

# Measuring Confidence in Internet Use: The Development of an Internet Self-Efficacy Scale

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**Abstract.** With the Internet distinguished across so many environments today, the need to measure how individuals relate to the Internet has become an extremely important aspect of Human-Computer Interaction research. However, the measurement of users' confidence with using the Internet is a poorly researched topic. This concept of confidence with using the Internet is known as Internet self-efficacy, described as a person's belief in their personal capabilities to achieve specific goals with the Internet [1]. Only a small number of studies [2, 3] have actually attempted to measure Internet self-efficacy through the use of psychometric scales. Regrettably, these attempts have produced unsatisfactory means of measuring Internet self-efficacy. Such issues include the failure to follow methodologies for the measurement of self-efficacy, wording of statements representing constructs other than Internet self-efficacy, and references to computer rather than Internet related tasks. One of the aims of this research was to develop a statistically reliable scale which measures Internet self-efficacy. This paper focuses on outlining the development of the Internet Self-Efficacy Scale.

**Keywords:** Internet, Self-Efficacy, Measurement, Scale Development, Validity, Gender differences, Age factors

## 1 Introduction

With an ever-increasing number of people accessing the Internet worldwide, the measurement of individuals' interactions with the Internet is of paramount importance in Human-Computer Interaction (HCI) research. However, the measurement of individuals' confidence in their ability to use the Internet is a poorly researched topic. Only a small number of studies [2, 3] have actually attempted to measure individuals' confidence with using the Internet through the use of psychometric scales. To make the situation even less satisfactory, these studies failed to employ appropriate methodologies for the measurement of this construct, also known as self-efficacy. These attempts have thus produced unsatisfactory means of measuring Internet self-efficacy and have raised issues that serve to obfuscate rather than clarify. As a result, the validity of such scales is questionable and unsatisfactory for use in HCI research as they stand.

The primary aim of this research was to develop a statistically reliable and psychometrically valid scale which accurately measures Internet self-efficacy. In order to do so, guidelines for the development of self-efficacy scales were taken into consideration. With this in mind, this paper outlines briefly the fundamental background from self-efficacy literature as it pertains to the development of the Internet self-efficacy scale. Following this, the three main issues in previous Internet self-efficacy literature are reviewed. The paper concludes with a brief outline of the newly developed Internet Self-Efficacy Scale.

### **1.1 Definition of Self-Efficacy**

Self-efficacy is defined by Bandura as “beliefs in one’s capabilities to organize and execute the courses of action required to produce given attainments” (p. 3) [4]. Only slight variations of this definition of self-efficacy exist in the literature, and most self-efficacy researchers are in agreement with Bandura’s proposed definition.

### **1.2 Theoretical Models of Self-Efficacy**

As Bandura has been hailed ‘the father of self-efficacy’, and with little or no conflicting evidence for his self-efficacy definition, it is hardly surprising that to date, there has been just one known theoretical model of self-efficacy proposed. Put forward by Bandura [5] himself in one of his first influential articles documenting the concept of self-efficacy, he suggests that self-efficacy expectations derive from four sources of information: performance accomplishments (more recently referred to as enactive mastery experience), vicarious experience, verbal persuasion, and physiological states.

### **1.3 Characteristics of Self-Efficacy**

The construct of self-efficacy has a number of distinctive characteristics. These features are extremely important in the study of self-efficacy as they provide a point of comparison with other psychological constructs and have four implications for how self-efficacy should then be measured [6].

