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# PREDICTORS OF SUCCESS IN E-LEARNING COURSEWARE USABILITY DESIGN

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## ABSTRACT

*The primary purpose of this study was to assess predictors of success in e-learning courseware usability. E-learning courseware usability was treated as the dependent variable. The independent variables were age, gender, number of online courses taken, proficiency with using e-learning courseware, and college status. Multiple linear regression analysis was conducted to identify variables that best predict the usability of e-learning courseware. Research findings, recommendations, and implications for future research are discussed.*

**Keywords:** e-Learning Courseware Usability, e-Learning Courseware, Learning Management Systems, Instructional Design

## INTRODUCTION

E-learning, or online education, is the delivery of instruction over electronic media such as the Internet. The use of e-learning in the USA continues to increase at a rapid rate as higher education institutions capitalize on this alternative method of course delivery. By eliminating geographic boundaries and providing scheduling flexibility for students, e-learning is especially appropriate for non-traditional students and individuals committed to living in somewhat remote locations, such as military installations or small towns far from a traditional university campus.

Allen and Seaman [1] reported the following regarding the state of the e-learning in the USA:

- "7.1 million higher education students are taking at least one online course.
- The 6.1 % growth rate represents over 400,000 additional students taking at least one online course.
- The percent of academic leaders rating the learning outcomes in online education as the same or superior to those as in face-to-face instruction grew from 57% in 2003 to 74% in 2013.
- The number of students taking at least one online course continued to grow at a rate far in excess of overall enrollments, but the rate was the lowest in a decade" [1].

E-learning courseware, also known as learning management systems (LMS) or learning platforms, is the tool that allows the instructional content to be delivered online. Koohang [7] asserted that a vital element in the success of e-learning instructional design is the incorporation of usability properties into the e-learning courseware.

Usability is defined by the International Standards Organization (ISO) as: "The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context" [5]. Nielsen [14] defined usability through five quality components. They are: "(1) Learnability: How easy is it for users to accomplish basic tasks the first time they encounter the design?; (2) Efficiency: Once users have learned the design, how quickly can they perform tasks?; (3) Memorability: When users return to the design after a period of not using it, how easily can they reestablish proficiency?; (4) Errors: How many errors do users make, how severe are these errors, and how easily can they recover from the errors?; and (5) Satisfaction: How pleasant is it to use the design?"

Usability is generally described as the determining factor in a product's ability to satisfy the needs and specifications of users. It is the measure of how users easily and effectively use a product. According to Keinonen [6, p. 62] usability can be defined as a characteristic related to: "(1) the product's design process, (2) the product itself, (3) use of the product, (4) user experiences of the product or (5) user expectations."

Usability in an e-learning context refers to diverse things such as the platform specifications, screen layout, the navigational systems and structure, the esthetic qualities of a product of platform, and all the traits that promote user-friendliness [8]. Usability is a significant factor in user satisfaction and user acceptance of a product [3, 4, 12, 13, 15, 16, 17].

The usability of e-learning courseware depends on a number of properties. Koohang [9] summarized and outlined a number of usability properties for e-learning courseware design. These included usability properties such as: (1) simplicity; (2) recognition; (3) comfort; (4) user friendliness; (5) control; (6) navigability; (7) load time; (8) visual appearance; (9) consistency; (10) well-organized; (11) understandability; and (12) relevancy. The author asserted that the design of these usability properties in e-learning courseware play significant roles in usability attributes. The usability attributes are user effectiveness, learnability, flexibility, user attitude, user satisfaction, and user view of product attractiveness [12, 17].

## PURPOSE OF THE STUDY

The purpose of this study was to create a multiple linear regression model that included five independent variables (age, gender, number of online courses taken, proficiency with using e-learning courseware, and college status) that best predict the dependent variable of e-learning courseware usability.

Age consisted of 4 categories: (1) 18-20, (2) 21-30, (3) 31-40, and (4) above 40). Gender included 2 categories: (1) female and (2) male. The number of online courses taken comprised of 4 categories: (1) 1–2, (2) 3–5, (3) 6-10, and (4) more than 10. Proficiency with using e-learning courseware contained 3 categories: (1) excellent, (2) good, and (3) average. College status included 4 categories: (1) freshmen, (2) sophomore, (3) junior, and (4) senior.

