

Relationship of Student Undergraduate Achievement and Personality Characteristics in a Total Web-Based Environment: An Empirical Study

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ABSTRACT

Web-based education is a popular format for the delivery of college courses. Research has shown that it may not be the best form of education for all students. Today, many students (and student advisors) face a choice in course delivery format (i.e., Web-based or more traditional classroom courses). This research study examines the relationship between student personality characteristics and their achievement scores as a means of identifying predictors of academic success in an undergraduate business program using Web-based education. The results of the study show that four basic personality characteristics are highly correlated to student achievement in Web-based courses. Use of these personality characteristics as variables in a regression model is shown to be a highly accurate predictive tool to aid students in the decision as to whether to take a particular Web-based course format or a more traditional classroom course.

Subject Areas: Empirical Research, Personality Trait Research, Student Performance, and Web Course Research.

INTRODUCTION

College students (and their course advisors) have to select courses each semester during their academic program. The decision to select a particular course can be based on many criteria. One recent complication to this decision is whether to choose a traditional classroom course (i.e., primarily via human resource delivery) or Web-based instruction (i.e., primarily via technology resource delivery). Web-based education is now typically found in most universities, due to its popularity for a variety of reasons, including convenience for students and cost efficiencies for

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colleges (Rockwell, Schwauer, Fritz, & Marx, 2002). Yet, this change in the delivery of education has resulted in a debate on the effectiveness of distance education via Web courses (Alavi, 1994; Barrick, Stewart, Neubert, & Mount, 1998; Dacko, 2001). We feel that this debate has missed an important decision factor that may explain both sides in the debate: consideration of the personality characteristics that contribute to a student learning as a qualifier to take Web-based courses. Our assertion is that it is not the course delivery, but the student, and in particular their personality that makes a difference in their eventual class performance. In the same way that students must qualify to be allowed to go to college, so too do we believe prospective students should qualify to be permitted to take Web courses by their personality characteristics.

LITERATURE REVIEW

It is well known that a Web-based *virtual learning environment* (VLE) offers benefits to students and instructors such as convenience and flexibility. A *total Web-based environment* (TWE) can be defined as a VLE that has no class meetings and little instructor contact. Interaction between the teacher and students may be limited to e-mails, online chat sessions, announcements posted on the Web, or, in emergency situations, a phone call. Everything students need in a TWE course is on the Web. One simplistic format of TWE is teaching an entire course or offering an entire degree via e-mail. Research has shown that TWE in this format may not be appropriate (Phoha, 1999), while others argue that depending on the course characteristics, TWE is a more effective format of teaching for some types of students (Decker, Frailey, McNell, & Mound, 2000).

The teacher's role in online TWE education is one of learning catalyst and knowledge navigator (Volery & Lord, 2000). Other researchers suggested that technology-mediated learning environments of TWE might actually improve students' achievement (Alavi, 1994; Hiltz, 1995; Maki, Maki, Patterson, & Whittmaker, 2000; Schutte, 1997; Wetzel, Radtke, & Stern, 1994), their attitudes toward learning (Schutte, 1997), and their evaluation of the learning experience (Alavi, 1994; Hiltz, 1995). Technology may also help to increase teacher/student interaction (Cradler, 1997; Hiltz, 1995; Schutte, 1997), and to make learning more student-centered (Cradler, 1997). Proponents of all types of VLEs suggest that they can potentially eliminate geographical barriers while providing increased convenience, flexibility, currency of material, student retention, individualized learning, and feedback over traditional classrooms (Kiser, 1999).

Most of these studies focused on the dimensions of a VLE such as learner satisfaction, interface design, or attitude of learners. For example, researchers studied students' interaction with computers in terms of educational theory (Leidner & Jarvenpaa, 1995), students' learning strategy (Jonassen, 1985), overall emphasis on analytical and planning skills (Dacko, 2001), and epistemological aspects (Jacobson & Spiro, 1995). However, some researchers suggested that effective learning in a VLE, compared to traditional classrooms, has been observed mostly for mature and motivated learners while less motivated and mature learners tend to suffer (Hiltz, 1995; Lawther & Walker, 2001). VLEs, especially TWE-based courses, have inherent problems in many hypermedia settings. Many users of

hypermedia systems have been found to lack the cognitive skills required to take full advantage of the medium (Heller, 1990; Trumbull, Gay, & Mazur, 1992). The unique cognitive skill characteristics that make up a student's abilities to be successful in a course appear from the literature to make a difference in the experience the student has in a course. Thus, it is important to examine if any students are significantly disadvantaged by the format of the course when they enrolled in a class offered as a TWE course due to characteristics, including their personality characteristics.

