INSPIRING STUDENTS
TO PURSUE COMPUTING DEGREES

Their aspirations are our possibilities.

The dot-com demise, end of the enterprise resource planning rollout, completion of Y2K overhauls, and offshoring have precipitated a sharp decline in the recruitment of information technology professionals and, in turn, the number of students seeking degrees in computing disciplines (for example, computer science, information systems, and so on) [5, 11]. Despite an economic downturn, recent employment forecasts indicate that IT positions represent the fastest-growing job segment, with growth expected to exceed 30% by 2012 [8]. These competing forces imply that the number of qualified graduates produced by computing programs may be insufficient to meet increasing industry demands. Addressing this situation will require a concerted effort toward attracting additional students to the computing disciplines.

While sound counsel to improve student recruitment has been offered previously [5], existing recommendations have been largely based on how educators perceive the enrollment issue from a macro perspective. In order to facilitate a more comprehensive understanding of this predicament, we also need to understand the mechanisms by which students are compelled to seek computing degrees *from their perspective*. Thus, this study addresses the question: *from the students' perspective, what are the factors that motivate students to choose a major*

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in the field of computing? Answering this question not only supplements prior work, but also enables opportunities that may strengthen student recruitment to be pinpointed.

To this end, this article introduces a model aimed at identifying and explaining the mechanisms that shape student choice of a computing major. We utilized the model to survey 205 students enrolled in an introductory computing course and using the results, we put forth a set of recommendations intended to help higher education institutions attract students to the computing disciplines.

Factor	Definition
Self-Efficacy	A student's judgment of his or her capability to perform effectively as a computing major.
Outcome Expectations	A student's judgment regarding the likelihood that valued rewards will occur as a result of pursuing a computing major.
Interest	An emotion that arouses attention to, curiosity about, and concern with a computing major.
Major Choice Goals	A student's aspirations to choose a computing major.

Table 1. Major Choice Goals Model factors and definitions.

Major Choice Goals Model

This study seeks to understand the factors affecting student choice of whether to pursue a computing major. To achieve this goal, we introduce a model from the vocational psychology literature that focuses specifically on career-related choices and apply the model in the context of computing major choice. Derived from Social Cognitive Theory [1], Social Cognitive Career Theory (SCCT) represents a conceptual framework aimed at understanding the mechanisms through which individuals develop goals to pursue a particular educational or occupational path, make choices among available opportunities, and perform in their selected fields of pursuit [9].

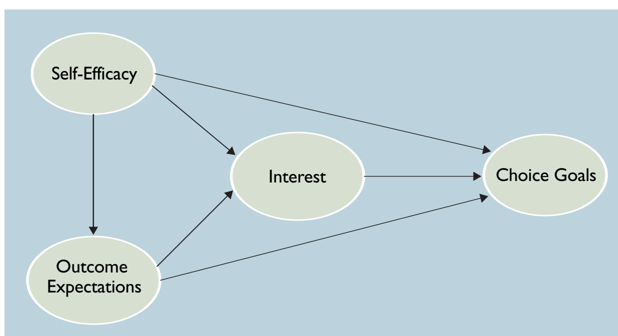

Figure 1. Major Choice Goals Model.

While SCCT covers a broad spectrum of career-related topics, the intent of this study is to examine the particular set of factors that sway students to choose a computing major. We concentrate on the major because, unlike the minor, it produces graduates well equipped to enter the IT work force [7]. Since the opportunity to persuade a prospective student typically disappears after a different major has been chosen, it is necessary to engage students who are still in the process of formalizing their decisions. Consequently, our investigation focuses on the underlying mechanisms that operate before a major has been formally selected. As a result, intervention strategies can be devised and implemented to attract a larger pool of students to the computing disciplines.

The Major Choice Goals Model, depicted in Figure 1, represents a subset of SCCT that is specifically tailored to the domain of computing. The model consists of four factors, each of which is defined in Table 1.

Our investigation ultimately targets major choice goals, which are defined as a student's aspirations to choose a computing major. According to the broader SCCT framework, choice goals constitute a decisive precursor to actual choices [9]. Intuitively, a student who aspires to choose a computing major is more likely to eventually pursue it. The model proposes that choice goals will be influenced by three factors: interest, self-efficacy, and outcome expectations. Interest refers to an emotion that arouses attention to, curiosity about, and concern with a computing major. When individuals are intrigued by a particular subject, they tend to seek additional exposure to satisfy their curiosity [9]. Thus, a student who is interested in a specific major should be more likely to set goals to choose it.

