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From Beliefs to Success:
Utilizing an Expanded TAM to Predict Web Page Development Success

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ABSTRACT

The technology acceptance model (TAM) is a popular model for the prediction of information systems acceptance behaviors, defining a causal linkage between beliefs, attitudes, intentions, and the usage of information technologies. Since its inception, numerous studies have utilized the TAM, providing empirical support for the model in both traditional and Internet-based computing settings. This article describes a research study that utilizes an adaptation of the TAM to predict successful Web page development, as an introduction of the TAM to a new domain, and the testing of a new dependent variable within the model. The study found some evidence to support the use of the TAM as a starting point for the prediction of Web development success, finding causal linkages between the belief constructs and the attitude constructs, and the intent construct and the successful development of Web pages. However, additional research is required to further study the expanded model introduced within this article.

Keywords: *computer attitudes; internet attitudes; system development success; technology acceptance model (TAM)*

INTRODUCTION

The TAM is a well-established model for the prediction of information systems usage. However, despite a number of studies being conducted with the Internet as a research domain, very few of these studies consider more than the usage of Internet technologies. We propose that this research should be extended to the domain of Web page development, as this activity forms a critical component of the Internet and its usage. Furthermore, Web page development is increasingly becoming a large part of the information technology activities of organizations (Taylor, McWilliam, Forsythe & Wade, 2002), and concerns have been raised about the increasing numbers of individuals who create Web pages without sufficient skills to do so (Gellerson & Gaedke, 1999). However, very little research has focused on the success of these applications or factors which may influence their success. The study described in this article uses an adaptation of the TAM to investigate the

relationships between an individual's beliefs, attitudes, intentions, and their subsequent success, as an attempt to ascertain whether these factors can be used to predict the success of Web application development.

The Technology Acceptance Model

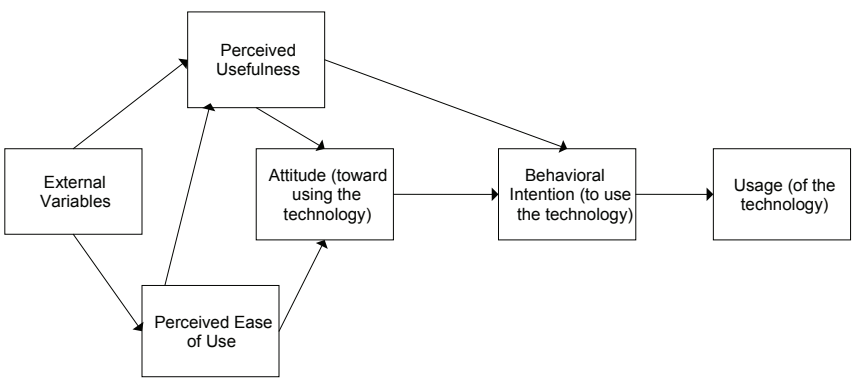
Davis's (1989) TAM is grounded in the theoretical underpinnings of the theory of reasoned action (TRA)(Fishbein & Ajzen, 1975). The TRA asserts that an individual's actual behavior is linked to their beliefs, attitudes, and intentions to perform that behavior, such that an individual's beliefs toward a particular action influences their attitudes (or "general feeling[s] of favorableness or unfavorableness") (Fishbein & Ajzen, 1975, p. 216) toward that action. These attitudes then influence their intention to perform that action, which finally affects their undertaking of that particular action (Fishbein & Ajzen, 1975).

The TAM refines the TRA in order to model the user acceptance of information systems (Davis, Bagozzi & Warshaw, 1989). This model has since been declared as "one of the most influential research models in studying the determinants of IT usage" (Chau, 2001, p. 26). It has also been important in the theorizing of the causal linkages between external factors, internal beliefs, attitudes, and behavioral intentions (Davis et al., 1989). The TAM is presented in Figure 1.

Guided by previous research in the field identifying determinants of information technology acceptance (e.g., DeSanctis, 1983; Robey, 1979; Schultz & Slevin, 1975; Swanson, 1987), the TAM utilizes the two variables of perceived usefulness and perceived ease of use as determinants of an individual's attitude toward using a particular technology. These two variables form the belief constructs within the TAM (Davis et al., 1989). Perceived usefulness has been defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989, p. 320); whilst perceived ease of use is defined as "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989, p. 320). These two factors are theorized to be the fundamental variables in the prediction of information technology acceptance (Davis et al., 1989).

The attitude construct within the TAM pertains to an individual's attitude toward using a particular information technology, whilst the intention construct refers to the individual's intention to use the technology in question, and the behavioral construct concerns the actual usage of the information system (Davis et al., 1989). Therefore, the TAM states that an individual's acceptance of an information technology is dependent on their beliefs about the usefulness and ease of use of the technology,

Figure 1. The technology acceptance model (TAM) (adapted from Davis, Bagozzi & Warshaw, 1989)



which in turn influences their attitudes toward using, and then intentions to use that technology. The intention to use is then causally linked to the individual's actual usage of a particular information technology.