Generally, researchers agree that five robust factors of personality dimensions (i.e., extraversion, emotional stability, agreeableness, conscientiousness, and openness to experience), referred to as the "Big Five" can serve as a meaningful taxonomy for classifying personality attributes (Digman, 1990; Norman, 1963). Other researchers, such as Digman (1989), labeled these same five dimensions as extraversion/introversion (i.e., extraversion), neuroticism/emotional stability or anxiety (i.e., emotional stability), friendly compliance/hostile noncompliance (i.e., agreeableness), will to achieve (i.e., conscientiousness), and intellect (i.e., openness to experience). The labels of each dimension may slightly differ among the researchers but the definitions in Table 1 are those used in this study as defined by Wonderlic (Mount, Barrick, Laffitte, & Callans, 1999).

The Big Five model has been widely applied to predict job performance. For example, Barrick et al. (1998) investigated the relation of the Big Five personality dimensions to three job performance criteria (i.e., job proficiency, training proficiency, and personnel data) for five occupational groups (i.e., professionals, police, managers, sales, and skilled/semi-skilled). Results indicated that one dimension of personality (i.e., conscientiousness) showed consistent relations with all job performance criteria for all occupational groups. Extraversion was a valid predictor for two occupations involving social interaction, managers and sales (across criterion

Table 1: Big Five personality characteristics measured on Wonderlic questionnaire (adapted from Barrick & Mount, 1991).

Wonderlic® Personality Characteristics Inventory™ (PCI) Scales	Definitions
Conscientiousness	A tendency to be hardworking, dependable, efficient, and achievement striving.
Openness to experience	A tendency to be imaginative, cultured, curious, polished, original, broadminded, intelligent, and artistically sensitive.
Emotional stability	A tendency to handle stress, to maintain an even temperament, and to have a high degree of composure and self-confidence across most situations.
Extraversion	A tendency to be sociable, gregarious, talkative, assertive, adventurous, active, energetic, and ambitious.
Agreeableness	A tendency to be courteous, helpful, trusting, good-natured, cooperative, tolerant, and forgiving.

types). Both openness to experience and extraversion were valid predictors of the training proficiency criterion (across occupations).

The Big Five model was also applied to educational research. One study used the Big Five model to predict students' achievement when the subjects were graduating from high school (Digman, 1972). One dimension of the Big Five model, conscientiousness, is responsible for much of the variance in achievement left unexplained by aptitude measures (Digman, 1969). Wiggins, Blackburn, and Hackman (1969) conducted a longitudinal study of graduate school success in psychology at the University of Illinois. They found correlations "in the .50's and .60's" between grade average and measures of only one factor of the Big Five model. However, there remains a relative void in the literature regarding the relationship between personality dimensions of Big Five model and training outcomes (Mount & Barrick, 1998).

In a recent study of 140 undergraduate students, Kim and Schniederjans (2004) found that Big Five personality factors (i.e., agreeableness, conscientiousness, extraversion, emotional stability, and openness to experience) were related to student grade performance. They also found that the top 10% of their sample (i.e., high performers on exams) and lower 10% (i.e., low performers) could be differentiated from each other by using the personality scores on individual traits.

While the prior research has shown a connection to personality traits and student performance, the decision as to whether a student should take a TWE course or a more traditional environment course has not yet been answered. To make this decision, a student (and equally important for college student advisors) would ideally need some information as to how the student might perform in a TWE course (i.e., ideally a final grade estimate).

Building on the Kim and Schniederjans (2004) study, this research has two objectives. Our first objective is to confirm or refute with a larger sample size the existence of any significant relationships between students' personal characteristics and student grade achievement in a TWE environment reported by Kim and Schniederjans (2004). Given that some set of personality characteristics can be associated with student achievement, our second objective will be to determine if a multiple regression model can be used as an accurate means of predicting achievement in a TWE course based on personality characteristics, so as to provide useful decision-making information to students (and college advisors) for the decision to take Web-based courses or not.

Hypotheses

There are two hypotheses we seek to test in this study. The first hypothesis has five parts and deals with testing each of the Big Five personality dimensions one at a time. All hypotheses are stated in the null form. To understand how the personality characteristic relates to learning achievement, related literature is presented after each hypothesis statement:

H_{1a}: Conscientiousness is not significantly correlated with student achievement scores in a TWE course.

Conscientiousness reflects dependability; that is, being careful, thorough, responsible, organized, and planned (Botwin & Buss, 1989; Noller, Law, & Comrey, 1987). In addition, it incorporates volitional variables, such as hardworking, achievement-oriented, and persevering (Bernstein, Garbin, & McClellan, 1983; Costa & McCrae, 1988; Digman & Inouye, 1986). Because of these traits, conscientiousness has shown consistent relations with all job performance criteria for all occupational groups. Many of these traits are related to maturity that has been linked to academic success in VLEs (Leinden & Javenppa, 1995). Oliver, Omari, and Herrington (1998) reported that implementing classroom-based WWW learning activities as collaborative exercises and with guiding printed notes provides a number of instructional advantages over individual and unguided use. In a TWE course, conscientious is an important characteristic to affect learning effectiveness because there is less interaction between the teacher and student, requiring the student to be more self-conscientious about completing course assignments and exams. We expect to reject H1a.

