Predicting Academic Performance in an Introductory College-Level IS Course

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This study describes a model to predict academic performance in an introductory college-level information systems course. We base the model on one developed by Eskew and Faley (1988) to predict grades in accounting classes. We collected data from students in four sections of an introductory college-level IS class at a single university. Motivation and GPA predict performance. Prior related courses do not predict performance. Unexpectedly, SAT predicts performance for male students but not for female students. We discuss these findings and suggest what faculty members can do to improve performance in the class.

Introduction

Recruiting and developing information systems professionals are consistently identified as key issues facing information systems managers (Brancheau, Janz, & Wetherbe, 1996). The information systems (IS) profession is one of the fastest growing occupations, and the demand for IS professionals is expected to continue to grow over the next several years (Bureau of Labor Statistics, 2002-2003). Many sources, however, report a widening gap between the demand for IS workers and the supply of such workers (e.g., Bureau of Labor Statistics, 2002-2003; Dash & Johnston, 2000). The number of graduates entering the IS workforce has declined and is well below demand (Schambach & Blanton, 2001). The number of women in the field has declined since 1986, further exacerbating this gap (Carver, 2000). To staff the IS profession adequately, we need to make sure that a sufficient number of students are completing information systems degrees. One of the ways to ensure students complete information systems degrees is to assure success in the early information systems classes. In particular, low grades in the early required classes account for much of the attrition of women from scientific and mathematics classes (Strenta, Elliot, Adaire, & Scott, 1994).

This paper develops a model to predict academic performance in the first college-level IS course. We base this model on one previously developed by Eskew and Faley (1988) who used it in accounting classes. This paper describes prior research in this area, our research model, the methodology used to test this model, the research results, and a discussion of those results.

Prior Research

What determines academic performance? Prior research shows that standardized measures of aptitude (e.g., SAT scores), prior academic performance, and effort or motivation explain a significant portion of the variation in class performance (e.g., Eskew & Faley, 1988; Grabe & Latta, 1981). Eskew and Faley (1988) developed a model to explain student performance in an introductory college-level financial accounting course. Their model showed that previous accounting experience in high school and college explained some of the variance in academic performance. We used a variation of this model to try to predict academic performance in an introductory college level IS course.

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When universities determine which students to admit, typical criteria include SAT, ACT or other achievement scores and high school GPA. Many studies show that these measures were the best predictors of college success (e.g., Camara & Echternacht, 2000; Garton, Dyer, & King, 2000). In their meta-analysis of such studies, Camara and Echternacht (2000) found that, predicting either first-year college GPA or individual course grades, the typical R^2 was about .70 and was significant. To predict further success in college, the best predictor tended to be college GPA (Camara & Echternacht, 2000).

SAT Scores

Much work has been done on whether the SAT is the best predictor of success for all college students, including analysis by race, gender, and economic background. Since the number of women in IS has dropped since 1986 (Carver, 2000), we are concerned with whether the model consistently predicts success for both male and female students. A recent meta-analysis done by the College Board concluded that the SAT predicts academic success equally well for men and women (Camara & Echternacht, 2000). Slight differences in predictions have been found; for example, one study showed that the SAT score tends to over predict male first year GPA and under predict female first year GPA at selective colleges and universities, but this pattern is reversed at less selective colleges and universities (Bridgeman, Jenkins, & Ervin, 1999). All studies suggest, however, that the SAT predicts college grades. Thus, the SAT is part of this study's model to explain grades in an introductory college-level IS course.

Present Academic Performance

As stated above, one of the best predictors of future college GPA is current college GPA (Camara & Echternacht, 2000). Numerous studies find that college GPA predicts performance in a single class (e.g., Eskew and Faley, 1988; Marcal and Roberts, 2000; Sexton, Hignite, Margavio, & Satzinger, 2001). Accordingly, this study's model includes GPA as a predictor of class performance.

Motivation/Effort

The third of the three variables that prior research relates to the prediction of grades in college courses is student motivation or effort. In a meta-analysis of numerous educational and psychological studies, Uguroglu and Walberg (1979) concluded that the mean correlation between motivation and academic achievement measures is .338. Uguroglu and Walberg looked at younger students and found that the prediction measures improve in the higher grades. In research on college students, Grabe and Latta (1981) found that motivation strongly predicted achievement, with the prediction higher for male students than female students. Cote and Levine (2000) concluded that motivation was a stronger predictor of college achievement than intelligence as measured by IQ score.

Measures of motivation are varied. Many studies measure motivation using survey questions (e.g., Cote & Levine, 2000). Other studies use a measure of effort such as performance on early quizzes or homework (e.g., Eskew & Faley, 1988; Wolfe, 1981). The reasoning behind such measures is that many college classes have numerous homework assignments or quizzes where some number of these assignments are either optional or the lowest grades are dropped. Usually the homework and quiz grades are a small percentage of the final grade. The more motivated students will do the earlier homework and quizzes and score higher grades than the less motivated students. As Orpen (1998) notes, procrastination is negatively associated with academic performance. We will use early homework grades to measure motivation in our model to predict performance.