Regardless of one's interest, self-efficacy and outcome expectations may also influence aspirations [9]. Self-efficacy is defined as a student's judgment of his or her capability to perform effectively as a computing major. Although students may not find a computing major appealing, they may aspire to pursue it simply because they believe they are qualified. Moreover, outcome expectations, which refers to a student's judgment regarding the likelihood that valued rewards will occur as a result of pursuing the major,[1] can influence one's choice goals. Even when a student may be disinterested, the rewards for majoring in a computing discipline (for example, salary, ability to find a job, peer recognition, sense of accomplishment) may be so enticing they make the option attractive. In turn, the student might develop aspirations to choose a computing major.

While choice goals represent the "ultimate prize" in

[1] Although outcome expectations consist of three subdimensions (self-evaluative, social, and physical), for simplicity purposes, we chose to discuss the construct at the major level. Interested readers are encouraged to consult [1, 2].

our model, it is important to understand the mechanisms by which the remaining factors function. Specific to interest, people tend to form enduring interests in activities in which they view themselves as capable [1]. Therefore, students with higher levels of self-efficacy should develop stronger interests. However, self-efficacy alone may be insufficient. Unless individuals expect an undertaking to result in favorable outcomes, they will likely find the activity less compelling [9]. Thus, if a student does not anticipate that sufficient rewards can be gained as a result of pursuing a major, he or she should be less likely to develop an interest.

Finally, the model proposes that self-efficacy should affect outcome expectations. Since valued rewards are more likely to be acquired when engaging in activities where one can perform effectively, it is reasonable to assume that students with higher self-efficacy should develop more robust outcome expectations [1, 4].

Survey and Results

Data was collected through a survey consisting of a set of questionnaires capturing the four factors in the model. The survey targeted undergraduate business students enrolled in an introductory information systems (IS) course at a large U.S. university. This particular course was chosen for four primary reasons. First, an individual's judgments (for example, self-efficacy, interest) are specific to a particular undertaking [9]. As a result, a specific type of computing major needed to be examined. Second, most students enrolled in the course had yet to finalize their decisions about which major to pursue. Third, the course was required for all students seeking business degrees, meaning some of these students would eventually choose majors other than IS. As such, the course provided fertile grounds for understanding the reasons that students are drawn to *and* discouraged from choosing IS. Finally, for the vast majority of students, the course served as their initial introduction to the IS field.

By the conclusion of the course, students developed an appreciation for the types of activities, topics, and demands that would be encountered in the IS major. In total, 205 students completed the survey at the end of the course. The average student age was 20.69 years and 52.8% were male.

As shown in Figure 2, the model successfully illuminates the underlying factors affecting students' aspirations to choose a computing major,[2] explaining 44.1% of choice goals. As expected, our findings demonstrate the positive relationship between interest and choice goals. Therefore, it is reasonable to conclude that students will aspire to select majors that are consistent with their interests [9]. Specific to computing, a student who is interested in a computing major is more likely to develop aspirations to choose it. On the other hand, neither self-efficacy or outcome expectations predict choice goals directly. Rather, their effects are channeled through interest, which, in turn, inspires students to choose a computing major.

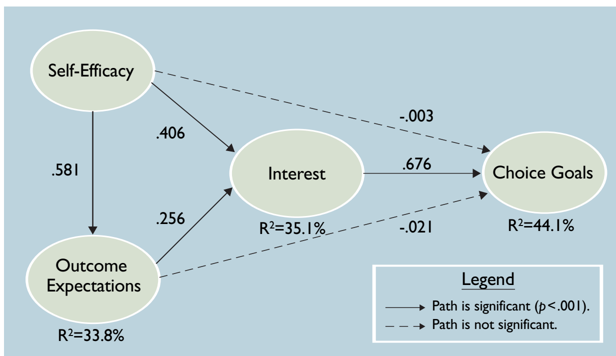

Figure 2. Survey results.

Although self-efficacy and outcome expectations fail to directly influence choice goals, this by no means diminishes their importance. Each plays a vital role in fueling student interest. We found 35.1% of interest was explained by the two factors. These findings are consistent with the assertions that students are more likely to develop interests in a computing major when they feel confident about their capabilities to succeed, and believe that favorable consequences are likely to occur as a result of pursuing the major. Also, our results show that higher levels of self-efficacy lead to more robust outcome expectations. Indeed, 33.8% of outcome expectations were explained by self-efficacy, meaning students who deem themselves as capable of succeeding tend to believe that valued rewards are more likely to be gained by majoring in a computing discipline. Combined, our findings broadly validate the model. Self-efficacy, outcome expectations, and interest constitute important factors that independently and cumulatively shape student aspirations to choose a computing major.