H_{1b}: Openness to Experience is not significantly correlated with student achievement scores in a TWE course.

Openness to experience includes the tendency to be imaginative, curious, broad-minded, and intelligent. It also has a characteristic of being open to culture and different experiences. Openness was found to be a valid predictor of training proficiency but not for job proficiency (Barrick & Mount, 1991). This research posed the possibility that individuals who score high on this dimension are more likely to have positive attitudes toward learning experiences in general. Other researchers have shown that a key component in the success of training programs is the attitude of the individual, such as motivation, when they enter a training program (Goldstein, 1986; Ryman & Biersner, 1975). Similarly, Sanders and Vanouzas (1983) have shown that the attitudes and expectations of the trainees influence whether or not learning is likely to occur. Leinden and Javenppa (1995) found that motivation has been linked to academic success in VLEs. In this regard, measures of openness to experience may provide a good indicator of which individuals are “training ready.” In other words, it may be useful in identifying who are most willing to engage in learning experiences and who are most likely to benefit from training programs in TWE courses. It is possible that openness is actually measuring ability to learn as well as motivation to learn. Especially in TWE courses, each student needs to learn on their own. Thus, openness that includes positive attitude such as motivation could be a critical indicator of student’s success in a TWE course. We expect to reject H1b.

H_{1c}: Emotional stability is not significantly correlated with student achievement scores in a TWE course.

One of the main objectives of a TWE course is providing “learner control” to each student. Learner control refers to the freedom of learners when interacting with instructional materials. These freedoms enable learners to make such decisions as paths to follow through instructional materials, the scope and extent of inquiry into different domains, and the content that will be followed. Increasing learner control aids learning by individualizing the instruction and making it more motivating

(Steinberg, 1989). Typical TWE courses provide students with a high level of learner control.

While the proponents of TWE claim learner freedom is a favored attribute in a Web-based course, it has inherent problems in many hypermedia settings. Many users of hypermedia systems have long been found to lack the cognitive skills required to take full advantage of the medium (Heller, 1990; Trumbull et al., 1992). Often learners have insufficient knowledge of a subject or their own learning and cognition to be able to make the best decisions in terms of paths to follow and inquiry strategies to employ to bring about the acquisition of knowledge. While the process of creating an instructional environment where students assume a degree of autonomy and responsibility for their own learning is critical to learning success, providing a means to guide and direct learners can also be a successful instructional strategy. In addition, Piccoli, Ahmad, and Ives (2001) claimed that computer self-efficacy is an important aspect to predict learning effectiveness in a technology-enhanced course. We believe that self-confidence and stress handling capability have a strong relationship with computer self-efficacy because computer tasks are often stressful to many people. Those traits are integrated into a personality dimension of emotional stability. Thus, it is expected that a student with a high stability will perform much better than one who has lower stability especially in TWE learning environment. We expect to reject H1c.

H_{1d}: Extraversion is not significantly correlated with student achievement scores in a TWE course.

It is widely agreed (e.g., Botwin & Buss, 1989; Krug & Johns, 1986; McCrae & Costa, 1985) that extraversion has traits such as sociable, gregarious, talkative, and active that are important characteristics for predicting job performance that mainly require interpersonal dispositions such as sales or management. In addition, in some training, extraversion is a valid predictor of training proficiency across occupations because being active and sociable may lead individuals to be more involved in training and consequently learn more (Mount & Barrick, 1998). Some students need social interaction of a teacher and other students in a classroom setting to satisfy psychological conditioning that may have come from prior traditional classroom learning. However, in a TWE course environment, we believe that extraversion is not an important determinant of effective learning because one of the most widely agreed benefits of a VLE is the individualized, self-paced learning process. This is particularly true in a TWE and as such, we expect to accept H1d.

H_{1e}: Agreeableness is not significantly correlated with student achievement scores in a TWE course.

This dimension of personal characteristics represents the traits of being courteous, flexible, trusting, good-natured, cooperative, forgiving, and tolerant. We believe this dimension does significantly influence the learning outcome of a TWE course in that there is a need to be trusting in any virtual activity or learning situation (Duarte & Tennant-Snyder, 1999). There is also a need to be flexible, good-natured, understanding, and tolerant of technology and communication problems inherent in all TWE courses. As such, we expect to reject H1e.

The second hypothesis will use a multiple regression model for testing purposes in a similar manner to Kim and Schniederjans (2004). This study's results will depend on the set of useful predictive variables (i.e., the personality dimensions) selected for inclusion in the multiple regression model.

H₂ The mean predicted student achievement scores will not be significantly different from the actual mean student achievement scores for the sample used in this study.

Assuming the multiple regression model meets the necessary conditions to predict achievement scores, we expect to accept H₂.

