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Attracting Students to the IS Major: The Role of IT Sophistication in Introductory IS Courses

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Abstract

The Information Systems (IS) discipline is facing an enrollment crisis. Despite the steady decline in IS enrollments, the demand for information technology (IT) professionals continues to increase. Using a survey of 151 students enrolled in introductory IS courses at two universities, this study investigates the role that the level of technological sophistication plays in attracting students to the IS discipline. Grounded in Social Cognitive Theory, the study finds that the degree to which students perceive the IT taught in introductory IS courses as sophisticated affects student aspiration to pursue an IS degree. Specifically, IT sophistication enhances students' confidence in their ability to successfully perform as an IS major (i.e., self-efficacy) and elevates students' expectations that valued rewards will be received by majoring in IS (i.e., outcome expectations). In turn, strong self-efficacy and outcome expectations foster student interest in the IS discipline. Interest serves as the primary mechanism through which goals to choose the IS major emerge.

Keywords: Information systems education, curriculum, enrollment, recruitment, social cognitive career theory

Introduction

A paradoxical situation confronts the Information Systems (IS) discipline. On one hand, the number of IS majors has declined nationwide (George et al., 2005). On the other hand, the demand for information technology (IT) professionals continues to accelerate (Hecker, 2004). If these trends persist, there will be a severe shortage of qualified IT employees in the near future. In order to overcome this dilemma, it is vital for educators to develop and implement programs to attract larger pools of students to the IS field.

Even though the IT community has been aware of the enrollment decline and its potential consequences, very little academic research has been conducted in this area (Lomerson and Pollicia, 2006). Despite the lack of empirical data, George et al. (2005) express the important role that introductory IS courses can play in enhancing student recruitment efforts. According to this line of logic, these courses provide a unique opportunity to attract students to the IS major, as most students enrolled in these courses have yet to finalize their decisions about which major to pursue. In particular, when the pedagogical process fosters a productive learning environment, students might be more likely to develop aspirations to choose IS as their primary field of study. Therefore, it is imperative for IS programs to carefully choose the content, instructors, and IT, as selecting inappropriate resources can reduce the course effectiveness and stifle student recruitment. In terms of IT, George et al. (2005) suggested that the IT taught in introductory level courses should reflect current industry practices and utilize contemporary applications. In other words, the IT should be sophisticated. In introductory IS courses, the use of sophisticated IT, such as Enterprise Resource Planning (ERP) systems and computer-based learning (CBL) (e.g., TAIT), continues to grow rapidly (Kegely, 2006). However, the sophistication of these technologies varies considerably across institutions and academic settings. Although reports indicate that more sophisticated technologies produce desirable organizational outcomes (Chwelos

et al. 2001), their affect on student learning and recruitment remains an open empirical issue. Therefore, this study addresses the research question of whether the level of IT sophistication in introductory IS courses influences student uptake.

The remainder of this paper is organized as follows. The next section provides a brief overview of the underlying theory base. A research model and an interrelated set of hypotheses are then put forth. The research methodology is subsequently outlined and the results presented. The paper concludes with a discussion of the findings and implications.

Background and Theoretical Development

This study utilizes Social Cognitive Theory (SCT) (Bandura 1986, 1997) and Social Cognitive Career Theory (SCCT) (Lent et al., 1994) to investigate the role of IT sophistication on students choice of IS as their major. SCT, as illustrated in Figure 1, is a robust and empirically validated model of individual behavior that has been extensively utilized in the IS field. SCT views psychosocial phenomena as mutually and reciprocally determined by environmental, personal, and behavioral factors (Bandura, 1986).

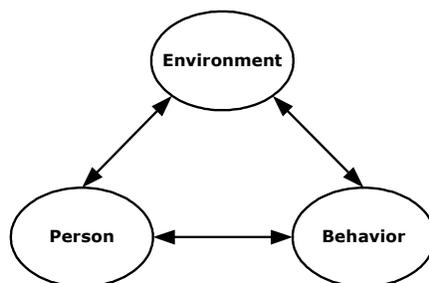


Figure 1. Social Cognitive Theory (Bandura 1986)

The majority of career choice and development models recognize that career-related behaviors are shaped by personal and environmental factors. As such, SCT provides an excellent framework that can be utilized to investigate the influences that these diverse yet interrelated factors can have on career development and behavior (Lent et al., 1994). Derived from SCT, SCCT represents a specific instantiation that focuses on the interplay among environmental, personal, behavioral factors to understand the development of academic and vocational interests, selection and pursuit of career-relevant choices, and performance and persistence in academic and vocational endeavors (Lent et al., 1994).

