response” and four for measuring computer anxiety. Affect or user attitude, they argued, represented the positive side (where a person enjoyed interacting with a computer) and anxiety represented the negative side (where a person experienced feelings of apprehension or anxiety when interacting). Compeau et al. used partial least square tests (PLS) to assess their measurement model and reported internal consistency greater than 0.7 for measures of computer anxiety and user attitude. We used the five items of user attitude and four items of computer anxiety of Compeau et al. Both computer anxiety and user attitude instruments used a five point Likert-type scale, where 1 = strongly disagree and 5 = strongly agree.

5. The study

A survey instrument containing measures of computer self-efficacy, Internet self-efficacy, user attitude, and computer anxiety was administered to business undergraduates at a large state university in the southwest region of the United States. Students in multiple sections of an introductory course participated in the study. The course is required for all business students. Class sizes ranged from 45 to 60. Course content and grade distribution were similar for all sections. The course covered information technology infrastructure, management and organizational support systems, information systems in the enterprise, electronic business, telecommunications and networks, management of hardware and software, file and database management, systems development, decision support systems, and aspects of a computer career.

The measures were administered at both the beginning and end of the course. The time between pre- and post-test ranged from 11 to 12 weeks. Respondents had no prior knowledge that they would be asked to repeat the survey at the end and were asked to respond to questions focusing on their current belief. Participation in the study was voluntary; student names were used to match pre- and post-training responses. A total of 347 usable matching responses consisting of 201 male (58%) and 146 female students were obtained. Incomplete responses and those with matching problems were omitted.

The survey also asked respondents about their educational interest and age. The sample was diverse in terms of respondents’ educational interest. They were majoring in accounting (19.7%), MIS (18.3%), management (16.8%), finance (15.7%), marketing (13.0%), economics (2.3%), and other. The respondents’ age distribution was: under 20 years (10.1%), 20–29 (77.8%), 30–39 (9.5%), and greater than 40 (2.6%). This sample was considered large enough to confirm the measures and test the research hypotheses.

6. Data analysis and results

The reliability (internal consistency) of items in each scale was examined using Cronbch’s alpha to confirm the adequacy of the measures for testing the hypotheses (see Table 2). These coefficients confirmed results of earlier studies and provided confidence in testing the hypotheses. The reliability results are based on pre-training data. However, post-training data had very similar results.

Respondents were grouped as people with ‘high’ or ‘low’ computer anxiety using the mean score of 1.95 (S.D. = 0.83) on the pre-test computer anxiety scale. Similarly, respondents were grouped as people with ‘favorable’ or ‘unfavorable’ attitude toward computers using the mean score of 3.98 (S.D. = 0.74) on the pre-test computer user attitude scale. Overall, computer user attitude scores were high for all respondents. This is consistent with recent studies and different from what was reported in earlier studies [34], suggesting an upward change in user’s attitude toward computers over the years.

<table>
<thead>
<tr>
<th>Factors</th>
<th>No. of items</th>
<th>Alpha</th>
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<tbody>
<tr>
<td>Computer self-efficacy</td>
<td>25</td>
<td>0.95</td>
</tr>
<tr>
<td>Internet self-efficacy</td>
<td>15</td>
<td>0.91</td>
</tr>
<tr>
<td>Attitude</td>
<td>5</td>
<td>0.81</td>
</tr>
<tr>
<td>Anxiety</td>
<td>4</td>
<td>0.81</td>
</tr>
</tbody>
</table>
6.1. Individual differences and self-efficacy development

Table 3 provides pre- and post-training scores for computer self-efficacy and Internet self-efficacy for all respondents. The score for each scale was equal to the total points divided by the number of items. The difference in mean scores was examined using a paired \( t \)-test procedure. Both differences in mean scores were significant at \( p < 0.001 \). The results suggested that respondents entered training programs with a relatively high level of computer and Internet self-efficacy but that the levels improved significantly after the course. These findings supported Hypotheses 1 and 2.

Data were also analyzed to examine the influence of computer anxiety and user attitude on computer and Internet self-efficacy as students went through the training program. The ANOVA method was used to examine the difference between subject responses as well as possible interaction effects of computer anxiety and user attitude on computer and Internet self-efficacy. Pre- and post-training data were used to examine the pattern of change in computer and Internet self-efficacy.