The properties that formed the dependent variable of e-learning courseware usability were simplicity, comfort, user friendliness, control, navigability, load time, recognition, visual appearance, consistency, well-organized, understandability, relevancy, adequacy/task match, and right to the point.

Based on the purpose, this study asks the following research question: Which of the five predictor variables (i.e., age, gender, number of online courses taken, proficiency with using e-learning courseware, and college status) are most influential in predicting the e-learning courseware usability?

## METHODOLOGY

### Instrument

The instrument used in this study is based on a stream of research on e-learning courseware usability [7, 8, 9]. The instrument includes the following 14 items:

1. **Simplicity:** The e-learning courseware is simple, uncomplicated, and straightforward to use.
2. **Comfort:** I am comfortable using the e-learning courseware.
3. **User friendly:** The e-learning courseware is easy to use.
4. **Control:** I feel I am in control of the tasks I accomplish with the e-learning courseware.
5. **Navigability:** Using the e-learning courseware, I can easily navigate and get to where I want to go.
6. **Load time:** I notice that the pages load quickly when I use the e-learning courseware.
7. **Recognition:** I quickly identify the key points presented for carrying out tasks when I use the e-learning courseware.
8. **Visual appearance:** The visual appearance (text boldfacing, italicizing, underlining, font size, link visibility) is present throughout the e-learning courseware.
9. **Consistency:** Consistency of appearance, terms, words, and action throughout the e-learning courseware.
10. **Well-organized:** The pages are well-organized and structured in the e-learning courseware.
11. **Understandability:** The information in the e-learning courseware is understandable and easy to read.
12. **Relevancy:** The information presented in the e-learning courseware is relevant to what I need to know.

13. **Adequacy:** The information presented in the e-learning courseware is no more/no less than what I need to know.
14. **Right to the point:** The information in the e-learning courseware is concise and right to the point.

The content validity of the instrument was determined by a panel of experts consisting of three university professors. The instrument used a Likert-type scale: strongly agree = 5, agree = 4, neither agree nor disagree = 3, disagree = 2, and strongly disagree = 1. The instrument was tested for reliability (alpha = .89) using 39 subjects independent of the sample of respondents used in the present study. The subjects were undergraduate students studying in an online information technology program in a mid-sized higher education institution in the Southeastern United States.

**Subjects and Procedure**

The subjects of this study were 135 students taking online courses in the field of information technology from a mid-sized higher education institution in the Southeastern United States. The subjects were males and females ranging from 18 to over 40 years of age. After obtaining Institutional Research Board (IRB) approval, the instrument was administered electronically to the subjects. The subjects were told that they were under no obligation to participate in the study and that their participation was completely voluntary. The subjects were assured anonymity.

**Data Analysis**

Multiple regression analysis (Enter Method) was conducted to answer the research question. This analysis shows which of the independent variables (age, gender, number of online courses taken, proficiency with using e-learning courseware, and college status) can best predict the dependent variable (e-learning courseware usability).

The analysis included:

1) The model summary includes multiple correlation ($R$), squared multiple correlation ($R^2$), and adjusted squared multiple correlation ($R^2_{adj}$). These indicate how well an independent variable or a combination of independent variables predict the dependent variable.

2) The ANOVA test includes the $F$ test with a $p$ value. If the F test is significant, then the relationship between the dependent variable and independent variables is linear.

3) The coefficients table represents the unstandardized regression coefficient *(B),* the standardized regression coefficient (beta), *t,* and *p* values, and three correlations (bivariate *r,* partial *r,* and part *r),* and tolerance coefficient. Tolerance measures the degree to which independent variables account for unique variance in the dependent variable. The acceptable tolerance for each independent variable is .1. This tolerance value should exist for each independent variable before the model summary, ANOVA summary table, and table of coefficients are interpreted. The independent variables that do not reach this value must be excluded and the regression analysis should be conducted again.

## RESULTS

Prior to conducting the multiple regression analysis, data were screened for missing values and outliers. No missing values were reported, however 3 responses were removed before conducting further analysis because of multivariate outliers. This yielded a final sample population of 132 subjects for inclusion in the analyses. In addition, data were evaluated for test assumptions-linearity, normality, and homoscedasticity with satisfactory results.