Environmental Factors. Environmental factors encompass the temporal and spatial forces beyond an individual's boundaries (Bandura, 1986). These factors can influence and be influenced by behavioral and personal factors. According to SCCT, individuals do not make educational and career choices in a vacuum, as they are cognizant of particular environmental circumstances. Therefore, environmental factors are expected to pervade every stage of the academic and career development process (Lent et al., 1994).

The literature has identified several environmental factors that individuals perceive as aiding their efforts to implement a particular educational or occupational goal. For instance, a variety of support factors have been mentioned in the literature including encouragement from others, role models, instrumental assistance, and financial resources (Lent et al., 2002). Beyond these mechanisms, the utilization of IT as a pedagogical tool has fundamentally altered the educational environment. According to SCT, environmental forces, which include the technological tools and resources at one's disposal, influence people and behavior in a similar fashion (Looney et al., 2006). Logically, when people are equipped with superior resources, such as more sophisticated technologies, the likelihood of accomplishing specific behaviors improves. Therefore, we expect IT sophistication to play an influential role in student psychology and behavior. In the context of our study, *IT sophistication* refers to the degree to which the IT taught in an introductory IS course reflects the technologies that contemporary organizations utilize.

Personal Factors. Individuals possess certain traits, histories, and cognitive resources to deploy during their interactions with the environment. Central to SCCT are the concepts of self-efficacy, outcome expectations, and interests (Lent et al., 1994).

Self-efficacy can be defined as a perception of one's ability to organize and execute courses of action to accomplish a particular task (Bandura, 1986). Self-efficacy functions by providing individuals with a set of beliefs regarding their capabilities to exercise control over their actions and the environment. Self-efficacy plays a central role in computing, including training (Agarwal et al., 2000; Johnson and Marakas, 2000), technology acceptance (Taylor and Todd, 1995), technology use (Compeau and Higgins, 1995a; 1995b), and virtual organizations (Staples et al., 1999) to name a few. Since self-efficacy judgments are situational and task-specific (Marakas et al., 1998), our study focuses on *IS major self-efficacy*, which refers to an individual judgment of one's capability to perform effectively as an IS major.

Outcome expectations capture the perceived likelihood that favorable consequences will occur as a result of a particular action (Bandura 1986; 1997). Although rewards ultimately materialize from one's actions, individuals do consider the prospective likelihood that their actions will produce favorable results before engaging in the activity. Individuals are more likely to undertake behaviors that they expect to result in favorable outcomes. Unless one expects the behavior to produce favorable outcomes, the individual may lack the necessary motivation (Bandura, 1986; 1997). Outcome expectations can be categorized into three major forms – social (e.g. recognition), self-evaluative (e.g., sense of accomplishment), and physical (e.g., angst) (see Bandura, 1986).

Interest can be defined as an emotion that arouses attention to, curiosity about, and concern with a particular educational path (Lent et al., 1994). In this study, the target of interest specifically focuses on majoring in IS. Even though individuals may try out and pursue many different activities throughout their formative years, they end up developing distinctive patterns of academic and career interests, as certain activities differentially intrigue people to varying degrees over time (Bandura, 1986).

Behavior. In the context of career-related choices, the behavior in question is operationalized as choice goals, which can be defined as the determination to engage in a particular educational or occupational activity (Bandura, 1986). Specific to this study, *choice goals* refers specifically to a students' aspirations to choose IS as a major. According to the SCCT, choice goals play an important role in the self-regulation of behavior. People set goals to organize and guide their behavior, as well as to increase the likelihood that desired outcomes will be attained. Goals play an important role in decision making theories, including career choice decisions. In this respect, career plans, aspirations, and expressed choices are considered as goal mechanisms (Lent et al., 1994).

Research Model and Hypotheses

Figure 2 represents the research model utilized in our study. As illustrated, IT sophistication, self-efficacy, outcome expectations, and interests are expected to independently and cumulatively affect choice goals. The following sections describe the hypotheses in detail.