Firstly, self-efficacy focuses on judgments of perceived capabilities to perform a task or activity rather than focusing on personal qualities such as physical or psychological traits and characteristics [7]. Second, self-efficacy perceptions are domain, context and task specific. Bandura [4] outlined that self-efficacy beliefs are multidimensional and should be measured in terms of “judgments of capability that may vary across realms of activity, under different levels of task demands within a given activity domain, and under different situational circumstances.....This requires clear definition of the activity domain of interest, and a good conceptual analysis of its difference facets, the types of capabilities it calls upon, and the range of situations in which these capabilities might be applied” (p. 42). Thirdly, self-efficacy is dependent on a mastery criterion of performance rather than on a normative criterion. Using an example of self-efficacy in terms of exam performance; individuals might rate how well

they performed in an exam at a specific level of personal performance rather than how better they performed than their peers. Fourthly and finally, self-efficacy beliefs are typically assessed prior to engaging in a particular task or activity so that self-efficacy may be conceptualized as a forethought process within self-regulation models [6].

In addition to the characteristics of self-efficacy as suggested by Zimmerman and Cleary [6], Bandura [4] put forward that efficacy beliefs vary on several dimensions that have important performance implications. These three dimensions of self-efficacy are (a) level, (b) generality, and (c) strength:

(a) The level of self-efficacy refers to its dependence on the difficulty level of a particular task. Perceived efficacy of different individuals may range from the ability to achieve simple task demands to extremely difficult demands within a particular domain;

(b) Generality refers to the transferability of personal efficacy judgments across tasks or activities. Individuals may feel efficacious across a wide range of activities or their efficacy beliefs may be limited to specific domains of functioning;

(c) Strength refers to the magnitude of one's conviction that they can complete the specified task.

#### **1.4 Self-Efficacy Measurement**

Self-efficacy is measured through the use of psychometric scales. Many psychometric scales, such as those used in the measurement of attitudes, require participants to indicate whether they agree or disagree with a statement. However, for the measurement of self-efficacy, Bandura [4] argues persuasively that individuals should be asked to rate the strength of their belief to complete specific activities in the domain in question on a self-rating interval scale instead of "agreeing" or "disagreeing" with the statement. The items presented to respondents should be phrased in terms of can do rather than will do because can is a judgment of capability whereas will is a statement of intention. Furthermore, Bandura suggests that the standard methodology for the measurement of self-efficacy should present participants with a 100-point scale to measure strength of belief, ranging in 10-unit intervals from 0 ('Cannot do') through intermediate degrees of assurance, 50 ('Moderately certain can do'); to complete assurance, 100 ('Certain can do').

##### **Self-Efficacy Measurement Principles**

Bandura's self-efficacy scales assume the following principles:

1) Self-efficacy scales should be unipolar; scales should range from 0 to a maximum strength (100 is the general maximum strength recommended by Bandura). Self-efficacy scales should not include negative numbers because a judgment of complete incapability (0) has no lower graduations.

2) Scales which "use only a few steps should be avoided because they are less sensitive and less reliable" (p. 44) [4] as suggested by Streiner and Norman [8]. Bandura [4] also advocates that the inclusion of too few steps "loses differentiating infor-

mation because people who use the same response category would differ if intermediate steps were included” (p. 44).

3) Preliminary instructions are given to participants which establish the appropriate mind-set that participants should have when rating the strength of belief in capability. People are asked to judge their operative capabilities as of now, and not their potential capabilities or their expected future capabilities [9].

### **Scoring Self-Efficacy**

Bandura [4] outlines that there are two formats which can be used to measure self-efficacy strength. The first involves what Bandura [4] refers to as a “dual-judgment format” (p.44) where respondents first indicate whether or not they can complete the outlined task. Only for tasks which they indicate they can complete, do respondents then rate the strength of their perceived efficacy using the self-rating 0-100 scale. The second method which Bandura describes as the “single-judgment format” (p.44), invites respondents to rate the strength of their perceived efficacy on all items presented in the scale. The method utilizing the single-judgment format is recommended by Bandura [4] as he suggests that this format provides “essentially the same information and is easier and more convenient to use” (p. 44). When participants complete rating their efficacy strengths, the efficacy strength scores are then summed and divided by the total number of statements. This then indicates the strength of self-efficacy in the domain in question. Finally, “a measure of efficacy level can be extracted by selecting a cutoff value below which people would judge themselves incapable of executing the activities in question” (p. 44) [4].