Table 1 shows the three parts of regression analysis: model summary, ANOVA summary table, and coefficients table for the independent variables of age, gender, number of online courses taken, proficiency with using e-learning courseware, college status and the dependent variable of e-learning courseware usability.

Review of the tolerance measures presented in the coefficients table (See Table 1) indicates that all of the independent variables were above the .1 acceptable tolerance level. This means that all of the independent variables

were tolerated in the model. As a result, the model summary, ANOVA summary table, and coefficients table were interpreted.

As can be ascertained, the overall model of the five independent variables (age, gender, number of online courses taken, proficiency with using e-learning courseware, and college status) significantly predicted the e-learning courseware usability ($R$ = **.598**, $R^2$ = **.357**, $R^2_{adj}$ = **.332**, $F(5,126)$ = 14.006, $p$ < **.001**). This model accounted for 35% of variance in the e-learning courseware usability.

A review of the beta weights in Table 1 shows only four of the five independent variables significantly contributed to the model: gender (*Beta* = **-. 154**, t = **-2.150**, p =**.033)**, the number of online courses taken (*Beta* = **-. 183**, t = **-2.261**, p =**.026)**, proficiency with using e-learning courseware (*Beta* = **-. 568**, t = **-7.802**, p =**.000)** and college status (*Beta* =**.161**, t = **1.993**, p =**.040**). Age was not a predictor of success. Table 2 shows mean, standard deviation, & correlations.

**Table 1.** Model Summary, ANOVA, & Coefficients - E-Learning Courseware Usability Properties

| **Model Summary** | | | | |
|---|---|---|---|---|
| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
| | .598 | .357 | .332 | .33952 |

| **ANOVA** | | | | | | |
|---|---|---|---|---|---|---|
| Model | | Sum of Squares | df | Mean Square | F | Sig. |
| | Regression | 8.072 | 5 | 1.614 | 14.006 | .000 |
| | Residual | 14.524 | 126 | .115 | | |
| | Total | 22.597 | 131 | | | |

| **Coefficients** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. | Correlations | | | Collinearity Statistics | |
| | | B | Std. Error | Beta | | | Zero order | Partial | Part | Tolerance | VIF |
| | | 5.132 | .172 | | **29.919** | **.000** | | | | | |
| | A | -.031 | .037 | -.062 | -.836 | .405 | -.020 | -.074 | -.060 | **.921** | 1.085 |
| | B | -.128 | .059 | **-.154** | **-2.150** | **.033** | -.192 | -.188 | -.154 | **.993** | 1.007 |
| | C | -.079 | .035 | **-.183** | **-2.261** | **.026** | -.045 | -.197 | -.161 | **.776** | 1.288 |
| | D | -.399 | .051 | **-.568** | **-7.802** | **.000** | -.542 | -.571 | -.557 | **.962** | 1.039 |
| | E | .070 | .035 | **.161** | **1.993** | **.048** | .062 | .175 | .142 | **.783** | 1.277 |

*Notes: A = age, B = gender, C = number of online courses taken, D = proficiency with using e-learning courseware, and E = college status*

**Table 2.** Mean, Standard Deviation, & Correlations - E-Learning Courseware Usability Properties

| **Descriptive Statistics** | | | |
|---|---|---|---|
| | Mean | Std. Deviation | N |
| Overall | 4.2505 | .41533 | 132 |

| **Correlations** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Overall | A | B | C | D | E |
| Pearson Correlation | Overall | 1.000 | -.020 | -.192 | -.045 | -.542 | .062 |
| | A | -.020 | 1.000 | -.031 | .216 | -.066 | .246 |
| | B | -.192 | -.031 | 1.000 | .037 | .056 | -.009 |
| | C | -.045 | .216 | .037 | 1.000 | -.156 | .430 |
| | D | -.542 | -.066 | .056 | -.156 | 1.000 | .010 |
| | E | .062 | .246 | -.009 | .430 | .010 | 1.000 |

*Notes: A = age, B = gender, C = number of online courses taken, D = proficiency with using e-learning courseware, and E = college status*

## DISCUSSION

Formal and informal education has been with us for thousands of years, and generally comes down to an interaction between a teacher and learner. The apprentice system illustrates this vividly, with the beginner learning and growing in skill and competence under the direction of a master. The introduction of readily available books led to the introduction of the lecture method, assembling a number of students in a central location and guiding their learning through interaction with an instructor. We are now transitioning into a decentralized format, utilizing technologies and the Internet to join learners together with an instructor, or at times with a learning system that serves as an instructor, while providing a robust array of supporting technologies and learning materials. This is a major shift in delivering education and while e-learning may offer substantial advantages over other instructional methods, including reduced costs and improved access to learning [2], student fear of failure and lack of confidence in moving from the traditional class setting are often impediments to effective e-learning [18]. When the e-learning courseware is easy to navigate, students with apprehension and/or limited computer skills will tend to have a more positive experience [11]. Students should spend their time mastering the course material, not the course navigation [2].