METHODOLOGY

Survey Instrument, Validity, and Reliability

Students' personal characteristics will be measured using a questionnaire provided by Wonderlic, Inc. entitled the Wonderlic® Personality Characteristics Inventory™ (PCI) survey assessment instrument (Barrick & Mount, 1991; Mount et al., 1999; Wonderlic, 2004). This questionnaire has been recognized as a reliable tool by psychology researchers for over 50 years as a means to measure personality characteristics. It has been used widely to measure the Big Five personality characteristics as presented in Table 1.

We chose the Wonderlic PCI survey because we wanted to use an instrument that was easily attainable for commercial use by student advisors in universities and business practitioners who might want to apply this methodological approach to student screening for TWE courses (Mount et al., 1999). The survey instrument consists of 150 questions covering the Big Five scales. All of the scales are based on an index score ranging from 0% to 100%, where 100% represents a high degree of the particular personality characteristic. The PCI instrument's scales are designed to be used individually or together in models for predicting an individual's potential for being able to handle particular jobs or training. The PCI instrument scales are the basic measures of personality characteristics used in this study.

Wonderlic, Inc. reported overall the instrument validity being very high, such as the alpha coefficients for extraversion, .86; agreeableness, .82; conscientiousness, .87; emotional stability, .86; and openness to experience, .83 (Mount et al., 1999). Test-retest reliability is measured using various groups of business and education participants, which had an average reliability coefficient not lower than .77 for any group. Construct validity and criterion-related validity are well proven through numerous research studies (Mount & Barrick, 1998; Wonderlic, 2004, <http://www.wonderlic.com>).

Subjects, TWE Course Content, Variables, and Test Statistics

The subjects used in this study were students in two large sections of an undergraduate management information systems class for business majors at the University of Nebraska-Lincoln. A total of over 500 students voluntarily participated by filling out the PCI instrument. To minimize the possibility of bias caused by the voluntary nature of the sample and to satisfy the randomization requirement

of the regression analysis, a group of 260 final participants were randomly taken from the 500 students. The five personality scores, all ranging from 0 to 100 from the PCI instrument, were collected as the independent, predictive variables in this study.

The TWE course used in this study is a self-paced course delivered to students via the Web using the Blackboard Educational Software System. The same TWE course was used without any type of change in format, instructor, or educational pedagogy in both semesters when the data were collected. Students were required to use a textbook, its supplementary materials (e.g., CD-ROM), and instructor-prepared, Web-available MS PowerPoint slide presentations on each chapter as preparation for the exams. Four exams were required to complete the course, each worth 25 points, adding up to a possible total score of 100. This score was used as the actual achievement score or the dependent variable in this study.

To determine the relational significance in the hypotheses tests, we used a *t* test for the significance of Pearson product moment correlation coefficients (McClave & Benson, 1985, p. 418). To determine the significance of the set of variables in the multiple regression model, we used *t* tests for the individual multiple regression coefficients and an *F* test for the model as a whole. To examine the accuracy of the regression model in predicting student achievement scores, a second random sample of 50 students was used. Their PCI scores were input into the model to generate predicted achievement scores that could be compared with their actual achievement scores using a *t* test. All statistical tests were run on SPSS.

RESULTS

The randomly selected 260 undergraduate students in this study ranged in age from 19 to 31 years, with a mean of 22.1 years. Participation and use of the PCI instrument by the students met all the requirements suggested by the Wonderlic Organization to have a valid and reliable survey experience (Mount et al., 1999). To ensure a successful application of the survey instrument, accuracy statistics are provided to confirm the validity of each of the student's answers. These accuracy indices include measures of *self-presentation bias* (i.e., subject exaggerating their personality characteristics), three *response pattern bias* (i.e., subject's tendency to over or underselect one type of response on the questionnaire), and an *infrequency bias* (i.e., subject endorsed too many or too few items on the survey). Each of the 260 subjects used in this study fell within the acceptable range (i.e., indicating a valid subject response) as designated by PCI guidelines (Mount et al., 1999).

In addition, to support the reliability of measures in this study several tests were run. Churchill (1979) recommends the use of Cronbach's alpha as a measure of internal consistency, followed by item-to-total correlation to eliminate the items that performed poorly in capturing the construct. This is then followed by a split-halves coefficient test to measure the homogeneity (Pedhazur & Schmelkin, 1991). As it turned out, the Cronbach's alpha coefficients in this study were all above the suggested alpha coefficient value of .80 (Davis, 1995). The item-to-total correlation measures more than met the rule of thumb correlation value above .3 deemed to be adequate for good internal consistency (Spector, 1992). Finally, the split-halves coefficients which assess reliability by measuring homogeneity were above the necessary .80 value, considered as adequate for a reliability test (Nunnally, 1978).