Studies Involving the TAM

Numerous studies of the predicted relationships within the TAM have been conducted in traditional as well as Internet computing environments. These studies have obtained valid and reliable empirical support for the model in both computing settings (e.g., Adams, Nelson & Todd, 1992; Lederer, Maupin, Sena & Zhuang, 2000; Moon & Kim, 2001; Seyal, Rahman & Rahim, 2002; Teo, Lim & Lai, 1999; Venkatesh & Davis, 1994, 1996). However, despite the large number of studies, few have utilized a dependent variable other than that of system usage.

As described previously, the TAM has been "specifically tailored for modeling [the] user acceptance of information systems" (Davis et al., 1989, p. 985), a measure of an information system's success (Mason, 1978). However, Mason (1978) has identified a number of other measures of information system success, including: user satisfaction, organizational impact, system quality, and information quality. Each of these constructs has been studied (e.g., DeLone & McLean, 1992; Guimaraes & Igbaria, 1997; Igbaria, Guimaraes, & Davis, 1995; Igbaria & Tan, 1997; McGill, Hobbs & Klobas, 2003), however, there has been little research on how these constructs might relate to the user acceptance modeled in TAM. In addition, the investigation of the relationship between behavior and objective outcome measures such as performance and quality within the TAM, is an issue which has been noted as requiring further study (Lee, Kozar, & Larson, 2004).

Furthermore, despite studies being conducted utilizing the Internet, few of these do more than consider the usage of the technology. We propose that studies should also be conducted on the development of Web pages, a critical component of the Internet, which determines a great deal of its usage. Furthermore, Web page development is playing an increasing role in organizational application development activities (Goupil, 2000; Nelson & Todd, 1999; Taylor et al., 2002). However, of particular concern is that Web development activity is predominantly undertaken on an ad hoc basis (Gellerson & Gaedke, 1999; Russo & Graham, 1998; Wiegers, 1999), with most current Web development procedures relying purely on the expertise of the individual developer (Gellerson & Gaedke, 1999), which may be inadequate for the tasks at hand.

Taylor et al. (2002, p. 390) warns that: "without appropriate Website design techniques … there is the real risk that overly complicated and messy Websites will be developed" leading to the failure of these information systems. However, little is yet known about what influences people to learn the skills necessary in order to create quality Web pages. Nor is much known about what factors affect an individual's success at Web page creation. The TAM is suggested as a starting point for these investigations into Web page development and Web page development success.

THE RESEARCH MODEL

Studies involving the TAM have consistently demonstrated that perceived usefulness is associated with the use of technologies (e.g., Adams et al., 1992; Venkatesh & Davis, 1994, 1996). The level of usage of technologies has also been proposed to influence the success of an information system (DeLone & McLean, 1992). There have also been several proposed extensions to the TAM that include performance or information systems success as the dependent variable (e.g., Dishaw & Strong, 1999; Lucas & Spitler, 1999). This study proposes and tests an extended TAM that incorporates the construct of Web development success to test the applicability of the TAM in the prediction of successful Web page development.

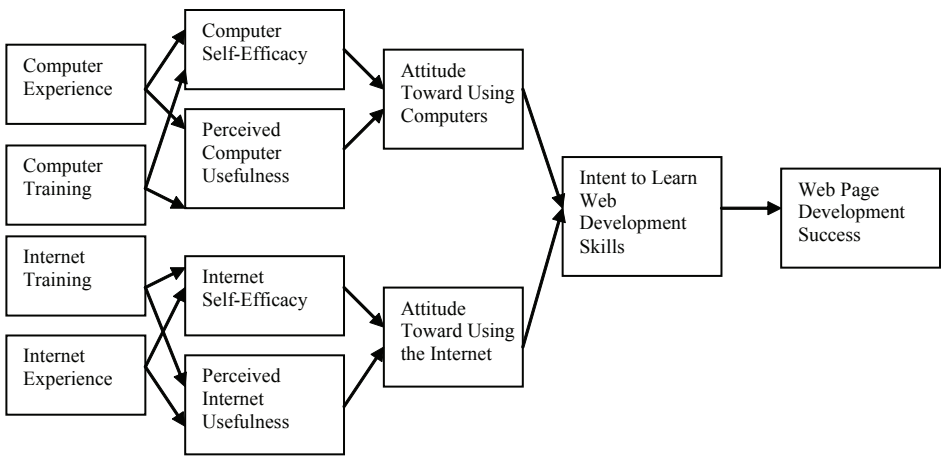
The model developed for this study is grounded in the theories that underlie the TAM. Similar to the TAM, our model identifies a causal linkage between an individual's beliefs, attitudes, intentions and behaviors. However,

the current research model considers beliefs and attitudes toward using computer and Internet technologies as independent constructs. In line with the TAM (see Figure 1), this study also introduces several demographic and related variables as antecedents to both computer-usage and Internet-usage related beliefs. This is in accordance with Davis's (1993) recommendation that external variables should be investigated as determinants of information technology beliefs. The variables chosen for this study include age, gender, computer experience, Internet experience, computer training, and Internet training.

