

Predicting Web Page Development Success: An Exploratory Study

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Abstract

Web page development by end users is an increasingly common organisational activity, yet very little research has focused on the success of these Web applications. The Technology Acceptance Model has been used widely to investigate the acceptance of information systems, with results identifying a causal relationship from an individual's beliefs, to their attitudes, to their intentions and then to their actions. The study described in this paper uses an adaptation of the TAM to investigate these relationships within an end user Web development context, in order to ascertain whether an end user developer's beliefs, attitudes and intentions can be used to predict the success of their Web application development. The results suggest that the beliefs, attitudes and intentions of end user developers do play a role in Web development success.

Keywords

Technology Acceptance Model, end user computing, Web development success, end user development.

INTRODUCTION

Web page development has become a common organisational task, with increasing numbers of end users developing Web pages as part of their work (Goupil 2000). Concerns have been raised about the risks of end user Web page development, yet very little research has focused on the success of these Web applications or on factors that might influence success. The Technology Acceptance Model (TAM) (Davis 1989; Davis, Bagozzi, & Warshaw 1989) has been used widely to investigate the acceptance of information systems, with results identifying a causal relationship from an individual's beliefs, to their attitudes, to their intention, and then to their actions. The study described in this paper uses an adaptation of the TAM to investigate these relationships within an end user Web page development context, in order to ascertain whether an end user developer's beliefs, attitudes and intentions can be used to predict the success of Web application development.

The Theory of Reasoned Action

One of the most popular models that identifies a causal link between an individual's beliefs, attitudes, intentions and behaviours is the Theory of Reasoned Action (TRA) (Fishbein & Ajzen 1975 pg. 216). This model states that an individual's internal ideas (beliefs) about a particular object or situation, will influence their "general feeling[s] of favorableness or unfavorableness" (pg 216) (attitude) toward that particular object or situation, which will then influence their motivation to respond in a certain way toward that object or situation (intention). Finally, the model postulates that an individual's actual behaviour is determined by this motivation or intention to perform that behaviour.

The Technology Acceptance Model

The TAM is an adaptation of the TRA and has been "specifically tailored for modeling user acceptance of information systems" (Davis et al. 1989 pg. 985). The TAM has since been described as "one of the most influential research models in studying the determinants of IT usage" (Chau 2001 pg. 26).

The TAM states that an individual's acceptance of information technologies is dependent on their beliefs about the usefulness and ease of use of the technologies themselves. These beliefs in turn affect an individual's attitudes toward the technology, and finally their level of acceptance of the technology (see Figure 1 below).

There have been numerous studies of the constructs and predicted relationships within the TAM (e.g. Adams, Nelson, & Todd 1992; Venkatesh & Davis 1994, 1996) providing valid and reliable results for the model, in a range of experimental environments. The success of the TAM has led to numerous additional constructs and

alterations to the TAM being proposed and studied with varying levels of success. These are discussed below.

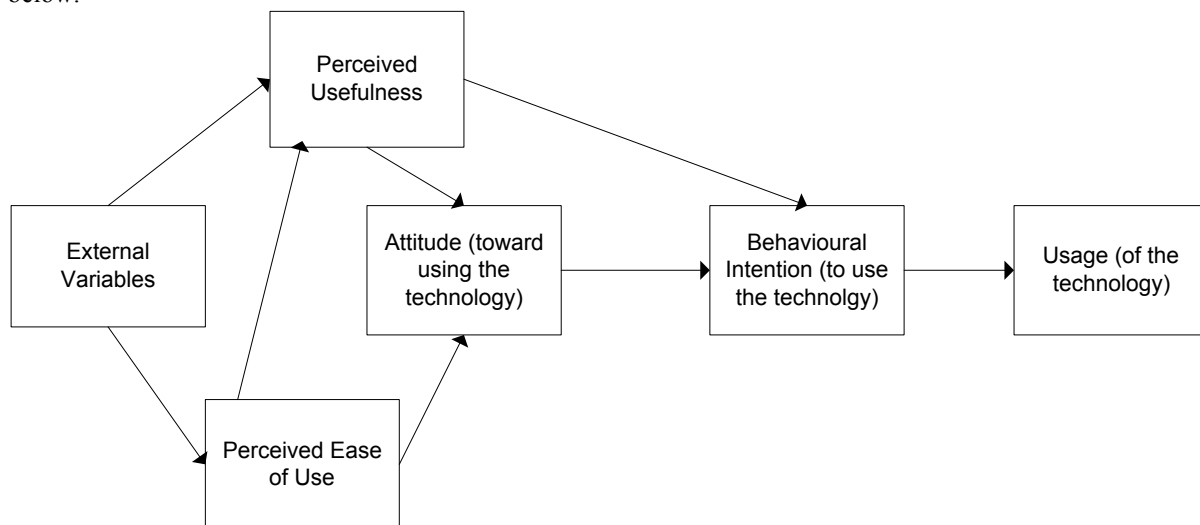


Figure 1: Technology Acceptance Model (adapted from Davis, Bagozzi, and Warshaw (1989))