To begin to confirm the aptness of the use of the multiple regression model (and the statistics used to test the hypotheses), a number of tests were conducted. To test the normality of the variables used in the study, Kline (1998, p. 81) suggests skewness and kurtosis can be used to test a distribution for non-normality. West, Finch, and Curran (1995) suggested the non-normality test could be done by interpreting the absolute values of the skewness and kurtosis indices. The skewness index values for the six variables in this study were all less than 2.0, indicating a nonskewed distribution. The resulting six kurtosis values were well below the 7.0 suggested by West et al. (1995), thus possessing little kurtosis. Based on these tests, we assume the distributions for all six variables lack substantial skewness or kurtosis to be considered non-normal, and therefore, can be assumed to meet the normality requirements sufficiently for conducting the statistical tests on the hypotheses.

Hypothesis H₁

The resulting Pearson correlation coefficients for the five tests used for H₁ are presented in Table 2. The results, as expected, confirm that four of the independent

Table 2: Correlations coefficients for H₁ tests.

Independent Variable	Hypothesis	Corr. Coeff. (<i>r</i>)	<i>p</i>	Hypoth. Decision
Conscientiousness	H _{1a} : Conscientiousness is not significantly correlated with student achievement scores in a TWE course.	.499	.000	Reject
Openness to experience	H _{1b} : Openness to experience is not significantly correlated with student achievement scores in a TWE course.	.488	.000	Reject
Emotional stability	H _{1c} : Emotional stability is not significantly correlated with student achievement scores in a TWE course.	.555	.000	Reject
Extraversion	H _{1d} : Extraversion is not significantly correlated with student achievement scores in a TWE course.	.098	.058	Accept
Agreeableness	H _{1e} : Agreeableness is not significantly correlated with student achievement scores in a TWE course.	.583	.000	Reject

variables (i.e., conscientiousness, openness to experience, emotional stability, and agreeableness) correlate highly with student achievement scores. The personality characteristic of extraversion is not significant even at a level of significance of .05. It is interesting to note that one of the two variables that was identified as having only a “moderate” relationship with achievement scores in the Kim and Schniederjans (2004) study had in this study the least significant results. The fact that the correlation significance level reported in the Kim and Schniederjans (2004) study (i.e., extraversion: p value of .044) was different maybe due to the increased sample size in this study. That is, the larger sample brings the potential for greater sampling accuracy, improving the chances of a more defined statistical result.

Hypothesis H₂

Utilizing a stepwise regression process, all five variables were examined initially to insure the exclusion of the extraversion variable was justified, and also to test for multicollinearity. The resulting F values were substantially improved by excluding the statistically insignificant extraversion variable. The resulting multiple regression model coefficients and t test beta coefficient values are presented in Table 3. All were statistically significant. The collinearity diagnostics provided by the SPSS package revealed no significant ($p < .001$) collinearity problems with the set of variables used in the model. The resulting analysis of variance had an F -test value for the model of 182.03939 with a p value of .000. The model's multiple r of .86060 with an r^2 value of .74063 is significant at $p < .001$. A visual review of the residuals showed no observable pattern or nonlinearity. The Durbin-Watson test statistic of 1.98761 revealed a very slight positive autocorrelation but was well within the statistical boundaries to accept the model's residuals as being uncorrelated (McClave & Benson, 1985, pp. 649–654) and normally distributed. Based on these results, we feel the multiple regression model in Table 3 meets the basic requirements (McClave & Benson, 1985, p. 452) for use as a predictive method to test H₂. We, therefore, choose to use just the four independent variables listed in Table 3 for the H₂ test.

The PCI scores of the second sample of 50 students were all within the ranges of the PCI scores used in the multiple regression model. This is important to avoid the common problem of making predictions outside the experimental region of the model parameters (McClave & Benson, 1985, p. 492). Using the PCI scores for the four independent variables in Table 3 from the second sample of 50 students,

Table 3: Regression model coefficients for H₂ test.

Independent Variable	Beta Coefficient	t	p
Conscientiousness	.258687	10.722	.000
Openness to experience	.245793	12.242	.000
Emotional stability	.212188	8.371	.000
Agreeableness	.219676	9.960	.000
Constant	49.573452	37.879	.000

their predicted achievement scores ranged from 41.203 to 98.678. As expected, that range was within the actual student achievement scores range from 40 to 99, supporting the credibility of the model. For the sample, the resulting mean for the predicted achievement scores was 81.263 (SD 16.454) and the actual achievement mean score was 81.320 (SD 16.450). The correlation between the two sets of values turned out to be near perfect at .999 ($p = .000$). Comparing the two means resulted in a t -test value of only .650 ($df = 49$), supporting the assertion that there is no statistically significant ($p = .518$) difference or inaccuracy in the forecast values between the actual and predicted student achievement scores. We therefore accept H_2 , and conclude that multiple regression model did accurately predict the group of student achievement scores.