The self-efficacy construct, as a measure of "an individual's perceptions of his or her ability to use computers in the accomplishment of a task" (Compeau & Higgins, 1995, p. 191) is included as a belief construct, in the research model. This construct was first mentioned in relation to the TAM as one of two basic mechanisms through which attitudinal and behavioral intentions are influenced (Davis et al., 1989). Since then, many studies have included the self-efficacy construct in their investigations of the TAM, in both traditional and Internet environments (Chau, 2001; Compeau & Higgins, 1995; Fenech, 1998; Igbaria & Iivari, 1995; Torkzadeh & Van Dyke, 2002; Venkatesh & Davis, 1996). From a consideration of these studies, it is apparent that an individual's self-efficacy (or self-confidence in their skills), is an important determinant of their attitudes toward using technology, and thus, a determinant of their actual behavior. Both computer self-efficacy and Internet self-efficacy are therefore included within the research model.

Perceived computer usefulness and perceived Internet usefulness are incorporated within the model directly from the TAM. These constructs as well as the computer and Internet self-efficacy constructs represent the beliefs of an individual which are considered to influence their attitudes toward using both information technologies. Research on the role of perceived ease of use in the TAM has been mixed. Whilst there is consensus about its influence on perceived usefulness, a number of studies have found that perceived ease of use has little direct effect on information technology acceptance (e.g., Subramanian, 1994; Venkatesh & Davis, 1996). Ma and Liu (2004) undertook a meta-analysis of research on the TAM and have concluded that the relationship between ease of use and acceptance is weak, and as such does not pass the fail-safe test. Therefore, the ease of use construct was not included in the research model.

Figure 2. The research model



The intent construct of the research model refers to an individual's intention to learn Web development skills. As such, it represents an individual's intention to succeed at Web page development. The behavior construct of this model is Web development success, or an individual's success at developing Web pages. This construct is considered to consist of aspects of the system quality, as well as the information quality of developed Web pages. The research model is presented in Figure 2.

RESEARCH QUESTIONS AND HYPOTHESES

The following research questions and hypotheses follow from the model presented in Figure 2 and the theories which underlie it.

- **RQ1:** How do an individual's background characteristics affect their beliefs toward a particular information technology?

There is evidence to suggest that greater experience with a particular information technology is related to a more positive set of beliefs in relation to that technology (e.g., Al-Jabri & Al-Khaldi, 1997; Igbaria & Iivari, 1995; Liaw, 2002; Orr, Allen, & Poindexter, 2001). The following hypotheses are thus proposed:

- **H1a:** Individuals with more experience with computers will have higher levels of computer self-efficacy than individuals with less computer experience
- **H1b:** Individuals with more experience with the Internet will have higher levels of Internet self-efficacy than individuals with less Internet experience
- **H1c:** Individuals with more experience with computers will have higher levels of perceived computer usefulness than individuals with less computer experience
- **H1d:** Individuals with more experience with the Internet will have higher levels of perceived Internet usefulness than individuals with less Internet experience

Evidence also suggests that individuals with more training with a particular information technology will have more positive beliefs in relation to that technology (Igbaria, 1990, 1993; Orr et al., 2001; Rozzell & Gardner, 1999). Thus the following hypotheses are proposed:

- **H2a:** Individuals with more training in computer technologies will have higher levels of computer self-efficacy than individuals with less training in computer technologies
- **H2b:** Individuals with more Internet training will have higher levels of Internet self-efficacy than individuals with less Internet training
- **H2c:** Individuals with more training in computer technologies will have higher levels of perceived computer usefulness than individuals with less computer training
- **H2d:** Individuals with more Internet training will have higher levels of perceived Internet usefulness than individuals with less Internet training

Whilst age and gender are not proposed to influence Web page development success, two sets of null hypotheses have been proposed to enable the confirmation of these proposals. These are presented within the following section.

Studies in the past have noted a distinction between older and younger individuals in regards to their beliefs toward information technologies, suggesting that younger individuals have more positive beliefs in relation to computer technologies than their older counterparts (Harrison & Rainer, 1992; Igbaria, 1993). However, due to the pervasiveness of computers and also that of Internet technologies, this age distinction has become less evident (e.g., Parish & Necessary, 1996). Therefore the following hypotheses are proposed:

- **H3a:** An individual's age will not affect their level of computer self-efficacy
- **H3b:** An individual's age will not affect their level of Internet self-efficacy

- **H3c:** An individual's age will not affect their perception of the usefulness of computers
- **H3d:** An individual's age will not affect their perception of the usefulness of the Internet

Past studies have reported that males are more confident (or self-efficacious) than females (e.g., Wilder, Mackie & Cooper, 1985) in relation to information technology. Recently however, information technologies have become more common in both the home and the workplace, particularly in the case of Internet technologies. Due to this factor, the gender distinction has largely disappeared (e.g., Parish & Necessary, 1996). Thus, the following hypotheses are proposed:

- **H4a:** An individual's gender will not affect their level of computer self-efficacy
- **H4b:** An individual's gender will not affect their level of Internet self-efficacy
- **H4c:** An individual's gender will not affect their perception of the usefulness of computers
- **H4d:** An individual's gender will not affect their perception of the usefulness of the Internet

- **RQ2:** How do an individual's information technology related beliefs affect their attitudes toward using a particular information technology?