This study was undertaken to evaluate predictors of success in e-learning courseware usability. Five predictor variables were referred to as independent variables. They were age, gender, number of online courses taken, proficiency with using e-learning courseware, and college status. The e-learning courseware usability was the dependent variable. Multiple regression analysis was conducted to determine the significant predictors of success in e-learning courseware usability. The overall model in the regression analyses revealed that all of the five independent variables (age, gender, number of online courses taken, proficiency with using e-learning courseware, and college status) were significant in predicting e-learning courseware usability. However, the results of the beta weights for the independent variables showed that only four of the five variables should be considered predictors of e-learning courseware usability. These variables were gender, number of online courses taken, proficiency with using e-learning courseware, and college status. Age was not considered a predictor of e-learning courseware usability.

If we look at each of these significant variables, gender is the variable that courseware designers will have the most difficulty addressing. While there are educational institutions that are all male or all female, they are few. Certain academic programs may tend to attract more of one gender, such as construction management being more attractive to male students and elementary education being more attractive to female students. Because gender was found to be a predictor of success, both males and females must be included in the design of e-learning usability.

The number of online courses taken as a significant variable could be considered intuitive for many. The more online courses a student has taken, the more likely the student will be able to effectively use the courseware. Students unfamiliar with the courseware due to lack of experience would be expected to be more tentative, and to have more difficulty when interacting with the system. Because the number of online courses taken by students (from 1 online course to more than 10 online courses) was found to be a predictor of success, it is imperative to include this variable in the design of e-leaning usability.

Proficiency with using e-learning courseware was found to be a predictor of success in e-learning courseware design. It may be fair to say that students who have more experience with e-learning courseware will generally have more proficiency in navigating and utilizing the features of the courseware. With proficiency often comes a degree of satisfaction. However, the design of e-learning usability must include various e-learning courseware proficiencies, i.e., excellent, good, and average.

College status was found to be a significant predictor of e-learning courseware usability. This finding can be considered a signal for courseware designers for first and second year students to take extra care in making courseware usability as straightforward and intuitive as possible. Usability is often founded on the ability of the learner to effectively use the courseware. It would be appropriate to make the assumption that beginning students most likely lack experience with e-learning courseware, therefore need more system navigation help and transparent operations. For more advanced students courseware designers can generally make some assumptions about their ability to navigate more complex learning systems and interfaces, and to have a better understanding of how the

courseware systems operate. Because college status was found to be a predictor of success, all college students (freshmen, sophomores, juniors, and seniors) must be included in the design of e-learning courseware usability.

## CONCLUSIONS

The properties that were recognized to contribute to the e-learning courseware usability design in the present study were simplicity, comfort, user friendliness, control, navigability, load time, recognition, visual appearance, consistency, well-organized, understandability, relevancy, adequacy/task match, and right to the point.

Gender, number of online courses taken, proficiency with using e-learning courseware, and college status are the variables that significantly contribute to the success of e-learning courseware usability and should be given careful attention in designing usability properties into e-learning courseware. Age was not shown to be a significant predictor of e-learning courseware usability. While these results may be intuitive to some, the benefit of this study is that it provides data supporting what until now have been intuitive assumptions.

The findings of this study have implications for the e-learning courseware usability design. Usability of the e-learning courseware is said to positively influence learning and therefore enhance the learning experience for learners [7, 8, 9, 10]. Therefore, it is imperative to understand and include the variables that are most influential in predicting the e-learning courseware usability when designing e-learning courseware.

This study is not without limitations. A sample of convenience was used and the sample size was moderate. Future studies may consider a random sample with increased sample size. In addition, the sample should be taken from various higher education institutions.

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