## **2 Internet Self-Efficacy**

Self-efficacy was earlier defined as “belief’s in one’s capabilities to organize and execute the courses of action required to produce given attainments” (p.3) [4]. Thus, Internet self-efficacy can be identified as “a person’s belief in their personal capabilities to achieve specific goals with the Internet” [1]. Principal failings in Internet self-efficacy research to date stem from a lack of clarity regarding how self-efficacy in general is conceptualized. Issues include:

- the failure to follow methodologies for the measurement of self-efficacy
- the wording of statements as representative of something other than Internet self-efficacy
- the inclusion of items representing computer related tasks rather than Internet related tasks.

The most significant of these issues has been the failure to follow fundamental principles for the measurement of self-efficacy.

## 2.1 Incorrect Self-Efficacy Measurement Methods

As earlier outlined, Bandura [4] advocates that individuals should be asked to rate the strength of their belief to complete specific activities in the domain in question on a self-rating interval scale instead of 'agreeing' or 'disagreeing' with the statement. However, many studies (e.g. [2], [3], and [10]) fail to incorporate such guidelines in the development of their self-efficacy scale. For example, Eastin and LaRose [2] developed an Internet self-efficacy scale in which items for the scale were informed by Compeau and Higgins' Computer Self-Efficacy Scale [11], findings from the Graphic, Visualization and Usability Center's Tenth Annual Survey [12], and Nahl's [13] study on perceived self-efficacy. Items from these scales were adapted in line with the definition of Internet self-efficacy offered by Eastin and LaRose, and were phrased to represent judgments of ability to use the Internet to produce overall attainments, rather than accomplishing specific Internet tasks. The final instrument consisted of eight items and participants were invited to indicate on a 7 point Likert-type scale whether they agreed or disagreed with each of the statements. There is a fundamental measurement issue with the scale as it would seem that levels of agreement with a statement are being obtained rather than information about individual's beliefs in their capabilities to achieve specific goals on the Internet.

Similarly, there are measurement issues present in Torkzadeh and Van Dyke's [3] self-efficacy scale. Torkzadeh and Van Dyke developed a self-efficacy instrument to measure the perception of individual's ability to interact with the Internet while also exploring the multidimensional nature of Internet self-efficacy. The authors set out to achieve such tasks by extending previous research on computer self-efficacy into the domain of the Internet. In order to successfully measure Internet self-efficacy, an extensive review of the literature on self-efficacy and information processing was carried out. This review generated a list of 24 items which were subsequently reviewed by five practitioners and four academics. Some of the items on the list were reworded following this review but all 24 original items were retained for purposes of analysis. Individuals were required to indicate their level of agreement with each statement on a 5-point Likert type scale. As with Eastin and LaRose's [2] study, there are concerns with such measurement methods. Participants were required to indicate their level of agreement with each statement on a 5-point Likert type scale. As earlier outlined, Bandura [4] argues persuasively for the use of a self-rating interval scale to measure self-efficacy instead of 'agreeing' or 'disagreeing' with the statement. Bandura's methodologies were not applied in this study and the results generated from this study again tell us more about one's level of agreement with the statements in the scale than about their perception of capability to use the Internet.

## 2.2 Unsuitable Wording of Statements

In addition to measurement issues, there have also been issues with the wording of statements in previous research ([2] and [10]). For example, in Eastin and LaRose's [2] study, there are concerns about the statements being representative of items which depict Internet self-efficacy. While the authors offer a definition of Internet self-

efficacy based on Bandura's general definition of self-efficacy, it is difficult to understand how the statements generated for Eastin and LaRose's scale correspond with this definition. For example, one of the items included in the scale is 'I feel confident describing functions of Internet hardware'. This statement refers to describing information about Internet hardware; something an Internet user would not need to know about to determine feelings of confidence about using the Internet. A second example of this in Eastin and LaRose's scale is the statement 'I feel confident explaining why a task will not run on the Internet' which is more representative of the ability to articulate computer issues than depicting feelings of Internet self-efficacy.