The following set of hypotheses is drawn directly from the theories that underlie the TAM. The relationships link an individual's beliefs directly to their attitudes toward using a particular technology:

- **H5a:** Individuals with higher levels of computer self-efficacy will have more positive attitudes toward using computers
- **H5b:** Individuals with higher levels of Internet self-efficacy will have more positive attitudes toward using the Internet
- **H5c:** Individuals with higher levels of perceived usefulness of computers will have more positive attitudes toward using computers
- **H5d:** Individuals with higher levels of perceived usefulness of the Internet will have more positive attitudes toward using the Internet

- **RQ3:** How do an individual's attitudes toward using a particular information technology affect their intent to learn to perform successfully with that particular information technology?

The following two hypotheses are adapted from the theories underlying the TAM, whereby an individual's intention to perform a particular behavior is governed by his or her attitude toward that behavior (Fishbein & Ajzen, 1975). In this case the behaviour in question is the usage of computer and Internet technologies and the following hypotheses are proposed:

- **H6a:** Individuals with more positive attitudes toward using computers will exhibit higher levels of intent to learn Web development skills
- **H6b:** Individuals with more positive attitudes toward using the Internet will exhibit higher levels of intent to learn Web development skills

- **RQ4:** How does an individual's intention to learn to perform successfully with a particular information technology affect their successful performance with that particular information technology?

The following hypothesis is adapted from the theories underpinning the TAM, whereby an individual's intention to perform a particular behavior, is related to his or her actual completion of that behavior (Ajzen, 1985; Fishbein & Ajzen, 1975). Ajzen has stated that in the majority of cases, individuals are observed to act consistently with their intentions in a va-

riety of situations (1985). Thus the following hypothesis is proposed:

- **H7a:** Individuals, who have higher levels of intent to learn Web development skills, will exhibit higher levels of Web development success

THE RESEARCH DESIGN

Research Procedure

The study was conducted with students taking part in an introductory Internet and Web development course. Within this course, students possess a wide range of backgrounds in computer and Internet usage as well as Web development. The research data were collected primarily by means of a questionnaire administered during the first lecture of the course. Additional data was collected by the evaluation of Web pages developed by the participants. It was stressed that participation in the research project was voluntary and that the study formed no part of their assessment. The questionnaire collected information relating to the background characteristics of participants, as well as information relating to their beliefs and attitudes toward using both computers and the Internet. The questionnaire was distributed to 280 students and 193 responses were received (a response rate of 68.9%). Of those who responded, 143 students were noted as attending the course's tutorials, and 154 of the original sample were noted as having undertaken the final Web page development assignment.

The research sample and environment was essentially one of convenience. However, its major strength is in the availability of a consistent measure of Web development success that could be used to compare all individuals within the research sample. Such a consistent measure would not ordinarily be available in the more generalizable setting of the workplace. Thus, the use of the chosen research sample and environment brings a high level of internal validity to the research undertaken.

Operationalization of Constructs

In order to ensure construct validity within this study, every effort was made to utilize well-validated measures that were shown to be reliable within previous studies. See Appendix 1 for a copy of the questionnaire items.

Computer and Internet experience were measured as the number of years that an individual had been using the relevant technology. An individual's level of training with both computers and the Internet was measured using self-report measures, which comprised of 7-point scales where (1) indicated no training and (7) indicated an extensive amount of training. Training for each of the technologies was measured with separate scales for both formal training and self-administered training. These measures were then summed for a measure of the individual's total training in each technology.

The computer related belief and attitude constructs were measured using three subscales of Loyd and Gressard's (1984) Computer Attitude Scale (CAS). Computer self-efficacy was measured using the computer confidence subscale, consisting of items 11-20 of the CAS (with a Cronbach's alpha of 0.96). Perceived computer usefulness was measured using the usefulness subscale, consisting of items 31-40 of the CAS (with a Cronbach's alpha of 0.93). Attitude toward using computers was measured using the computer liking subscale, consisting of items 21-30 of the CAS (with a Cronbach's alpha of 0.95).

The belief and attitude constructs relating to the Internet were measured using three subscales of Liaw's (2002) Web Attitude Scale (WAS). Internet self-efficacy was measured using the Web self-efficacy subscale, consisting of items 1-4 of the WAS (with a Cronbach's alpha of 0.93). Perceived Internet usefulness was measured using the Web usefulness subscale, consisting of items 9-12 of the WAS (with a Cronbach's alpha of 0.85). Attitude toward using the Internet was measured using the Web liking subscale, consisting of items 5-8 of the WAS (with a Cronbach's alpha of 0.83). All of the six subscales used to measure computer and Internet beliefs and attitudes were shown to be

reliable with Cronbach alphas of above 0.70 as suggested by Nunally (1978).

Intent to learn Web development skills was measured by utilizing an individual's voluntary tutorial attendance (out of a possible 12), as recorded by the tutors during class time. This score forms a surrogate measure for an individual's intent to successfully create Web pages. The skills required to create quality Web pages are taught during these classes, and thus if a student intends to perform successfully in the development of Web pages, it is likely that he or she will attend more tutorials in order to better learn these skills.