While the regression model has been shown to be an acceptable predictive tool when looking at a group of achievement scores, its application in the decision situation of course selection is more assured by some additional analysis. The intent of this article was to show that the model could be used to forecast or predict achievement scores for individual student's decision making, so a further comparison showing the individual results is justified. To provide users with some idea as to what students and student advisors might expect as a possible error value in estimating a particular student's achievement score might be, we examined the accuracy of the regression model by comparing each of the individual achievement scores predicted by the model using the *mean squared error* (MSE) statistics from field of forecasting (Heizer & Render, 2004, p. 114). The resulting MSE for the sample of forecast values is .396214. Adding three times plus or minus the MSE reveals the 99% expected range of error possible from a given student's achievement score on the PCI. In this study, it means that a student's score should fall within ± 1.189 points of their forecast achievement score using the multiple regression model and their PCI scores for the four independent variables. Comparing the sample of 50 student achievement scores, all 50 scores fell within the ± 1.189 point range. We conclude from this sample result that the multiple regression model can be highly accurate in providing student course achievement information. Such information can be useful in predicting student outcomes in Web courses and in turn might act as a guide for the student in the decision to choose this format of instruction.

DISCUSSION

Unlike the original study by Kim and Schniederjans (2004), where all of the Big Five PCI characteristics including extraversion were found to be statistically significant, our study found that only four of the characteristics (i.e., conscientiousness, openness to experience, emotional stability, and agreeableness) are significant predictors of grade performance in a TWE course. Based on the literature and our results, we found that extraversion is not an important determinant of effective learning in the TWE course environment. Students who psychologically need a more social setting that offers extraversion characteristics of social recognition, opportunities to verbally communicate and interact with others, logically, will not be as motivated to achieve in a TWE educational setting. It should be noted that of the Big Five PCI characteristics in the Kim and Schniederjans (2004) study,

extraversion had the weakest relationship with only moderate statistical significance (i.e., $p = .044$). We feel that the results of this larger sample-based study improved the precision of the statistical tests and helped to clarify the less conclusive findings in Kim and Schniederjans (2004).

The ability of the regression model to provide predictions that will forecast a possible achievement score in a course students have yet to take is probably the most ideal piece of information they could have on which to make a decision about taking a course format. Why? Because it may represent the best summery measure of how much a student may learn in the course. While the accuracy of the particular model will vary by the nature of data used, this paper has shown just how precise or accurate a model that predicts achievement can be.

Implementation Issues

Most university faculty will agree that TWE courses are growing on campuses and will continue to serve larger numbers of students in the future (Buckman, 2002). On the other hand, there are those who also feel that TWE is only appropriate for a limited number of courses in any educational program (Phoha, 1999; Decker et al., 2000). We agree with both of these groups and suggest that the use of the regression model for aiding course decision making be applied only where it will be most effective by the nature of the volume or cost of decisions that will be made. We suggest that the model screening be used in either large classroom settings or where the cost of instruction is excessively high (the latter may be more common in industry). Since Hiltz (1995) and others have found that students may not fare well under VLE courses, it is important to help those students avoid an undesirable learning experience that will not make best use of the unique personality characteristics they bring to their learning experience. The original study by Kim and Schniederjans (2004) supports this observation and the results of study have confirmed its likelihood in a TWE environment.

To generalize the predicting model developed in this article to other courses may require additional study including several courses in many different disciplines because of the differences in content and pedagogic issues. But the methodological approach can be used immediately for any TWE course. Because the large-section courses tend to be in the minority of course offerings at universities, the amount of model development effort is not unreasonably impractical. We believe that a sample of only a couple of semesters in each large class, such as was used in this study, will be adequate to develop a regression model useful for predictive purposes. The model, once developed, would only need to be revised when a substantial change (e.g., possibly a pedagogy change or instructor change) is implemented. The PCI survey instrument is available from Wonderlic, Inc. worldwide and takes only minutes to administer. The regression model can easily be placed into a spreadsheet system for students or student advisors to determine the student potential in the course and to provide information on the decision to take the TWE course or not.

University-wide screening might also be practical. By using the PCI survey instrument (or one developed by the university), a general guide of student

performance based on multiple courses might also be developed to serve as a screening guide for all Web classes. Developing a model on a wider spectrum of classroom experiences might not result in as statistically accurate a result as models developed for individual classes, but it may serve as general guide to aid in student Web course placement. Requiring the survey to be taken by students could be implemented as a condition to take any Web course. University administrators could then either disqualify students based on their score or just use the information in an advisory capacity to allow the student to make their own decision. Over time and with the continued collection of new data, the resulting regression model might become increasingly more accurate and useful.

CONCLUSIONS

The research presented in this article supports the conclusion that four personality characteristics (i.e., conscientiousness, openness to experience, emotional stability, and agreeableness) of the Big Five are highly correlated to student achievement in college Web course work. Moreover, the results also reveal that multiple regression can be used to formulate a predictive model that can be used to accurately (within the limits stated in the article) predict or forecast a student's possible achievement score in a course. Such information might be useful to guide a student in the decision of choosing a TWE course approach or to take a more traditional classroom course format. This type of decision is important now and will grow in importance as the TWE course format grows to meet student needs.