Additions and Adaptations to the TAM

Self-efficacy in relation to the use of information technology has been defined as “an individual’s perceptions of his or her ability to use computers in the accomplishment of a task” (Compeau & Higgins 1995 pg. 191). The self-efficacy construct has since been included in many studies involving the TAM, including those of Chau (2001), Igbaria and Iivari (1995), and Venkatesh and Davis (1996). Thus, an individual’s self-efficacy, or self-confidence in his or her computer skill, can be considered to be an important determinant of an individual’s attitudes, and thus a determinant of his or her actual behaviour.

Another construct that has been suggested for inclusion within the TAM context is computer anxiety (Davis et al. 1989). Computer anxiety has been defined as “the tendency of individuals to be uneasy, apprehensive, or fearful about current or future use of computers” (Igbaria & Parasuraman 1989 pg. 375). This construct has since been included in a number of studies relating to the TAM including those of Harris (1999; 2000) and Igbaria (1990; 1993). These studies indicated that there is a strong negative relationship between computer anxiety and attitudes towards computer technologies. Therefore, it seems likely that computer anxiety may be a major indirect determinant of behaviour through its affect on attitudes. Therefore, further attention to the place of these two constructs within technology models such as the TAM is warranted.

The TAM and the Internet

As can be seen from the discussion above, the TAM has been utilized greatly in the study of computer technologies. However, most of this research was undertaken before the Internet age. Current studies are taking the TAM into the Internet domain and studying the acceptance of Internet based technologies, with results supporting those of earlier studies (e.g. Lederer, Maupin, Sena, & Zhuang 2000; Moon & Kim 2001; Seyal, Rahman, & Rahim 2002; Teo, Lim, & Lai 1999).

Current studies in the Internet domain have measured the self-efficacy construct and its relationship to behaviours within the Web domain (e.g. Fenech 1998; Liaw 2002b; Torkzadeh & Van Dyke 2002). These studies have all provided support for the relationship between self-efficacy and Internet-based behaviours. Although computer anxiety has been identified as an important addition to the TAM (Davis et al. 1989), few studies have included it in research within the Internet domain and none have addressed the relationship between computer anxiety and attitudes, or computer anxiety and behaviours or usage of technologies. Although there has been little research in the area at present, it is clear that the constructs of self-efficacy and computer anxiety are important additions to the theoretical structure of the TAM, and thus warrant further attention, particularly within the Internet domain.

USING AND EXTENDED TAM TO PREDICT END USER WEB DEVELOPMENT SUCCESS

Development of Web pages is becoming a large part of the information technology activities undertaken by organisations (Taylor, McWilliam, Forsythe, & Wade 2002) and end users are playing an increasing role in Web

page development (Goupil 2000; Nelson & Todd 1999). Yet very few studies have addressed end user Web page development.

An area of particular concern is the fact that this type of development is predominantly undertaken on an ad hoc basis (Gellerson & Gaedke 1999; Russo & Graham 1998; Wiegiers 1999), but little is known about what influences end users to learn the skills necessary to develop Web pages, and what influences their success at Web page development. Most current Web development procedures rely purely on the expertise of the individual developer (Gellerson & Gaedke 1999). This is of particular concern as Taylor et al (2002 pg. 390) states: “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 systems. These design techniques are often learnt through formal training in Web page construction, and are integral to the success of the Web pages developed. The TAM can provide a starting point for investigations into end user Web development.