Web page development success was measured using the participants' mark on the final Web page development assignment. The assignment consisted of the creation of a set of linked Web pages in basic XHTML. Marks were allocated for content (e.g., meeting requirements, clarity of information provided), design features (e.g., use of color, text, and images), and factors relating to the coding of the Web page (e.g., layout, commenting, and the ability to pass basic code validators). These features are all measures relating to the system and/or information quality of the Web pages, and thus overall, form an operational measure of Web page development success.

RESULTS AND DISCUSSION

The summarized results of the descriptive analysis of the research variables and constructs are presented in Table 1, and discussed in this section.

Table 1. Summary of descriptive statistics for external variables and model constructs

	Number	Mean	Standard Deviation	Minimum	Maximum
Background Variables					
Computing Experience (yrs)	184	8.55	4.60	0.58	30.00
Internet Experience (yrs)	187	4.50	2.08	0.00	11.00
Computer Training (/14)	193	8.37	2.39	3.00	14.00
Internet Training (/14)	192	7.52	2.53	2.00	14.00
Age (yrs)	192	22.39	6.94	17.00	52.00
Belief Constructs					
Computer Self-Efficacy	193	38.11	8.70	12.00	50.00
Perceived Computer Usefulness	190	40.61	8.31	4.00	50.00
Internet Self-Efficacy	188	17.30	3.08	5.00	20.00
Perceived Internet Usefulness	188	17.05	2.82	5.00	20.00
Attitude Constructs					
Attitude toward using Computers	191	35.35	9.47	9.00	50.00
Attitude toward using the Internet	188	15.82	3.31	4.00	20.00
Intent Construct					
Intent to Learn Web Development Skills (/12)	143	7.82	4.07	0.00	12.00
Success Construct					
Web Development Success Score (/100)	154	38.12	31.14	0.00	86.00

The final research sample consisted of 193 individuals of whom 138 (71.5%) were male, and 55 (28.5%) were female. The ages of the participants ranged from 17 years of age to 52 years of age, with the average age being 22 years of age. The participants' experience with computers ranged from several months to a number of years, with the average amount of experience being 8.5 years. Experience with the Internet ranged from no experience at all, to 11 years of Internet use. The average amount of Internet experience was 4.5 years. In terms of computer training, on average relatively high levels (above mid-level) of training were reported, with an average of 8.38 out of a possible 14. Internet training was also reported to be above mid-level, averaging 7.52 out of a possible 14.

The participants expressed generally positive beliefs toward using both computers and the Internet. Computer self-efficacy was scored highly, with the mean of all scores being 38.1 out of 50, and computers were also perceived to be very useful, with an average score of 40.6 out of 50. A similar pattern was noted in terms of Internet technologies. Internet self-efficacy scores resulted in a mean of 17.3 out of 20, whilst perceived usefulness of the Internet was on average 17.1 out of 20.

The research participants also expressed attitudes toward using computers and the Internet that were positive. On average the attitude toward using computers score was 35.4 out of 50, whilst the average attitude toward using the Internet score was 15.8 out of 20.

The measure of intent to learn Web development skills averaged 7.82 out of a possible 12 (i.e., on average participants attended between 7 and 8 of the 12 tutorials). The Web development success score was on average 38.1 out of a possible 100.

Hypothesis Testing

Path analysis using Ordinary Least Squares hierarchical multiple regression was performed to test the proposed hypotheses. The results are shown in Table 2, and discussed in this section.

Computer experience was significantly related to computer self-efficacy (β=0.160, p=0.016), confirming hypothesis H1a. Similarly, Internet experience was found to be significantly related to Internet self-efficacy (β=0.280, p=0.000), providing support for hypothesis H1b. However, computer experience was not found to be significantly related to perceived computer usefulness, and thus, hypothesis H1c was not supported. However, hypothesis H1d was supported with Internet experience found to be significantly related to perceived Internet usefulness (β=0.311, p=0.000).

The nonsignificant result between computer experience and perceived computer usefulness contradicts the findings of previous studies (e.g., Al-Jabri & Al-Khaldi, 1997; Igbaria & Iivari, 1995; Liaw, 2002; Orr et al., 2001), which found that increased experience with a technology was associated with more positive beliefs toward using it. This contradictory result may be related to the operationalization of experience as length of time of use, without consideration of the frequency or duration of computer usage. Consideration of the frequency and duration of usage may have allowed for a better measure of the experience variable. Further research is required to study these alternative measures of experience in terms of their relationships to an individual's information technology related beliefs.