While screening methods, such as the PCI survey instrument, can be costly, schools might be able to develop their own less expensive instruments. Also, the continual development and research on such instruments can offer researchers opportunity for interesting joint research in a wide variety of disciplines. Indeed, further research on the use of other decision science methods for predicting student achievement is recommended for future research.

One final comment on one of the motivations behind this study is worth mentioning. We have been teaching TWE courses since 1998. In reviewing many student evaluations over that time, it has become quite apparent that a thankfully small portion of the students really disliked the TWE experience. One student put it this way, "This is my first Web course and my last. I didn't learn a thing." It is a disservice to students like that to end up taking a TWE course when alternative traditional classroom course sections are available. With proper screening, using methods like those presented in this article, such a student might have avoided wasted effort and received a better quality educational experience in a traditional classroom setting (and we might have had a slightly higher student evaluation). [Received: March 2004. Accepted: October 2004.]

REFERENCES

- Alavi, M. (1994). Computer-mediated collaborative learning: An empirical evaluation. *MIS Quarterly*, 18(2), 159-174.

- Barrick, M. R., & Mount, M. K. (1991). The Big Five personality dimensions and performance: A meta-analysis. *Personnel Psychology, 44*(1), 1–26.
- Barrick, M. R., Stewart, G. L., Neubert, M. J., & Mount, M. K. (1998). Relating member ability and personality to work-team processes and team effectiveness. *Journal of Applied Psychology, 83*(3), 377–391.
- Bernstein, I. H., Garbin, C. P., & McClellan, P. G. (1983). A confirmatory factoring of the California Psychological Inventory. *Educational and Psychological Measurement, 43*, 687–691.
- Botwin, M. D., & Buss, D. M. (1989). Structure of act-report data: Is the five-factor model of personality recaptured? *Journal of Personality & Social Psychology, 56*, 988–1001.
- Buckman, A. (2002). The future of e-learning communities. *Communications of the ACM, 45*(4), 60–63.
- Cradler, J. (1997). *Summary of current research and evaluation of findings on technology in education*. Working paper. San Mateo, CA: Educational Support Systems.
- Churchill, G. A. (1979). A paradigm for developing better measures of marketing constructs. *Journal of Marketing Research, 16*, 64–73.
- Costa, P. T., Jr., & McCrae, R. R. (1988). From catalog to classification: Murray's needs and the five-factor model. *Journal of Personality & Social Psychology, 55*, 258–265.
- Dacko, S. G. (2001). Narrowing skill development gaps in marketing and MBA programs: The role of innovative technologies for distance learning. *Journal of Marketing Education, 23*(3), 228–239.
- Davis, D. (1995). *Business research for decision making*. Belmont, CA: Wadsworth.
- Decker, T., Frailey, D., McNell, E., & Mould, D. (2000). Forum: Debating distance learning. *Communications of the ACM, 43*(2), 11–15.
- Digman, J. M. (1972). High school academic achievement as seen in the context of a longitudinal study of personality. Paper presented at the Annual Convention of the American Psychological Association, Honolulu, HI.
- Digman, J. M. (1989). Five robust trait dimensions: Development, stability, and usability. *Journal of Personality, 57*(2), 195–214.
- Digman, J. M. (1990). Personality structure: Emergence of the five-factor model. *Annual Review of Psychology, 41*, 417–440.
- Digman, J. M., & Inouye, J. (1986). Further specification of the five robust factors of personality. *Journal of Personality & Social Psychology, 50*, 116–123.
- Duarte, D. L., & Tennant-Snyder, N. (1999). *Mastering virtual teams: Strategies, tools, and techniques that succeed*. San Francisco: Jossey-Bass.
- Goldstein, I. L. (1986). *Training in organizations: Needs assessment, development, and evaluation*. Monterey, CA: Brooks/Cole.