The dependant variable within the TAM is system or application usage, and therefore all research studies that have utilised the TAM or derivatives of the TAM in the past, have been concerned with the usage of computer technologies. However, usage is not the only measure of a favorable reception of an information technology. Another outcome of importance in the case of end user Web development is the success of the resulting applications. System success can be measured by constructs such as information quality, system quality and individual impact (DeLone & McLean 1992). Unfortunately, the streams of research involving the relationships between beliefs, attitudes, intentions and information technology usage, and information technology success, have largely been separate fields of study. Behavioural intention models such as the TAM may be useful in understanding end user development success. The studies involving the TAM have consistently demonstrated that perceived usefulness is associated with use of technologies (e.g. Adams et al. 1992; Venkatesh & Davis 1994, 1996) and it makes intuitive sense to propose that perceived usefulness is associated with actual usefulness and therefore with the success of a system (McGill, Hobbs, & Klobas 2003) 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 proposed model is shown in Figure 2 below. It is based on the theories underlying the TAM, but includes the two new belief constructs of self-efficacy and computer anxiety, as suggested by the review of the related literature discussed above. As in the TAM, the model identifies the causal chain from an individual’s beliefs to their attitudes, then to their behavioural intention and finally to their behaviour. The model proposes that attitudes towards information technologies influence intent to learn Web development skills, and that this in turn influences Web development success.

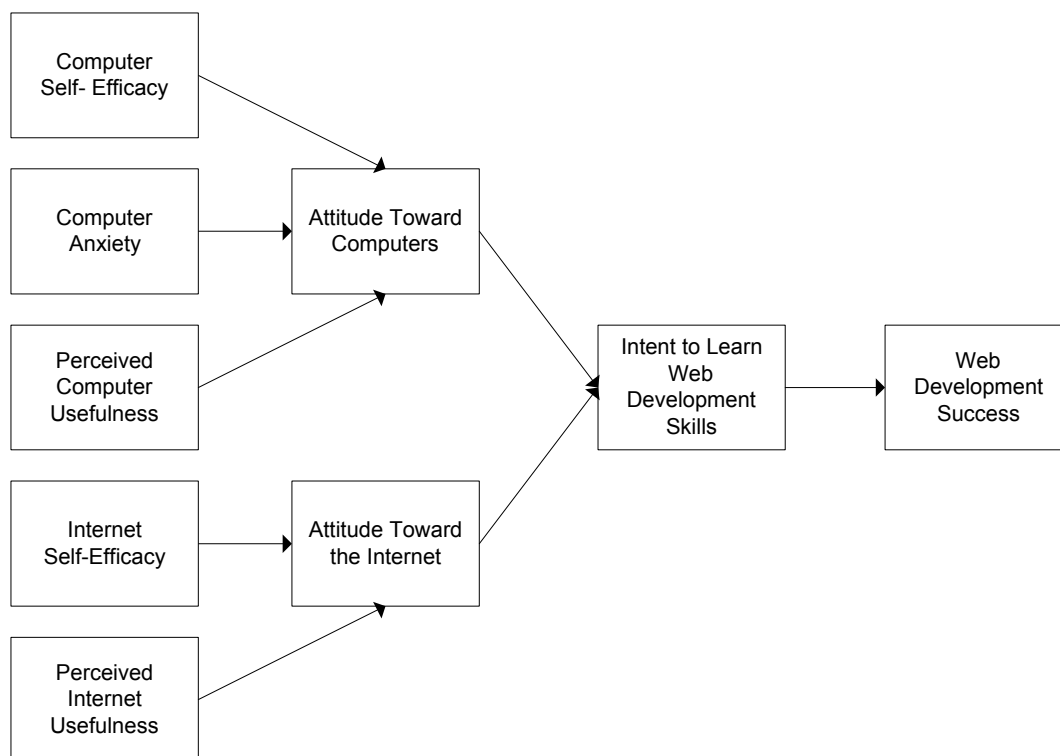


Figure 2: Adaptation of the TAM tested in this study

As in the TAM, the research model identifies the relationship between beliefs, attitudes, intentions and success, but considers these measures in relation to computer technologies and Internet technologies independently. The ease of use construct has not been included in the model as Davis et al's (1989) study indicated that it had only a minimal effect on the attitude construct. Therefore, it is considered that the construct of perceived usefulness is a much more important determinant of attitudes than perceived ease of use.

The following research questions and hypotheses follow from the model presented in Figure 2.

RQ1: How do an individual's information technology related beliefs affect their attitudes toward a particular information technology?

H1: End user Web developers with higher levels of computer self-efficacy will have more positive attitudes towards computers.

H2: End user Web developers with higher levels of Internet self-efficacy will have more positive attitudes towards the Internet.

H3: End user Web developers with lower levels of computer anxiety will have more positive attitudes towards computers.

H4: End user Web developers with higher levels of perceived usefulness of computers will have more positive attitudes towards computers.