A significant relationship was found between computer-related training and computer self-efficacy (β=0.424, p=0.000), as predicted by hypothesis H2a. Similarly, Internet-related training was found to be significantly related to Internet self-efficacy (β=0.171, p=0.026), in accordance with hypothesis H2b. However, computer-related training was not significantly related to perceived computer usefulness; and neither was Internet-related training related to perceived Internet usefulness. Thus, hypotheses H2c and H2d were not supported. This result does not conform to other previous studies (Igbaria, 1990, 1993; Orr et al., 2001; Rozzell & Gardner, 1999), which found that increased levels of training are associated with more positive beliefs. These inconsistent results suggest that

Table 2. Summary of path analysis results

PATH			
From	**To**	**Coefficient**	**Probability**
Computer Experience	Computer Self-Efficacy	0.160	0.016
Computer Training	Computer Self-Efficacy	0.424	0.000
Age	Computer Self-Efficacy	0.075	0.236
Gender	Computer Self-Efficacy	-0.305	0.000
R^2	**0.385**		
Computer Experience	Perceived Computer Usefulness	0.095	0.233
Computer Training	Perceived Computer Usefulness	0.112	0.163
Age	Perceived Computer Usefulness	0.049	0.521
Gender	Perceived Computer Usefulness	-0.297	0.000
R^2	**0.129**		
Internet Experience	Internet Self-Efficacy	0.280	0.000
Internet Training	Internet Self-Efficacy	0.171	0.026
Age	Internet Self-Efficacy	-0.045	0.537
Gender	Internet Self-Efficacy	-0.024	0.734
R^2	**0.148**		
Internet Experience	Perceived Internet Usefulness	0.311	0.000
Internet Training	Perceived Internet Usefulness	0.066	0.393
Age	Perceived Internet Usefulness	0.017	0.819
Gender	Perceived Internet Usefulness	-0.133	0.061
R^2	**0.132**		
Computer Self-Efficacy	Attitude toward using Computers	0.578	0.000
Perceived Computer Usefulness	Attitude toward using Computers	0.319	0.000
R^2	**0.654**		
Internet Self-Efficacy	Attitude toward using the Internet	0.346	0.000
Perceived Internet Usefulness	Attitude toward using the Internet	0.465	0.000
R^2	**0.620**		
Attitude toward using Computers	Intent to Learn Web Development Skills	-0.362	0.011
Attitude toward using the Internet	Intent to Learn Web Development Skills	0.195	0.176
R^2	**0.113**		
Intent to Learn Web Development Skills	Web Development Success	0.440	0.000
R^2	**0.314**		

(Note: Gender was coded as male = 1 and female = 2)

although training may increase an individual's self confidence in their skills, training alone does not contribute to an individual perceiving a technology to be more or less useful than any other technology. It may also be possible that computer-related technologies are currently so pervasive that that they are considered to be useful by the general population, regardless of the amount of experience or training that an individual may have. However, further research should attempt to better understand these relationships.

An individual's age was not found to be significantly related to any of the belief constructs within the research model, providing support for hypotheses H3a-d. Significant relationships were found between gender and computer self-efficacy (β=-0.305, p=0.000) and also gender and perceived computer usefulness (β=-0.297, p=0.000), indicating that females are still less confident and less convinced of the usefulness of computers than males are, contradicting hypotheses H4a and H4c. However, no significant relationship was noted between gender and Internet self-efficacy, or gender and perceived Internet usefulness, in accordance with hypotheses H4b and H4d. This finding indicates that in terms of pervasive Internet technologies, gender differences in self-confidence and perceptions of the usefulness of these particular computer systems have largely dissipated.

Computer self-efficacy was found to be significantly related to attitudes toward using computers (β=0.578, p=0.000), as predicted by hypothesis H5a. A significant relationship was also found between perceived computer usefulness and attitudes toward using computers (β=0.319, p=0.000), providing support for hypothesis H5b. Similarly, significant relationships were found between Internet self-efficacy and attitudes toward using the Internet (β=0.346, p=0.000) and between perceived Internet usefulness and attitudes toward using the Internet (β=0.465, p=0.000) consistent with hypotheses H5c and H5d. All of these findings are consistent with the theories that underlie the TAM.

A significant, but negative relationship was found between attitudes toward using computers and the intent construct (β=-0.362, p=0.011); however, this relationship is in the opposite direction to that predicted, and thus hypothesis H6a is not supported. This finding suggests (in consideration of the theories underlying the TAM) that an individual with more negative attitudes toward using computers will intend to learn Web development skills to a greater degree than an individual with more positive attitudes toward using computer technologies. This relationship may exist because individuals who feel unfavorably toward using computers may not feel that they have the necessary skills to easily pass a Web development course, and thus attend more tutorials to gain the necessary skills to perform well within this environment.

No significant relationship was identified between attitudes toward using the Internet and the intent construct. Thus, no support was found for hypothesis H6b. This contradicts the relationship predicted by the theories underlying the TAM, and implies that regardless of whether an individual feels favorably or unfavorably toward using the Internet, there is no association between that attitude and his or her intention to succeed within a Web development environment. This could be explained if there is a distinction between attitudes toward using the Internet as a source of information and entertainment and attitudes toward using it for Web page development activities. Attitudes toward Web development might therefore be a more useful construct than attitudes toward using the Internet within this context. Another explanation for this finding, might be that because the Internet is such a pervasive technology, individuals already have gained some Web development skills prior to enrolling in the Web development course, and thus may not consider that they need to attend the tutorials to learn Web development skills. Therefore, regardless of their attitude, an individual may not believe that he or she needs to attend the course's tutorials, as they believe that they already have the skills they need to be successful.