- Heizer, J., & Render, B. (2004). *Operations management*, 7th ed. Upper Saddle River, NJ: Pearson/Prentice Hall.
- Heller, R. (1990). The role of hypermedia in education: A look at the research issues. *Journal of Research on Computing in Education*, 22(4), 431–441.
- Hiltz, S. R. (1995). Teaching in a virtual classroom. *International Journal of Educational Telecommunications*, 1(2), 185–198.
- Jacobson, M. J., & Spiro, R. J. (1995). Hypertext learning environments, cognitive flexibility, and the transfer of complex knowledge: An empirical investigation. *Journal of Education Computing Research*, 12(4), 301–333.
- Jonnassen, D. H. (1985). Learning strategies: A new educational technology. *Programmed Learning and Educational Technology*, 22(1), 26–34.
- Kim, E., & Schneiderjans, M. J. (2004). Considering personality characteristics in totally web-based distance education courses. *Communications of the ACM*, 47(3), 95–98.
- Kiser, K. (1999). 10 things we know so far about online training. *Training*, 36(11), 66–74.
- Kline, R. B. (1998). *Principles and practices of structural equation modeling*. New York: Guilford.
- Krug, S. E., & Johns, E. F. (1986). A large scale cross-validation of second-order personality structure defined by the 16PF. *Psychological Reports*, 59, 683–693.
- Lawther, P., & Walker, D. (2001). An evaluation of a distributed learning system. *Education + Training*, 43(2/3), 105–116.
- Leidner, D. E., & Jarvenpaa, S. L. (1995). The use of information technology to enhance management school education: A theoretical view. *MIS Quarterly*, 19(3), 265–291.
- Maki, R. H., Maki, W. S., Patterson, M., & Whittmaker, P. D. (2000). Evaluation of a web-based introductory psychology course: Learning and satisfaction in on-line versus lecture courses. *Behavior Research Methods, Instruments, and Computers*, 32(2), 230–239.
- McClave, J. T., & Benson, P. G. (1985). *Statistics for business and economics*. 3rd ed.. San Francisco: Dillion Publishing.
- McCrae, R. R., & Costa, P. T., Jr. (1985). Updating Norman's adequate taxonomy: Intelligence and personality dimensions in natural language and in questionnaires. *Journal of Personality & Social Psychology*, 49, 710–721.
- Mount, M. K., & Barrick, M. R. (1998). Five reasons why the 'Big Five' article has been frequently cited. *Personnel Psychology*, 51(4), 849–857.
- Mount, M. K., Barrick, M. R., Laffitte, L. J., & Callans, M. C. (1999). *Administrator's guide for the personal characteristics inventory*. Technical manual. Libertyville, IL: Wonderlic.

- Noller, P., Law, H., & Comrey, A. L. (1987). Cattell, comrey, and eysenek personality factors compared: More evidence for the five robust factors? *Journal of Personality and Social Psychology*, *53*, 775–782.
- Norman, W. T. (1963). Toward an adequate taxonomy of personality attributes: Replicated factor structure in peer nomination personality ratings. *Journal of Abnormal & Social Psychology*, *66*, 574–583.
- Nunnally, J. C. (1978). *Psychometric theory*, 2nd ed.. New York: McGraw-Hill.
- Oliver, R., Omari, A., & Herrington, J. (1998). Investigating implementation strategies for WWW-based learning environments. *International Journal of Instructional Media*, *25*(2), 121–138.
- Pedhazur, E. J., & Schmelkin, L. P. (1991). *Measurement, design, and analysis: An integrated approach*. Hillsdale, NJ: Erlbaum.
- Phoha, V. V. (1999). Can a course be taught entirely via e-mail? *Communications of the ACM*, *42*(9), 29–30.
- Piccoli, G., Ahmad, R., & Ives, B. (2001). Web based virtual learning environment: A research framework and a preliminary assessment of effectiveness in basic IT skills training. *MIS Quarterly*, *25*(4), 401–426.
- Rockwell, S. K., Schwauer, J., Fritz, S. M., & Marx, D. B. (2002). Incentives and obstacles influencing higher education faculty and administrators to teach via distance. <http://www.westga.edu/~distance/rockwell24.html>.
- Ryman, D. H., & Biersner, R. J. (1975). Attitudes predictive of training success. *Personnel Psychology*, *28*, 181–188.
- Sanders, P., & Vanouzas, J. N. (1983). Socialization to learning. *Training and Development Journal*, *37*, 14–21.
- Schutte, J. G. (1997). Virtual teaching in higher education: The new intellectual superhighway or just another traffic jam? Northridge, CA: California State University (available at <http://www.csun.edu/sociology/virexp.htm>).
- Spector, P. E. (1992). *Summated rating scale construction: An introduction*. Sage University Paper Series on Quantitative Applications in the Social Sciences, Newbury Park, CA: Sage.
- Steinberg, E. (1989). Cognition and learner control: A literature review, 1977–1988. *Journal of Computer-Based Instruction*, *16*(4), 117–121.
- Trumbull, D., Gay, G., & Mazur, J. (1992). Students' actual and perceived use of navigational and guidance tools in a hypermedia program. *Journal of Research on Computing in Education*, *24*(3), 315–328.
- Volery, T., & Lord, D. (2000). Critical success factors in online education. *International Journal of Educational Management*, *14*(5), 216–224.
- West, S. G., Finch, J. F., & Curran, P. J. (1995). Structural equation models with no-normal variables: Problems and remedies. In R. H. Hoyle (Ed.), *Structural equation modeling*. Thousand Oaks, CA: Sage, 56–75.
- Wetzel, C. D., Radtke, P. H., & Stern, H. W., (1994). *Instructional effectiveness of video media*. Hillsdale, NJ: Erlbaum.

Wiggins, N., Blackburn, M., & Hackman, J. R. (1969). The prediction of first-year success in psychology. *Journal of Educational Research*, 63, 81–85.

Wonderlic. (2004). *Wondelic®2004 resource guide*. Libertyville, IL: Wonderlic, Inc. (available at <http://www.wonderlic.com>).

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