H5: End user Web developers with higher levels of perceived usefulness of the Internet will have more positive attitudes toward the Internet.

RQ2: How do an individual's attitudes toward 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 both the TAM and the TRA; where an individual's intention to perform a particular behaviour, is governed by his or her attitude toward the behaviour (in this case, the use of computer and Internet technologies).

H6: End user Web developers with more positive attitudes toward computers will exhibit higher levels of intent to learn Web development skills.

H7: End user Web developers with more positive attitudes toward the Internet will exhibit higher levels of intent to learn Web development skills.

RQ3: 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 and the TRA, whereby an individual's intention to perform a particular behaviour, is related to his or her actual completion of that behaviour (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 variety of situations, as predicted by the TRA (Ajzen 1985), and several studies by Igarria have used models based on the TRA and TAM and found that intentions were related to behaviours (Igarria 1993; Igarria, Guimaraes, & Davis 1995).

H8: Web developers, who have higher levels of intent to learn Web development skills will exhibit higher levels of Web development success.

METHOD

Procedure

The study was conducted with students taking part in an introductory Internet and Web development course. Data was collected primarily by means of a questionnaire, administered during the first lecture of the course, and by the evaluation of Web pages developed by the participants. It was stressed that participation 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 both computers and the Internet. The questionnaire was distributed to 280 students and 193 responses were received (a response rate of 68.9%).

The research sample and environment was essentially one of convenience. However, its major strength is the availability of a consistent measure of Web development success that could be used to compare all participants. This uniformity would not normally be available in the more generalisable setting of the workplace.

Participants

The participants in the study were students taking part in an introductory Internet course; 71.5% (138) were male, and 28.5% (55) 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. Experience with computers ranged from several months to many years, with the average amount of computing experience recorded as 8.5 years of usage. Experience with the Internet ranged from having no experience with the technology at all, to 11 years of Internet use. The average length of Internet experience was 4.5 years.

The Questionnaire

In order to ensure construct validity within this study, every effort was made to utilise well-validated measures.

Beliefs and Attitude Measures

Lloyd and Gressard's Computer Attitude Scale (CAS) (1984; 1985), which consists of the dimensions: computer confidence, computer anxiety, computer usefulness and computer liking, was used to measure the constructs of computer self-efficacy, computer anxiety, perceived computer usefulness, and attitudes toward computers. Each item was measured on a 5 point Likert scale where (1) was labeled 'strongly disagree' and (5) was labeled 'strongly agree'. These scales were shown to be reliable with Cronbach alphas of 0.96, 0.93, 0.93 and 0.95 respectively.

Liaw's Web Attitude Scale's (WAS) (2002a), which contains the dimensions of Web self-efficacy, Web usefulness and Web liking, was selected to measure Internet self-efficacy, perceived Internet usefulness and attitudes toward the Internet. Each item was measured on a 5 point Likert scale where (1) was labeled 'strongly disagree' and (5) was labeled 'strongly agree'. These scales were shown to be reliable with Cronbach alphas of 0.93, 0.85 and 0.83 respectively.

Intent to Learn Web Development skills

Intent to learn Web development skills was measured by tutorial attendance (the number of tutorials attended by participants out of a possible 12). This score forms a surrogate measure for a potential developer's intent to successfully create Web pages, as the skills required to develop quality Web pages are taught during tutorials. It was thus assumed that if a participant intended to perform well in the development of Web pages, he or she would then attend more tutorials in order to gain the necessary skills.

Web Development Success

Web development success was measured using the participants' marks for a Web page creation task that was part of the Web development unit. The assignment consisted of the development and publishing (on the unit Web site) of a home page and related pages in basic XHTML. The Web pages were to be consistent with the Web Content Accessibility Guidelines and also contain Dublin Core Metadata. The documents were to be generated utilizing a text or HTML editor, and the assessment was worth 15% of the student's final grade for the unit.

Marks for the Web pages were allocated initially for design (use of colour, text and images), content (clarity and amount of information presented), navigation (intuitiveness and accessibility) and features relating to the coding of the Web page (layout, commenting and the ability to pass basic code validators). Marks were then deducted for Web pages not written in XHTML and non-compliance with Dublin Core Metadata standards and Web Accessibility standards. This score forms a surrogate measure of the success of the individual's Web page development, consisting of estimates of the Web page's system quality and information quality, with system quality referring to the performance of the Web system itself, and information quality referring to the quality of the information output by the Web system (Mason 1978).