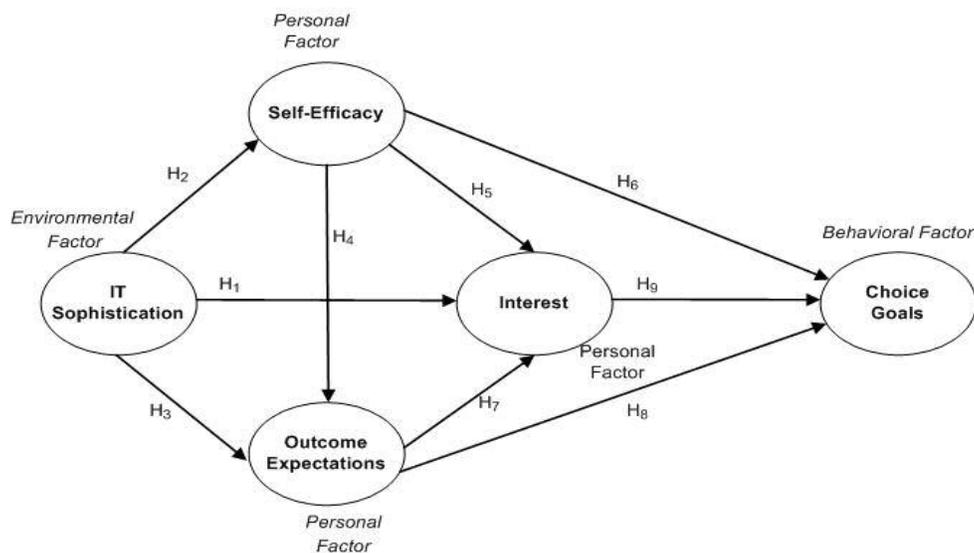


Figure 2. Research Model

IT Sophistication is included in our model as an environmental factor. Studies indicate that environmental factors play an important role in shaping individuals' experiences that lead to the development of particular educational and career interests and choices (Lent et al. 1994). In his discussions about the interplay among personal and environmental factors on behavior, Bandura (1999, 2000) stated that most external influences affect human functioning through intermediary self processes rather than directly. Along these lines, Lent et al. (2003) provided evidence that environmental factors indirectly affect choice behavior through self-efficacy, outcome expectations, and interests.

Being exposed to modern, state-of-the-art information technologies that are similar to those utilized in organizations can trigger students' interest in the IS field. Compared to mundane sorts, sophisticated technologies are more novel as they represent contemporary industry practices. Novelty represents a primary mechanism that piques interest (Berlyne, 1978). Moreover, as students gain hands-on experience with these applications, they develop a better understanding of the IS field and the tasks that IS professionals typically perform. Combined, we therefore expect IT sophistication to influence interest.

H₁: IT sophistication will have a significant positive influence on interests.

According to SCT, environmental factors, which include the technological tools and resources at one's disposal, can have a profound influence on self-efficacy and outcome expectations (Bandura, 1986; 1997). Since more sophisticated resources better enable individuals to perform certain behaviors, we expect that IT sophistication will affect students' self-efficacy perceptions. Students who are trained using the more sophisticated technologies are more likely to develop higher levels of confidence in their abilities to perform as an IS major, as they believe that they are acquiring the necessary skills to succeed in the field. Similarly, IT sophistication may promote outcome expectations, as it may reflect current industry practices, and may therefore provide clues about the consequences that may occur as a result of pursuing an IS major (Compeau and Higgins, 1995a). When students perceive that they are being exposed to state-of-the-art applications, they are apt to believe that rewards are more likely to be obtained as a result of majoring in the IS field.

H₂: IT sophistication will have a significant positive influence on self-efficacy.

H₃: IT sophistication will have a significant positive influence on outcome expectations.

The relationship between self-efficacy and outcome expectations has been repeatedly studied in the IS literature. Research has shown that self-efficacy beliefs influence outcome expectations (Compeau and Higgins, 1995a; 1995b; Compeau et al., 1999; Looney et al. 2006). Self-efficacy judgments influence outcome expectations. People expect to achieve desirable outcomes in activities at which they deem themselves as capable. In essence, an individual who possesses a strong sense of efficacy is more likely to believe that favorable consequences will arise from her or his actions. Therefore, it is reasonable to assume that students who have higher levels of self-efficacy will develop robust outcome expectations.

H₄: Self-efficacy will have a significant positive influence on outcome expectations.

Lent et al. (1994) has demonstrated that perceptions of self-efficacy an important role in the formation of educational and vocational interests and behaviors. People tend to form enduring interests in activities in which they view themselves as capable (Bandura and Schunk, 1981). Thus, it is reasonable to assume that students with higher levels of self-efficacy will be more interested in pursuing majors and careers within the field of IS. Self-efficacy beliefs are also assumed to have direct effects on choice goals. Bandura (1986) has proposed that self-efficacy affects an individual's goals to perform a specific behavior. When high self-efficacy prevails, individuals are more likely to set goals to engage in a particular behavior. As such, students who are confident in their abilities to perform as an IS major would be more likely to develop aspirations to major in the IS field.