Table 4 presents the ANOVA results; they suggested computer and Internet self-efficacy scores were significantly different for respondents with ‘high’ and ‘low’ computer anxiety. In the between subjects tests, there were significant main effects of computer anxiety on both computer and Internet self-efficacy. In the within-subjects tests, there was a significant main effect for both computer self-efficacy and Internet self-efficacy. These results supported Hypotheses 3 and 4.

Table 5 presents the ANOVA results that suggested that computer and Internet self-efficacy scores were significantly different for respondents with ‘favorable’ and ‘unfavorable’ attitudes toward computers. In the within-subjects tests, there was a significant main effect for both computer self-efficacy and Internet self-efficacy. In the between-subjects tests, there were significant main effects of user attitude on both computer self-efficacy and Internet self-efficacy. These results supported Hypotheses 5 and 6.

6.2. Interaction effects

Table 6 presents the ANOVA results; they suggested that the interaction between user attitude and computer anxiety had a significant effect on computer and Internet self-efficacy.
computer anxiety influenced the outcome of training for computer self-efficacy (at 0.05) but not for Internet self-efficacy. These results supported Hypotheses 7 but not 8. Results supported earlier analyses.

Data were analyzed to further examine the interaction effects of possible scenarios for individual differences. Respondents were grouped as having ‘high’ or ‘low’ computer anxiety as well as having ‘favorable’ or ‘unfavorable’ attitude toward computers. This enabled us to analyze four possible scenarios of individual differences. Table 7 depicts these scenarios and shows the sample size for each. The sample size is sufficiently large to warrant test of difference in mean scores for the pattern of change in computer and Internet self-efficacy as individuals go through training.

Both Tukey and Scheffe multiple comparisons procedures were used to test differences between possible mean scores; they produced similar results. Among the four possible situations, scenarios 2 and 3 were expected to have the most influence on self-efficacy development, in an opposite direction. Results suggested significant differences (at 0.01) between mean score for scenario 2 and for the other three scenarios for both computer and Internet self-efficacy. Results also suggested significant differences (at 0.01) between mean score for scenario 3 and for the other three scenarios for computer self-efficacy and scenarios 1 and 2 of Internet self-efficacy; there was no significant difference between mean scores for scenario 3 and 4 for Internet self-efficacy.

### Table 7

<table>
<thead>
<tr>
<th>Scenarios for individual differences</th>
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<tbody>
<tr>
<td>Favorable attitude</td>
</tr>
<tr>
<td>High Anxiety</td>
</tr>
<tr>
<td>n = 76</td>
</tr>
<tr>
<td>Low Anxiety</td>
</tr>
<tr>
<td>n = 121</td>
</tr>
<tr>
<td>Total</td>
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<tr>
<td>197</td>
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</table>

7. Discussion

User acceptance and the effective use of information technology have been considered essential success factors for technology management [43]. In order to manage information technology better, we need to understand why individuals readily accept and use computer applications, persist at improving their computer skills, select challenging projects, search for innovative and new ways of using computer systems, and eventually have high rates of success. The construct of computer self-efficacy is thus important to our understanding of computer user behavior; it helps predict user perceptions and subsequent acceptance and use of computer systems [42].

There has been increased research to help understand computer self-efficacy construct and its correlates. Studies have examined the role of training in computer self-efficacy development. The results of our study support earlier findings that training programs influence self-efficacy. More specifically, we examined the role of training in computer and Internet self-efficacy. We examined the influence of individual differences on the outcome of self-efficacy development. User attitude and computer anxiety were shown to influence the pattern of change in computer and Internet self-efficacy as students went through a computer course.

The results suggested that individuals with ‘favorable’ attitudes toward computers improved their computer and Internet self-efficacy significantly more than individuals with ‘unfavorable’ attitudes. The results also suggested that individuals with ‘low’ computer anxiety improved their computer and Internet self-efficacy significantly more than individuals with ‘high’ computer anxiety. The results support the hypothesis that the interaction between user attitude and computer anxiety influence the level of improvement in computer and Internet self-efficacy. Individuals with ‘low’ computer anxiety and ‘favorable’ attitudes toward computers improved their computer and Internet self-efficacy significantly more than any other group. In contrast, individuals with ‘high’ computer anxiety
and ‘unfavorable’ attitudes toward computers improved their computer and Internet self-efficacy less than any other group. Analyses of scenarios for individual differences suggested that computer anxiety exerted more influence on self-efficacy development than did user attitude.