Other examples of this issue exist in Eachus and Cassidy's [10] study. Examples of statements in their study include 'I am not really sure what a modem does' and 'Using ftp to upload web pages to a server is quite complicated'. These statements tell us more about an individual's reflection on their knowledge of *how* the Internet works rather than their confidence about using the Internet. Thus, as with Eastin and LaRose's scale items, such statements are unrepresentative of feelings of Internet self-efficacy.

### **2.3 Inclusion of Non-Internet Related Tasks**

Similar to the issue of unsuitably worded items to denote feelings of Internet self-efficacy is the issue where self-efficacy items are included which describe computer related tasks instead of Internet related tasks. For example, in Torkzadeh and Van Dyke's [3] study, a list of 24 items was generated to develop a self-efficacy instrument which measured perception of individual's ability to interact with the Internet. However, some of the included items refer to computer, rather than Internet related tasks. Examples of such items include 'I feel confident scanning pictures to save on the computer' and 'I feel confident playing an audio CD on my computer'. These examples refer to activities that an individual may carry out on a computer but are activities that one does not require the Internet for, nor indeed would use the Internet for. Thus, the validity of such items as representative of feelings of Internet self-efficacy is questionable.

### **2.4 Addressing Issues in Previous Research**

In order to develop a valid and statistically reliable scale which measures Internet self-efficacy, it was important that the issues highlighted above were addressed. With this in mind, it was important to ensure that the Internet self-efficacy scale followed appropriate methodologies for the measurement of self-efficacy to ensure correct measurement of self-efficacy beliefs. Additionally, it was of critical importance to ensure that items on the scale refer to Internet related tasks and that statements were worded in an appropriate manner to capture feelings of Internet self-efficacy. Finally, it was important to obtain a varied sample of Internet users with varying levels of experience to ensure a representative Internet user sample. Keeping these issues in mind, the development of the Internet self-efficacy scale is now briefly described.

### **3 Development of the Internet Self-Efficacy Scale**

As earlier outlined, Bandura's [4] theoretical model of self-efficacy is the theoretical model and framework which was followed for the development of the Internet Self-Efficacy Scale (ISES). However, little empirical research is available in general investigating Bandura's [4] four proposed sources as influential in self-efficacy. Thus, this research first sought to clarify Bandura's [4] sources theory in Internet self-efficacy research. Additionally, the other issue under investigation in this research concerns the measurement of self-efficacy. Bandura [9] proposed guidelines for the creation of self-efficacy scales and the measurement of self-efficacy beliefs. This research identified flaws in these current measurement methods and sought to resolve such issues with a particular focus on the area of Internet self-efficacy. Thus, both of the outlined issues were investigated in detail where each issue was individually addressed at different stages in the development of the ISES.

#### **3.1 Sources of Internet Self-Efficacy**

The four sources of self-efficacy as put forward by Bandura [4] are mastery experience, vicarious experience, verbal persuasion and physiological states. However, there is an apparent lack of concrete evidence to support the hypothesis that self-efficacy beliefs are influenced by these four sources across varying self-efficacy domains. While extensive research has been completed in areas such as academic self-efficacy and these four sources have been confirmed to be influential in this particular domain, no known research to date has examined Bandura's [4] proposed sources as influential in feelings of self-efficacy in a domain such as the Internet. With this in mind, it was important to investigate these sources in the current domain of interest (the Internet) to determine if these sources had any effect on Internet self-efficacy scores.