H₅: Self-efficacy will have a significant positive influence on interest.

H₆: Self-efficacy will have a significant positive influence on choice goals.

Similar to self-efficacy, an individual's expectations about the consequences of pursuing educational and vocational paths shape interests (Lent et al., 1994). In essence, when a student expects pursuing a major or career in the IS field will result in favorable outcomes, he or she will be more likely to find that IS field compelling and develop an interest. Outcome expectations can also affect choice goals directly. People develop goals, in part, based on the rewards they expect to receive. The higher the likelihood of obtaining valued outcomes, the more likely that people will adopt particular career goals.

H₇: Outcome expectations will have a significant positive influence on interest.

H₈: Outcome expectations will have a significant positive influence on choice goals.

In addition to self-efficacy and outcome expectations, we anticipate that interest will influence choice goals. Research indicates that people tend to select academic and career options that match their primary interests (Holland, 1985). Emergent interests lead to cognized choice goals for further activity exposure (i.e. intention plans, or aspirations to engage in a particular academic or career direction), fostering the development of goals to choose particular actions (e.g., declaring a

corresponding major) (Lent et al., 1994). Therefore, students who are interested in the IS field will be more determined to major in the IS discipline.

H₉: Interest will have a significant positive influence on choice goals.

Methodology

Study participants consisted of students enrolled in an introductory level information system course at two large state universities. At each university, IT sophistication varied considerably, as one university emphasized ERP systems, whereas CBL systems served as the primary pedagogical tool in the other. Surveying students who were exposed to different levels of IT sophistication increased sample variation. Restricting the survey to a single institution could have biased the results, preventing us from making broader inferences. A web-based survey was used to collect the data. A total of 151 usable responses were obtained. Forty two percent of the respondents were female and respondents averaged 21.6 years of age ($SD = 2.23$).

A total of five scales were required to test the research hypotheses. A review of literature was undertaken to identify existing scales. Whenever possible, previously validated scales were used. Adapted and developed measures were subjected to rigorous pre-testing in separate studies. Self-efficacy was measured with a six-item scale. The response format for the questions included an 11-place Likert type scale ranging from 0 (*Cannot Do*) to 10 (*Certain Can Do*). A ten-item scale was used to measure outcome expectations. The response format consisted of an 11-place Likert-type scale anchored by 0 (*Will Never Occur*) to 10 (*Will Always Occur*). Interest, choice goals, and IT sophistication were measured using five, four, and six items respectively. These scales were adapted from previous studies (Chwelos et al. 2001; Lent et al., 2002). For each scale, the response format consisted of 7-place Likert-type response formats ranging from 1 (*Strongly Disagree*) to 7 (*Strongly Agree*).

Partial Least Squares (PLS) was used for data analysis (Barclay et al. 1995; Wold, 1985). More specifically, PLS-Graph Version 3 was utilized (Chin, 1998). PLS is classified as a latent structural equations modeling (SEM) technique that utilizes a component based approach to estimation (Joreskog and Sorbom, 1993). PLS was chosen over regression analysis because, as a SEM technique, it allows all paths to be analyzed simultaneously. Also, PLS was chosen over LISREL because it is a more suitable technique when the objective of the study involves theory building (Barclay et al. 1995; Gefen et al., 2000). The present study represents one such case.

The psychometric properties of the measurement model were confirmed prior to estimating structural model parameters, as discussed in the following sections.

Measurement Model Analysis

As recommended by Barclay et al. (1995), reliability and validity of the indicators and constructs were examined in three stages. Reliability of each construct was examined to ensure that the items collectively measured their intended construct consistently (Gefen et al., 2000). Reliability was assessed by examining the reliability of individual items (Cronbach's α) and the composite reliability of constructs (Barclay et al., 1995; Fornell and Larcker, 1981). As shown in Table 1, both Cronbach α 's and composite reliability scores were well above the recommended level (0.70) for acceptable reliability (Barclay et al., 1995; Fornell and Larcker, 1981). As such, the reliability of the scales was confirmed.