Studies have also examined gender issues in self-efficacy development. Earlier findings suggested that males reported higher self-efficacy than females [8,24,28] or males feel more in control when interacting with computers [20]. More recent studies suggested that there were no significant differences in responses for males and females or that the gender difference in computer skill is diminishing [35]. It seemed appropriate to examine the relationship between training and self-efficacy for males and females here, especially since the sample included sufficient responses for each sex.

Analysis suggested that the pattern of change in computer and Internet self-efficacy is similar for males and females (see Table 8): both improved significantly for all students. Computer anxiety significantly influenced computer and Internet self-efficacy for both male and female respondents. User attitude significantly influenced computer and Internet self-efficacy for male respondents only. User attitude significantly influenced computer self-efficacy, but not Internet self-efficacy, for female respondents. The results are mixed and non-significant when data are split.

Results of our study represent several implications. They underlined the importance of individual differences and their effects on computer training and self-efficacy development. Evaluating individuals’ attitude toward computers may be necessary at the beginning of a training program, given the eventual influence of attitude on the outcome. Favorable attitudes may be reinforced through user involvement in system development activities or through job enrichment and career development programs. User involvement in the design and development of IT applications is broadly accepted as an essential factor influencing user acceptance and system use.

Self-efficacy development may also be influenced by other conditions, such as required versus voluntary involvement in training programs. Individuals may not want to participate if they do not feel that it will help their career objectives. College students show greater interest in courses and programs that they feel will help them with job opportunities or desired career paths. As with other such studies, there is a limitation in using student responses.

8. Conclusion

We examined the effect of computer training on computer self-efficacy and Internet self-efficacy and the influence of user attitude and computer anxiety on training outcome in terms of pattern of change in computer and Internet self-efficacy. Results suggested that computer training significantly influenced computer and Internet self-efficacy development and further suggested that user attitude and computer anxiety significantly influenced computer and Internet self-efficacy development. Data analyses suggested that there was an interaction between user attitude and computer anxiety and the effect of that interaction on computer self-efficacy but not on Internet self-efficacy. These findings have implications for the design as well as the evaluation of computer training programs.
Appendix A. Self-efficacy, user attitude, and computer anxiety measures

Computer self-efficacy
I feel confident...

- working on a personal computer (microcomputer)
- getting software up and running
- using the user’s guide when help is needed
- entering and saving data (numbers or words) into a file
- escaping/exiting from a program or software
- calling up a data file to view on the monitor screen

understanding terms/words relating to computer hardware
understanding terms/words relating to computer software
handling a disk correctly
learning to use a variety of programs (software)
- making selections from an on-screen menu
- using a printer to make a “hardcopy” of my work
- copying a disk
- copying an individual file
- adding and deleting information from a data file
- moving the cursor around the monitor screen
- writing simple programs for the computers
- using the computer to write a letter or essay
- describing the function of computer hardware (keyboard, monitor, disk drives, computer processing unit)
- understanding the three stages of data processing: input, processing, output
- getting help for problems in the computer systems
- using the computer to organize information
- getting rid of files when they are no longer needed
- organizing and managing files
- troubleshooting computer problems

Internet self-efficacy
I feel confident...

- browsing the World Wide Web (WWW)
- surfing the World Wide Web (WWW)
- encrypting my email messages
- encrypting my email messages before sending them over the Internet
- decrypting email messages that I receive
- creating a home page for the World Wide Web (WWW)
- making changes on a home page
- downloading from another computer
- scanning pictures to save on the computer
- sending a fax via the computer
- receiving a fax on my computer
- recovering a file I accidentally deleted
- editing (size, color) a scanned picture
- finding information on the World Wide Web (WWW)

User attitude
I like working with computers.
I look forward to those aspects of my job that require me to use a computer
Once I start working on the computer, I find it hard to stop
Using a computer is frustrating for me
I get bored quickly when working on a computer

Appendix A (Continued)

Computer anxiety
I feel apprehensive about using computers
- It scares me to think that I could cause the computer to destroy a large amount of information by hitting the wrong key
- I hesitate to use a computer for fear of making mistakes
- I cannot correct
- Computers are somewhat intimidating to me

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