A final explanation for the lack of support for the relationships hypothesized in H6a and H6b may come from the operationalization of the intent construct. In hindsight, it can be questioned whether tutorial attendance is a good indication of the intent to learn Web development skills. Participants had access to online teaching materials and may have exhibited intent to learn outside the traditional classroom environment.

Intent to learn Web development skills was found to be significantly related to Web development success ($\beta = 0.440$, $p = 0.000$). This suggests that the greater the intention to learn Web development skills (i.e., the more tutorials that an individual attends) the more successful that individual will be in developing Web pages. This provides support for hypothesis H7a, and also provides support for the theories underlying the TAM. However, given the concern expressed about the operationalization of the intent construct, this result must be treated with a degree of caution. The relationships discussed in the preceding section are illustrated as a path diagram, presented in Figure 3.

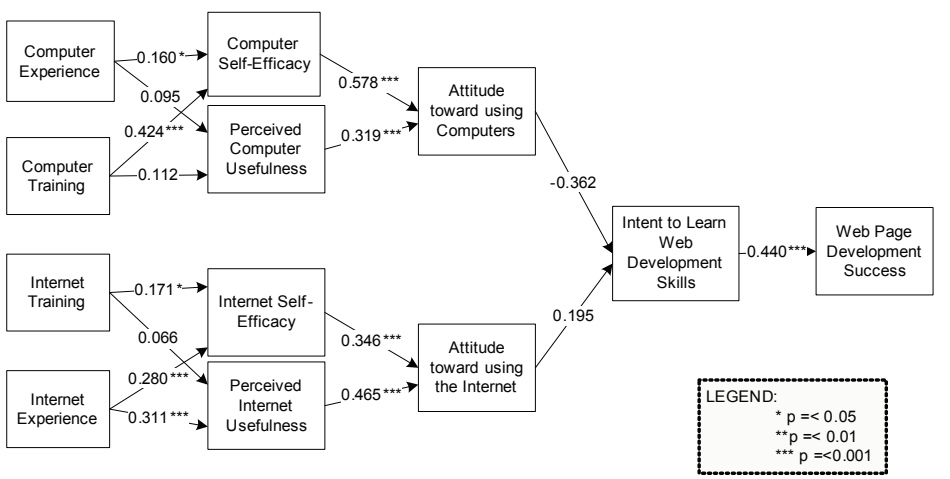
The Research Model

This section analyzes the predictive power of each of the constructs within the research model, as indicated by the R^2, reported in Table 2.

The external variables proposed as influencing the belief constructs within the research model were found to explain a moderate amount of the variance in computer self-efficacy, with an R^2 value of 38.5% (i.e., 38.5% of the variability in self-efficacy was explained by the external variables present within the research model). However, the variables only explained a small proportion of the variability of the constructs of perceived computer usefulness (12.9%), Internet self-efficacy (14.8%), and perceived Internet usefulness (13.2%). This suggests that additional variables not included within the current model also directly influence the belief constructs.

The research model was found to explain a high proportion of the variance in computer and Internet attitudes with R^2 values of 65.4% and 62.0% respectively. However, the model only explained a small proportion of the variance in the intent construct (intention to learn Web

Figure 3. Path diagram of the research model showing strengths of individual paths



development skills), resulting in an R^2 value of 11.3%. This result may be indicative of the weak operationalization of the intent construct as discussed within the previous section. Thus, further research is required to test the relationship between intent and success.

The research model explained a moderate proportion of the variance in Web development success, with a R2 value of 31.4%. This result suggests that there are additional constructs that may also directly influence Web development success. These constructs may include cognitive ability (Simon, Grover, Teng & Whitcomb, 1996) and prior Web development experience. There is also the possibility that mechanisms other than that of beliefs and attitudes may exist through which success is influenced. Whilst the TAM suggests that the influence of external variables on behavior is mediated through beliefs, studies have shown that user characteristics have a direct influence on performance (e.g., Hubona & Cheney, 1994). Future research should test an expanded research model that considers additional constructs and explores these possible direct effects. A student-learning model such as Biggs' (2003) 3P model of teaching learning might also be useful in explaining the outcomes.

CONCLUSION

The study described in this article uses an adaptation of the TAM to investigate whether an individual's beliefs, attitudes, and intentions can be used to predict the success of their Web application development. An evaluation of the proposed model has provided mixed evidence about the role of beliefs and attitudes in the success of an individual's Web page development activities. Beliefs about computers and the Internet determined attitudes toward using computers and the Internet, respectively; and intent to learn Web development skills predicted Web development success. However, attitudes toward using computers and the Internet did not predict intent to learn Web development skills. Despite some contradictory findings, the research model provides support for the theories that underlie it. As a first step in the introduction of Web development success as the dependent variable of a model derived from the TAM as well as the introduction of the TAM into the Web development domain, the results of the study provide a starting point for future research, which should explore the generalizability of this model to real world development.