Prior Related Courses

Unlike the other measures discussed above, studies have found mixed results about the relationship between performance in prior related classes and performance in a later class (Eskew & Faley, 1988). Eskew and Faley found that both previous accounting courses and a previous similar course

contributed to the explanation of performance in an introductory college-level financial accounting class. Marcal and Roberts (2000) found, however, that a computer literacy prerequisite was not associated with student performance in a business communication class. Numerous studies have been done in economics showing that prior economics or calculus classes tend to be associated with performance in a college-level economics class (e.g., Butler, Finegan, & Siegfried, 1994; Durden & Ellis, 1995). In contrast to these economics and accounting results, Sexton et al. (2001) found that prior courses in IS do not predict IS GPA. Because the preponderance of the research indicates that prior courses do affect GPA, we include prior IS courses in our model as a potential predictor of academic performance.

Prior IS Research

No published IS research has looked at the same model (SAT scores, present academic performance, motivation/effort, and prior course-related courses) for prediction of success in an IS course. More typical of the IS literature are models that look at computer efficacy or learning styles to predict performance, such as Chamillard and Karolick (1999). Sexton et al. (2001) used a different method to predict success in the IS major in general. They used a genetic algorithm to predict success and found that neither the hours of IS courses taken nor the ACT score predicted the IS major GPA.

Measures

We summarize the independent variables used in this study in Table 1. The academic aptitude and present academic performance measures are straightforward and are based on prior studies (e.g., Eskew & Faley, 1988; Grabe & Latta, 1981). The academic aptitude variable is based on SAT score, and the present academic performance variable is based on collegiate GPA. We developed a measure of effort or motivation based on scores on early homework assignments in the first IS course. Homework in this course is assigned weekly, with the two lowest homework grades dropped. Wolfe (1981) used weekly quiz grades as a measure for effort. She found that the grades on the first five quizzes (out of fifteen) were highly predicative of final grades. Eskew and Faley (1988) used the number of quizzes taken for a measure of effort and motivation. We used homework grades (following Wolfe) but compared that measure with the number of homework assignments completed (as used by Eskew and Faley) because the two models yielded the same results. The measure of previous exposure to the same subject area is student self-reported and could be based on a high school course, community college course, or other university course for transfer students. The final predictor is exposure to computer programming, which was also self-reported.

Our dependent variable, academic performance in the first college-level IS course, is determined by the final course grade and reported by the instructor of the course. Grades were assigned by two different faculty members; therefore, the z-score of the final semester grade was used as the dependent variable.

Objectives of This Study

The objective in this study was to predict academic performance in an introductory college-level IS course. The first hypothesis was that the model would be similar to the model used in other disciplines.

Hypothesis 1: Academic aptitude, present academic performance, effort/motivation, previous exposure to the same subject material, and previous

Table 1: Independent Variables & Measures

Independent Variable	Measure
Academic Aptitude	SAT Score
Present Academic Performance	Collegiate GPA
Effort/Motivation	Grades on First Third of Homework Assignments Completed
Previous Exposure to Same Subject Material	Yes or No
Previous Exposure to Programming Classes	Yes or No

exposure to programming classes will relate to academic performance in the first college-level IS course.

The second hypothesis was stated as a null hypothesis. The proposed model for student performance was the same for males and females.

Hypothesis 2: The model for academic performance will not be affected by the individual's gender.

Methodology

The participants for this survey included students enrolled in a required introductory information systems course at a single university. This class was a survey class describing how computers are used in business today. All business students are required to take this course, usually in their sophomore year. We collected data in three ways:

1. We surveyed students about prior computer classes using a written questionnaire. The survey instrument was created by us and included general demographic questions (e.g., rank, credit hours, gender) and course specific questions (e.g., expected grade, work experience, school experience).
2. We base motivation data (homework grades) and performance data on the two professors' grade sheets for the classes. The homework was based upon the lecture and the book and collected weekly. The students' two lowest homework scores were dropped.
3. SAT scores and college grades were collected from the registrar's office. Participation was voluntary and students were assured that their participation or lack of participation would not influence their course grades. We asked students to provide their written consent for data collection from the professors and the registrar.

We analyzed the data using regression analysis to check the model and check for gender moderating effects.

Results

We collected data in April 2001 in four sections of the required introductory information systems class at a single university. Two different faculty members taught the four sections. Ninety-four students provided usable responses. The response rate was 46%. Eighteen percent were computer information systems majors, and the majority (78%) were other business majors, with only four participants being non-business majors. The majority (88.3%) were sophomores, and the average college credit earned in prior semesters was just over 50 hours (range 24-74 with the one outlier of 149 hours). The average GPA was 2.9 (range 1.8-4.0) on a 4.0 scale. We collected previous college credit earned and GPA from college transcripts. Table 2 summarizes the demographics of the sample.

Hypothesis 1: Academic aptitude, present academic performance, effort/motivation, previous exposure to the same subject material, and previous exposure to programming classes relate to academic performance in the first college-level IS course.