Convergent validity was also assessed at the individual item and construct levels by examining the individual item loadings and the average variance extracted (AVE) respectively (Fornell and Larcker, 1981). Individual item loadings of 0.707 demonstrate that the indicator shares more variance with its construct than error variance (Gefen et al., 2000). All individual items exhibited adequate loadings. No unacceptable cross loadings emerged. An AVE of 0.50 or greater implies that the construct as a whole shares more variance with its indicators compared to error variance (Fornell and Larcker, 1981). As shown in Table 1, the AVE score for each construct is well above the recommended level. Therefore, convergent validity was confirmed.

Table 1. Construct Reliability, Correlations, and Discriminant Validity

Construct	α	CR	Construct ^a					
			AVE	ITSOPH	SE	OEXP	INTRST	CGOAL
ITSOPH	0.916	0.936	0.708	0.841				
SE	0.953	0.963	0.815	0.321	0.903			
OEXP	0.951	0.959	0.702	0.391	0.500	0.838		
INTRST	0.937	0.952	0.800	0.202	0.455	0.515	0.894	
CGOAL	0.977	0.984	0.937	0.020	0.395	0.390	0.643	0.968

Note: α = Cronbach's alpha. CR = composite reliability. AVE = average variance extracted. ITSOPH = IT sophistication, SE = Self-efficacy. OE = Outcome expectations. INTRST = Interest, CGOAL = Choice goals.

Discriminant validity was assessed by comparing the AVE values associated with each construct to the correlations among constructs (Barclay et al., 1995; Staples et al., 1999). The discriminant validity analysis is provided in Table 1. Diagonal elements show the square root of the AVE, whereas the off-diagonal elements show the correlations among constructs. In order to claim discriminant validity, the diagonal elements should be larger than any other corresponding row or column entry (Staples et al., 1999). According to the results, each construct sufficiently differed from the other constructs. Therefore, the measures demonstrated discriminant validity.

Given the results of the reliability and validity analysis, it was concluded that the scales exhibited acceptable psychometric properties.

Structural Model Analysis

Statistical significance of the paths was determined using two-tailed t-tests calculated using the bootstrap resampling method. All constructs were modeled as reflective and included in the model using multiple indicators (Karahanna et al., 2006). The results of the structural model analysis are represented in Figure 3.

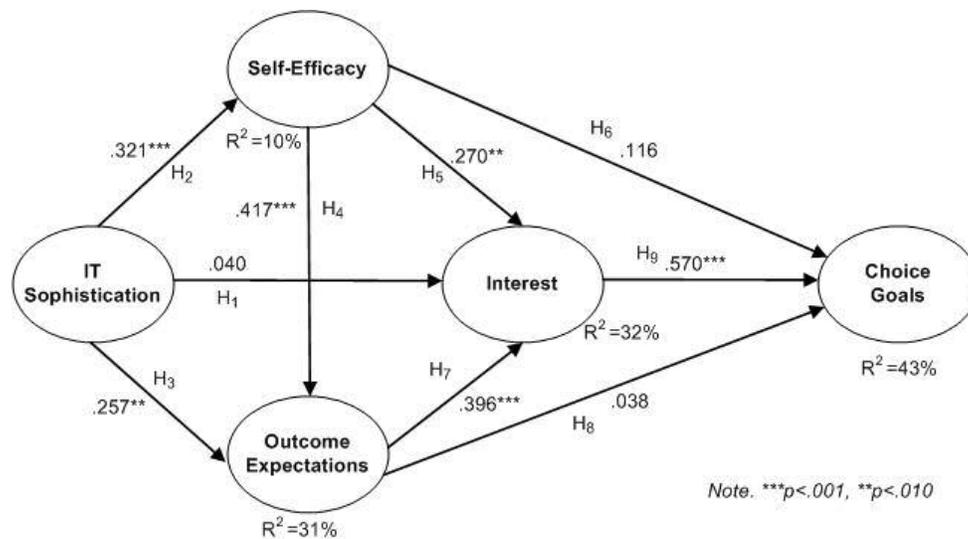


Figure 3: Structural Model Results

The results indicate that the model explains a sizeable proportion of the variance in choice goals (43 percent), interest (32 percent), outcome expectations (31 percent), and self-efficacy (10 percent).

Despite our expectations, IT sophistication was not a significant predictor of interest (0.040, *ns*). Therefore no support was offered for H₁. As expected, IT sophistication was a significant predictor of self-efficacy (0.321, $p < 0.001$) and outcome expectations (0.257, $p < 0.01$), supporting hypotheses H₂ and H₃.