RESULTS AND DISCUSSION

The results of the analysis are summarised in Tables 1 and 2 and illustrated graphically in Figure 3. The participants expressed generally positive overall beliefs toward both computers and the Internet. Computer self-efficacy was scored highly, with the mean of all scores being 38.1 out of 50. A very low level of computer anxiety was noted, with the average score of 14.0 out of 50. Computers were also perceived to be useful, with an

average of 40.6 out of 50. A similar pattern was noted in terms of Internet technologies. Internet self-efficacy had an average of 17.3 out of 20, whilst perceived usefulness of the Internet was on average 17.1 out of 20. The research participants expressed attitudes toward computers and the Internet that were also positive. On average the attitude toward computers score was 35.4 out of 50, whilst the average attitude toward the Internet was 15.8 out of 20. These affirmative beliefs and attitudes can be accounted for by the average age of the respondents being in their early twenties. This age group has been exposed to information technologies for a great part of their lives, and therefore could be expected to be more confident, more able to cite the usefulness of, be less anxious of, and have more favourable attitudes toward these technologies.

	Number	Mean	Standard Deviation	Minimum	Maximum
Background Variables					
Age (yrs)	192	22.39	6.94	17.00	52.00
Computing Experience (yrs)	184	8.55	4.60	0.58	30.00
Internet Experience (yrs)	187	4.50	2.08	0.00	11.00
Belief Constructs					
Computer Self-Efficacy	193	38.11	8.70	12.00	50.00
Computer Anxiety	193	14.04	6.39	10.00	46.00
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 Computers	191	35.35	9.47	9.00	50.00
Attitude Toward 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

Table 1: Summary of background and model constructs

Hypothesized Relationships

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

PATH	From	To	Coefficient	Probability
	Computer Self-Efficacy	Attitude toward Computers	0.485	0.000
	Computer Anxiety	Attitude toward Computers	-0.124	0.023
	Perceived Computer Usefulness	Attitude toward Computers	0.314	0.000
	R²	0.626		
	Internet Self-Efficacy	Attitude toward the Internet	0.368	0.000
	Perceived Internet Usefulness	Attitude toward the Internet	0.465	0.000
	R²	0.589		
	Attitude toward Computers	Intent to Learn Web Development Skills	-0.314	0.018
	Attitude toward the Internet	Intent to Learn Web Development Skills	0.147	0.236
	R²	0.089		

Intent to Learn Web Development Skills	Web Development Success	0.427	0.000
R²	0.231		

Table 2: Summary of the path analysis

Intent to learn Web development skills averaged 7.8 out of a possible 12 (i.e.: on average the participants attended 7.8 out of 12 tutorials). The Web development success score for the research participants was on average 38.0 out of a possible 100. Computer self-efficacy was found to be significantly related to attitudes toward computers ($\beta = 0.485$, $p = 0.000$), providing support for hypothesis H1. A significant relationship was also found between Internet self-efficacy and attitudes toward the Internet ($\beta = 0.368$, $p = 0.000$) so hypothesis H2 was also supported. A significant negative relationship was noted between computer anxiety and attitudes toward computers ($\beta = -0.124$, $p = 0.023$), thus hypothesis H3 was supported. Perceived computer usefulness was found to be significantly related to attitudes toward computers ($\beta = 0.314$, $p = 0.000$), providing support for hypothesis H4. A significant relationship was also found between perceived Internet usefulness and the attitude toward the Internet construct ($\beta = 0.465$, $p = 0.000$), providing support for hypothesis H5. These findings are all consistent with the relationships predicted within the TRA and the TAM.

The results indicated that a significant, although negative relationship exists between attitudes toward computers and the intent construct ($\beta = -0.314$, $p = 0.018$). However, this relationship is in the opposite direction to that predicted, and thus the hypothesis was not supported. This finding suggests (in contradiction of the theories underlying the TRA and TAM) that an individual with more negative attitudes toward computers will intend to learn Web development skills to a greater degree than an individual with a more positive attitude toward computers. This might be because individuals who feel unfavourably toward computers might not feel that they have the necessary skills to easily pass a Web development course, and thus attend more tutorials in order to learn the necessary skills to perform well.