#### **3.2 Format of Questionnaire**

The questionnaire, consisting of four main sections, was distributed to 176 students studying Psychology in University College Cork, Ireland. The first section of the questionnaire asked for information about how frequently participants performed specific tasks on the Internet (mastery experience) and invited participants to indicate how frequently they perform a list of major Internet activities on a 5 point scale with the following response anchors: Never, Rarely, Sometimes, Frequently, Very frequently. The second section asked for information on acquaintances and their use of tasks on the Internet (vicarious experience) by asking participants to indicate on a 5 point scale how many Internet users they knew personally who performed the listed Internet activities. The response anchors for this question were: No-one I know, Very few people I know, Some people I know, A lot of people I know, Everyone I know. The subsequent section requested information about how much help and encouragement was available to participants should they encounter difficulties using the Internet (verbal persuasion). Participants were asked to indicate how much encouragement they would receive from others if they encountered difficulty with the listed activities.

There were five response anchors: None at all, Very little, Some encouragement, A fair amount, A large amount. Finally, the fourth section requested information on people's level of confidence in performing various tasks on the Internet (self-efficacy) by asking participants how confident they felt they can do each of the listed activities, as of now. The five response anchors were: Not at all confident, Slightly confident, Somewhat confident, Very confident, Extremely confident. Physiological states were not investigated as a predictor of Internet self-efficacy as the focus of this research is on stable predictors of self-efficacy. As self-efficacy is concerned with beliefs which are more concerned with trait characteristics, rather than state characteristics, it was deemed inappropriate to evaluate individuals' state characteristics such as their mood and feeling when determining feelings of Internet self-efficacy. Furthermore, Bandura [4] outlines that somatic indicators are particularly relevant in domains that involve physical accomplishments. As the Internet is not concerned with physical accomplishments, it was decided that it was unnecessary to measure physiological states when evaluating Internet self-efficacy.

### **3.3 Results**

In order to determine if the three variables (mastery experience, vicarious experience and verbal persuasion) were significant predictors of self-efficacy scores, regression analyses were carried out on the data. A multiple regression analysis was carried out for each of the individual Internet tasks. The results demonstrated that the first independent variable (mastery experience) was a significant predictor of self-efficacy scores across all Internet tasks, achieving a significant p value of  $<.001$ . The second variable (vicarious experience) was a significant predictor of self-efficacy for some tasks. The verbal persuasion variable was the least significant predictor of self-efficacy scores achieving significance on just one task. The total variance explained by the model as a whole ranged from 18% to 41% indicating that about a quarter to a third of the variability in Internet self-efficacy scores is predicted by mastery experience, vicarious experience and verbal persuasion. Mastery experience made the strongest unique contribution to explaining self-efficacy scores when the variance explained by the other independent variables in the model was controlled for.

### **3.4 Conclusion**

The results of the multiple regression analysis suggest that the proposed model is not a satisfactory predictor model of Internet self-efficacy. Across all tasks, only one of the independent variables (mastery experience) was a consistently significant predictor of self-efficacy scores. Results of post-hoc comparisons demonstrated that correlations for mastery experience and self-efficacy were the only variables which achieved medium to strong correlation values. Correlation values between the other variables were weak with low significance levels suggesting little or no relationship between the variables. As a result, it can be concluded that mastery experience is the only strong predictor of self-efficacy scores.



### 3.5 Scale Refinement

Following on from the previous analysis, refinements to the scale were necessary. Information which would inform the item pool for the Internet self-efficacy scale had been collected at multiple points throughout the course of this research. Data which was collected in the early stages of scale development (outlined above) was also taken into consideration when finalizing the items for inclusion in the final scale. During that data collection, a participant noted that while the listed Internet activities incorporated shopping and buying items on the Internet, no activity encapsulated the selling of items. Thus, a new activity (e-commerce) was created for inclusion in the final scale.

Additionally, the response options were also revised after the previous data collection. Response options in the scale described above involved five response items for self-efficacy measurement. However, it was felt that five response options may have been too few options to do justice to nuances of self-efficacy. This was further highlighted by a large number of responses obtained for options one and five at the extreme ends of the scale. As a result, it was decided to increase the number of response options from five to seven options to best capture feelings of Internet self-efficacy.