Table 2: Demographic Statistics

Variable		Summary Statistics
Gender	Male	n = 46 48.9%
	Female	n = 48 51.1%
Major	CIS	n = 17 18.1%
	Computer Science	n = 1 1.1%
SAT	Verbal	$\bar{x}$ = 568.5
	Mathematics	$\bar{x}$ = 598.0
	Total	$\bar{x}$ = 1166.5
College GPA		$\bar{x}$ = 2.9
Class	Freshman	n = 1 1.1%
	Sophomore	n = 83 88.3%
	Junior	n = 9 9.6%
	Senior	n = 1 1.1%
College Credits		$\bar{x}$ = 50.9

This hypothesis was partially supported. The model used for prediction of academic performance in prior studies yielded an adjusted R^2 of .57. Not all relationships were significant, however. It was particularly interesting that the SAT score was significant only at the .06 level. The relationship of present academic performance and effort/motivation were significant, similar to previous studies. Neither taking a similar course prior to this course nor taking programming classes was significant. The regression results are shown in Table 3.

Hypothesis 2: The model for academic performance is not affected by the individual's gender.

To test this hypothesis, we used the partial model that predicted academic performance from Hypothesis 1. We found that gender did matter in the model; thus, Hypothesis 2 was not supported. SAT scores did not predict academic performance for female students. This result is highly unusual as SAT scores have been shown to predict academic performance in a single class or in all college classes in numerous studies (Camara & Echternacht, 2000). Table 4 shows the results for males, Table 5 for females.

Table 3: Hypothesis 1—Test of the Model for All Students

Adjusted R^2	.5687		
ANOVA	F = 21.44, significance .0000		
Independent variables	P-value	Standardized coefficient	t statistic
Intercept	.0000		-6.791
SAT Score (Academic aptitude)	.0604	.149	1.902
Present Academic Performance (College GPA)	.0009	.277	3.425
Effort/Motivation	.0000	.643	7.995
Previous Exposure to Same Subject Material	.9277	.116	1.610
Previous Exposure to Programming Classes	.1111	.007	.091

Table 4: Hypothesis 2—Test of the Model for Male Students

Adjusted R^2	.5590		
ANOVA	F = 15.26; significance .0000		
Independent variables	P-value	Standardized coefficient	t statistic
Intercept	.0000		-5.969
SAT Score (Academic aptitude)	.0365	.237	2.162
Present Academic Performance (College GPA)	.0225	.271	2.372
Effort/Motivation	.0000	.627	5.903

Table 5: Hypothesis 2—Test of the Model for Female Students

Adjusted R^2	.5842		
ANOVA	F = 17.51; significance .0000		
Independent variables	P-value	Standardized coefficient	t statistic
Intercept	.0003		-3.961
SAT Score (Academic aptitude)	.6939	.048	.396
Present Academic Performance (College GPA)	.0236	.273	2.347
Effort/Motivation	.0000	.644	5.327

Discussion

We find that the accounting model provides an explanation of students' performance in an introductory college-level IS course in that motivation and GPA predict performance. We did not find a relationship between prior related courses and performance. This lack of a relationship, while different from Eskew and Faley's model, is not unprecedented (e.g., Marcal & Roberts, 2000;

Sexton et al., 2001). We did find one very surprising result, however: SAT predicts performance for male students but not for female students. Why does the typical model for academic performance not explain female students' performance in this class? While other studies have found that college GPA and motivation are better predictors than the SAT score, none have found that the SAT score is non-significant. We speculate that this result is connected to the fact that fewer women are interested in IS as a major (e.g. De Palma, 2001; Fox, Hindi, & Remington, 2001). The first college-level IS class is a required class for all business students, and perhaps more women are in the class under duress rather than because they are interested in the field. Because of this, a student's effort may be more important than his or her aptitude. The standardized regression coefficients indicate that effort is the most important contributor to performance. Both motivation, which reflects effort, and college GPA, which reflects prior effort in the classroom, were associated with women's performance in the course. We suggest future research into this area. Attitudes toward IS in general and the class in particular may moderate the relationship between SAT and performance.

Conclusions, Implications, and Recommendations

The paper developed a model based upon one developed by Eskew and Faley (1988) to predict grades in an introductory IS course. We found that motivation and GPA do predict performance and that prior related courses do not predict performance. Unexpectedly, we found that SAT scores predict performance for male students but not for female students.

For IS faculty, this study can indicate which students might be at risk for failure in their first college-level IS course. Effort/motivation is strongly associated with success in this course, so failure to turn in the first few assignments can serve as an early warning indicator for potential failure. The professor should monitor this signal and use early remediation.

There are several limitations of this study. First, the participants were from one university and one course, which could bias the results. Second, the sample size may be too small to generalize. Further research should include participants from other institutions to rule out university bias. A larger, more diverse sample is needed to generalize the results.

In addition to the research implications, faculty members should take the opportunity during this first computer class to correct misconceptions that students may have about IS as a career and to encourage female students. Perhaps female students are more likely to view IS as the career for programmers rather than as a creative, people-oriented field. Fox et al. (2001) found that students who have these beliefs are far less likely to choose IS as a major. Faculty members should actively encourage and mentor female students in the major (Cohoon, 2001). We recommend further research to determine if this gender difference continues to hold throughout the IS degree path and to determine if attitude may moderate the significant relationships.

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