Self-efficacy was found to be a significant predictor of outcome expectations (0.417, $p < 0.001$) and interest (0.270, $p < 0.01$). Therefore, hypotheses H₄ and H₅ were supported. On the other hand, self-efficacy did not serve as a significant predictor of choice goals (0.116, *ns*). As a result, no support was offered for hypothesis H₆.

Outcome expectations was a significant predictor of interest (0.396, $p < 0.001$), supporting hypothesis H₇. However, in opposition to our expectations, outcome expectations did not have a significant influence on choice goals (0.038, *ns*). Therefore, hypothesis H₈ was not supported. Finally, interest was found to be a significant predictor of choice goals (0.570, $p < 0.001$), supporting hypothesis H₉. Table 2 below provides a summary of hypotheses testing.

Table 2. Summary of Hypotheses Testing

	Hypothesis	Conclusion
H ₁ :	IT sophistication will have a significant positive influence on interests.	Not supported
H ₂ :	IT sophistication will have a significant positive influence on self-efficacy.	Supported
H ₃ :	IT sophistication will have a significant positive influence on outcome expectations.	Supported
H ₄ :	Self-efficacy will have a significant positive influence on outcome expectations.	Supported
H ₅ :	Self-efficacy will have a significant positive influence on interest.	Supported
H ₆ :	Self-efficacy will have a significant positive influence on choice goals.	Not Supported
H ₇ :	Outcome expectations will have a significant positive influence on interest.	Supported
H ₈ :	Outcome expectations will have a significant positive influence on choice goals.	Not supported
H ₉ :	Interest will have a significant positive influence on choice goals.	Supported

Discussion

Over the past few years, there has been a decline in the number of students pursuing IS degrees. In order to overcome this dilemma, the IS community has started to look for mechanisms to re-fuel student interest in the discipline. To address this important issue, we investigated how such a mechanism – IT sophistication – influences students' aspirations to pursue an IS degree. As such, our findings have important implication for IS educators, as the information gained herein can be utilized to design and implement a specific intervention strategy to attract larger pools of students to the IS discipline.

Specifically, our findings indicate that teaching sophisticated IT in introductory IS courses plays an important role in student uptake. Teaching sophisticated IT promotes students' self-efficacy and outcome expectations. Utilizing state-of-the art technologies that reflect current industry practices not only enhances students' confidence in their ability to successfully perform as an IS major, but also elevates students' expectations that valued rewards will be received by majoring in IS. Unexpectedly, our results failed to provide support for the direct effects of IT sophistication on student interest. Rather, the effects of IT sophistication on interests are channeled indirectly through self-efficacy and outcome expectations. In essence, strong self-efficacy and outcome expectations were found to foster student interest in the IS discipline. Therefore, it is reasonable to assume that students are more likely to develop an interest in the IS discipline when they feel efficacious and expect to receive valued rewards. However, our results did not provide support for the direct effects of self-efficacy and outcome expectations on choice goals. Apparently, aspirations to major in IS do not develop simply because students deem themselves as qualified or solely based on beliefs that prized outcomes are likely to occur. In contrast, choice goals develop through strong interests, which evolve, in part, form a robust sense of efficacy and outcome expectations. Finally, it was also

found that self-efficacy leads to more robust outcome expectations. Not surprisingly, students who deem themselves as capable of majoring in IS perceive that value rewards are more likely to be obtained. Finally, our findings also provided strong support for the positive relationship between interests and choice goals; confirming that interest serves as the primary mechanism through which goals to choose IS major emerges.

As a result of this study, we have gained a theoretical understanding of the role IT sophistication can play in the student recruitment process. The model not only supports the notion that IT sophistication can be used to attract larger pools to the IS discipline, but also explains how and why IT sophistication influences the student aspirations. Nonetheless, the constructs in the research model represent a relatively limited subset of the factors that could plausibly affect student choices. In order to develop a more comprehensive set of intervention strategies targeted at student recruitment, a wider range of factors needs to be considered and validated. The research model can be readily adapted to study these and other barriers that might be impairing student enrollments.

In conclusion, the results allow us to confidently conclude that deploying sophisticated IT in introductory IS classes can be used as a powerful lever to attract additional students to the IS discipline. Therefore, we encourage educators to teach state-of-the-art IT that reflect current industry practices. In doing so, IS programs should witness a boost in student confidence and expectations of value rewards will be obtained by pursuing an IS degree. Ultimately, these effects stimulate student interest, which helps students develop aspirations to choose IS as a major. Utilizing these technologies also has the potential to increase student success in the classroom, provide a richer and more engaging learning environment for students, and help students become more attractive to recruiters.

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