## 4 Scoring Internet Self-Efficacy

Earlier in this paper, Bandura's [4] methods for scoring self-efficacy were outlined in detail. Bandura put forward the dual-judgment format and the single-judgement format for measuring the strength of self-efficacy beliefs. Bandura further suggested that the preferred method is the latter for which respondents' rate the strength of their perceived self-efficacy for all items presented on the scale and when this is complete, the efficacy scores are summed, and then divided by the total number of statements to give an average self-efficacy score. In other words, average self-efficacy over all the tasks, regardless of how often they are done. This will hereafter be referred to as Bandura's self-efficacy score. However, scoring self-efficacy in this manner only gives the researcher limited information about the way in which individuals formulate their self-efficacy beliefs. Keeping the findings of this research in mind (that mastery experience is highly correlated with self-efficacy), it was decided that it would be important to incorporate people's scores on mastery experience, with their self-efficacy scores, to give a 'true' self-efficacy score. In doing so, individuals are providing further information which can be used to extract a clearer identification of their 'true' self-efficacy scores.

In order to do so, it is imperative that researchers collect two elements of information from participants: the first part invites respondents to indicate how often they complete each of the Internet tasks on a 5-point scale. In the second part, participants' are invited to rate how confident they feel that they can perform each of the ten listed Internet tasks 'as of now' on the 7-point response scale. With this information obtained for each participant, a formula was devised to obtain an overall self-efficacy score for each individual hypothesizing a multiplicative relationship between mastery experience and self-efficacy. Thus, respondents who rate themselves high on self-

efficacy for tasks which they do not perform often score within a middle range compared to those with high self-efficacy and high frequency. Similarly, those who rate themselves low on self-efficacy but high on frequency are in a middle range in comparison to those who score low on both self-efficacy and frequency. The multiplicative relationship mutually accentuates the two effects which have been shown to be correlated in earlier parts of this research. Using this formula to measure self-efficacy results in possible scores ranging from 0 – 100 where 0 indicates an extremely low self-efficacy score and 100 indicates an extremely high self-efficacy score.

#### **4.1 Gender Differences**

Many studies [14-16] have investigated gender difference with technology in an effort to better understand how males and females interact with it. However, the evidence for gender differences in how confident individuals feel about using the Internet is conflicting. This disparity in the evidence quite likely results from the issues with Internet self-efficacy research outlined earlier in this paper.

The results of the analyses in the present study found no significant differences in Internet self-efficacy scores between the males and females. Effect sizes for the differences between the sexes are so small as to be negligible.

#### **4.2 Age Differences**

While there has been speculation about gender differences in Internet self-efficacy, little research has investigated age differences in Internet self-efficacy. This research hypothesized that there may well be a division in groups between those who have grown up within a readily accessible Internet environment (digital natives) and those who have had to learn about this new technology (digital immigrants). Age differences in Internet self-efficacy scores were found in the current analyses. Participants aged 25-34 years obtained the highest scores on Internet self-efficacy while participants aged <18 years obtained the lowest scores. Additionally, for participants increasing in age beyond 44 years, Internet self-efficacy scores started to decrease with age. The differences between the groups were significantly different. What was surprising was the low Internet self-efficacy scores achieved for the youngest age group (<18 years). However, the number of participants in the sample for this age group was extremely small (n = 11) so these results must be interpreted with caution. Further exploration of Internet self-efficacy in this age category is thus necessary.

### **5 Conclusion**

Following extensive testing and analyses of the Internet Self-Efficacy Scale, the final scale consists of 10 items where confidence in ability is rated on a seven point scale. The construct validity of the questionnaire is at least positively commendable and the authors hope that other researchers interested in Internet self-efficacy will be challenged enough by our results to want to adopt our scales in their research.

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