No significant relationship was identified between attitudes toward the Internet and the intent construct. Thus no support was found for hypothesis H7. This contradicts the relationship predicted by the theories underlying the TRA and the TAM. This finding implies that regardless of whether an individual feels favourably or unfavourably toward the Internet, there is no association between that attitude and his or her intention to succeed within Web development. This could be explained if there is a distinction between attitudes to the Internet (as a source of information and entertainment) and attitudes towards Web development. Attitude towards Web development might thus, be a more useful construct than attitude to the Internet in this context. A second explanation may be that since the Internet is such a pervasive technology, end users already have gained some Web development skills prior to enrolling in the Web development course, and thus may not have considered that they needed 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 courses 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 hypothesised in both H6 and H7 may come from the operationalisation 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. Further research is needed to explore the operationalisation of this construct.

Intent to learn Web development skills was found to be significantly related to Web development success ($\beta = 0.427$, $p = 0.000$). This suggests that the greater the intention to learn Web development skills (i.e.: the more tutorials that an end user attends) the more successful an end user will be in developing Web pages. This provides support for hypothesis H8, and also provides support for the theories underlying the TRA and the TAM. However, given the concern expressed above about the operationalisation of the intent construct, this result must be treated with caution.

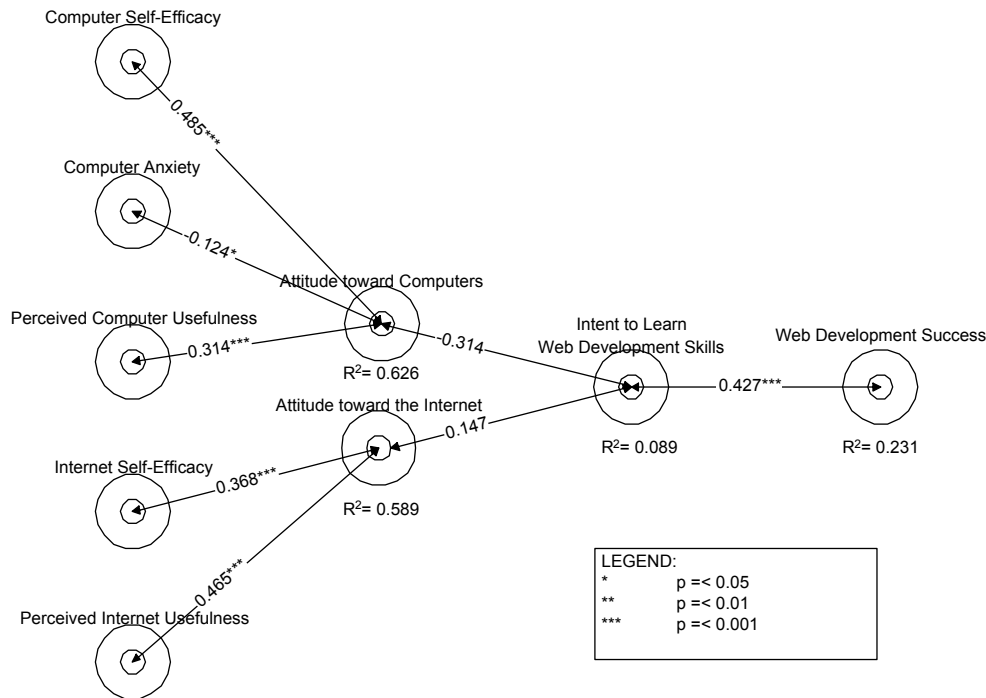


Figure 3: Path diagram of the results of the path analysis

The Model

The R² values reported in Table 2 show that the model explained a high proportion of the variance in computer and Internet attitudes (62.6% and 58.9%), however it was not successful in accounting for the variance in intent to learn Web page development skills (8.9%). The model also explained only 23.1% of the variability in Web development success. The lack of predictive power for the intent and success constructs suggests that there are additional constructs that should perhaps be included in the model. These might include characteristics of the end user developers that may influence intent to learn or success via a mechanism separate from beliefs and attitudes. These characteristics might include previous training, cognitive ability (Simon, Grover, Teng, & Whitcomb 1996) and prior Web development experience. Both the TRA and the TAM suggest that the influence of background variables on behaviour is mediated through beliefs, yet studies have shown user characteristics to have a direct influence on performance (e.g. Hubona & Cheney 1994). In future research an expanded research model that explores direct effects should be considered.

CONCLUSION:

The study described in this paper uses an adaptation of the TAM to investigate whether an end user developer's beliefs, attitudes and intentions can be used to predict the success of their Web application development. The results of the study suggest that the beliefs and attitudes of end user developers do play a role in the success of their attempts at Web page development. Beliefs about computers and the Internet determined attitudes towards computers and the Internet, and intent to learn Web development skills predicted Web development success. 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 dependant 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 strong starting point for future research.

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