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APPENDIX A.
Questionnaire Items

1. Gender Male Female
2. Age: ___
3. How long have you been using computers? Years___ Months___
4. How long have you been using the Internet/World Wide Web?
   Years___ Months___

		None						Extensive
5.	How would you describe your level of formal computer training (i.e. training from school/TAFE/university etc.)?	1	2	3	4	5	6	7
6.	How would you describe your level of self-administered computer training (i.e. training yourself from a book/CD-ROM/computer program/trial and error etc.)?	1	2	3	4	5	6	7
7.	How would you describe your level of formal Internet/ World Wide Web training (i.e. training from school/ TAFE/university etc.)?	1	2	3	4	5	6	7
8.	How would you describe your level of self-administered Internet/World Wide Web training (i.e. training yourself from a book/CD-ROM/computer program/trial and error etc.)?	1	2	3	4	5	6	7

Please indicate the degree to which you agree with the following statements by circling the most appropriate option.

These questions relate to how you feel about computers

		strongly disagree				strongly agree
1.	Computers scare me	1	2	3	4	5
2.	Working with a computer would make me very nervous	1	2	3	4	5
3.	I feel threatened when others talk about computers	1	2	3	4	5
4.	I feel aggressive and hostile toward computers	1	2	3	4	5
5.	It would bother me to take computer courses	1	2	3	4	5
6.	Computers make me feel uncomfortable	1	2	3	4	5
7.	I would not feel at ease in a computer class	1	2	3	4	5

APPENDIX A. CONTINUED

8.	I get a sinking feeling when I think of trying to use a computer	1	2	3	4	5
9.	I would not feel comfortable working with a computer	1	2	3	4	5
10.	Computers make me feel uneasy and confused	1	2	3	4	5
11.	I am good with computers	1	2	3	4	5
12.	Generally I would feel OK about trying a new problem on the computer	1	2	3	4	5
13.	I think I would do advanced computer work	1	2	3	4	5
14.	I am sure I could do work with computers	1	2	3	4	5
15.	I am the type to do well with computers	1	2	3	4	5
16.	I am sure I could learn a computer language	1	2	3	4	5
17.	I think using a computer would be very easy for me	1	2	3	4	5
18.	I could get good grades in computer courses	1	2	3	4	5
19.	I think I could handle a computer course	1	2	3	4	5
20.	I have a lot of self-confidence when it comes to working with computers	1	2	3	4	5
21.	I would like working with computers	1	2	3	4	5
22.	The challenge of solving problems with computers appeals to me	1	2	3	4	5
23.	I think working with computers would be enjoyable and stimulating	1	2	3	4	5
24.	Figuring out computer problems appeals to me	1	2	3	4	5
25.	When there is a problem with a computer application that I can't immediately solve, I would stick with it until I have the answer	1	2	3	4	5
26.	I understand how some people can stand so much time working with computers and seem to enjoy it	1	2	3	4	5
27.	Once I start to work with the computer, I would find it hard to stop	1	2	3	4	5
28.	I will do as much work with computers as possible	1	2	3	4	5
29.	If a problem is left unresolved in a computer class, I would continue to think about it afterward	1	2	3	4	5
30.	I enjoy talking with others about computers	1	2	3	4	5
31.	I will use computers many ways in my life	1	2	3	4	5
32.	Learning about computers is not a waste of time	1	2	3	4	5
33.	Learning about computers is worthwhile	1	2	3	4	5
34.	I'll need a firm mastery of computers for my future work	1	2	3	4	5
35.	I expect to have much use for computers in my daily life	1	2	3	4	5
36.	I can think of many ways that I will use computers in my career	1	2	3	4	5
37.	Knowing how to work with computers will increase my job possibilities	1	2	3	4	5
38.	Anything that a computer can be used for, I will not be able to do as well in some other way	1	2	3	4	5
39.	It is important to me to do well in computer classes	1	2	3	4	5
40.	Working with computers will be important to me in my life's work	1	2	3	4	5

APPENDIX A. CONTINUED

These questions relate to how you feel about the Internet/World Wide Web

		strongly disagree				strongly agree
41.	I feel confident using the Internet/World Wide Web (WWW)	1	2	3	4	5
42.	I feel confident using E-mail	1	2	3	4	5
43.	I feel confident using WWW browsers (e.g. Internet Explorer, Netscape Communicator)	1	2	3	4	5
44.	I feel confident using search engines (e.g. Yahoo, Excite, Lycos)	1	2	3	4	5
45.	I like to use E-mail to communicate with others	1	2	3	4	5
46.	I enjoy talking with others about the Internet	1	2	3	4	5
47.	I like to work with the Internet/WWW	1	2	3	4	5
48.	I like to use the Internet from home	1	2	3	4	5
49.	I believe using the Internet/WWW is worthwhile	1	2	3	4	5
50.	The Internet/WWW helps me to find information	1	2	3	4	5
51.	I believe the Internet makes communication easier	1	2	3	4	5
52.	The multimedia environment of WWW (e.g. text, image) is helpful to understand online information	1	2	3	4	5
53.	I believe the Internet/WWW has potential as a learning tool	1	2	3	4	5
54.	I believe that the Internet/WWW is able to offer online learning activities	1	2	3	4	5
55.	I believe that learning how to use the Internet/WWW is worthwhile	1	2	3	4	5
56.	Learning Internet/WWW skills can enhance my academic performance	1	2	3	4	5

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