Recommendations

By understanding the mechanisms through which students aspire to choose computing as a major, specific intervention strategies can be developed to attract prospective students to the computing disciplines. Table 2 provides a list of recommendations that can potentially be deployed to enhance student recruitment. Although these recommendations are targeted at introductory computing courses, where

[2]Data was analyzed using Partial Least Squares (PLS). All constructs exhibited satisfactory levels of reliability, as well as convergent and discriminant validity.

students typically acquire their first exposure to computing fields [5], programs might consider implementing some of these strategies before students enroll in their courses. For instance, at one of our institutions, prospective students often participate in a student fair, where they are exposed to the various business majors before they enroll in any business courses. Engaging students early on might further catalyze recruitment efforts.

Self-efficacy beliefs indirectly affect choice goals by intensifying interest in a computing major. Furthermore, self-efficacy influences the perceived likelihood that rewarding outcomes will be derived as a result of pursuing a computing major. Consequently, fostering a robust sense of self-efficacy represents a profitable enterprise to enhance the appeal of a computing major. Self-efficacy tends to be weaker and more malleable in the absence of relevant experiences [6]. Although the majority of students enrolled in introductory computing courses are seasoned computer users [5], most have had minimal exposure to computing within a vocational setting and, therefore, should exhibit more uncertainty about their ability to successfully handle material in an introductory computing course. Since nascent self-efficacy beliefs tend to be easily modifiable, student confidence can be strengthened by providing immediate and frequent opportunities for them to achieve. Students that master tasks develop a "can do" mentality, whereas failures instill a sense of incompetence [2, 6].

Although mastery experiences pack the greatest punch, self-efficacy can also be enhanced through behavioral modeling, social persuasion, and positive psychological states [2]. Regarding the former, demonstrating computing tasks before students are asked to complete them elevates students' confidence that they can perform likewise [4]. When relevant, individuals are persuaded by others, especially peers, that they can perform effectively, thus bulding confidence. tends to rise. Therefore, recruiting peer groups, such as members of a computing club, to communicate persuasive messages along these lines may amplify student confidence. Finally, creating a classroom environment that arouses positive psychological states (for example, enjoyment, amusement) while alleviating negative ones (for example, anxiety or stress) can help students feel more capable [2].

Like self-efficacy, instilling expectations that positive outcomes will arise from pursuing a computing major can generate student interest. The results of our survey highlighted some key outcomes that students found particularly attractive. Students who exhibited strong interests tended to be driven by rewards such as developing a sense of pride and personal accomplishment. These individuals also pointed out that gaining the admiration of their peers, being recognized as competent, and having potential employers view them as strong job candidates represented salient outcomes that swayed their decision making. Moreover, job security, good salaries, and not having to worry about finding a job upon graduation were often indicated as contributors. Consequently, communicating these types of rewards constitutes an important mission. Peer groups, program alumni, IT professionals, and others who have actually reaped such rewards may prove invaluable in delivering these messages.

In addition to self-efficacy and outcome expectations, research shows that interest can be influenced via novelty, complexity, conflict, and uncertainty [3]. While the latter two would surely produce undesirable side effects in an educational setting, novelty and complexity offer fruitful areas to enhance student interest. Novelty can be instated in various ways. As technologies continue to rapidly evolve, it is important to deliver course content that is fresh, current, and aligned with students' interests [5] (for example, mobile computing, phishing, and MP3). Discussing contemporary topics exposes students to intriguing subjects while allowing them to immediately apply concepts to solve today's problems. Utilizing a variety of innovative pedagogical techniques might also promote interest. Drawing on different delivery methods, such as guest speakers, videos, discussions about issues facing IT professionals, and firsthand exposure

Focus Area	Recommendation
Self-Efficacy	• Ensure students experience immediate and frequent successes • Demonstrate tasks before asking students to complete them • Recruit peer groups to deliver persuasive messages to students • Create classroom environments that are fun and entertaining

Outcome Expectations	• Promote the rewards that are likely to occur by pursuing a computing major
	  • Sense of pride
	  • Sense of personal accomplishment
	  • Peer admiration
	  • Recognition, being perceived as competent
	  • Potential employers viewing the student as a strong job candidate
	  • Less anxiety about finding a job upon graduation
	  • Job security
	  • Good salaries

Interest	• Ensure course content stays current and is aligned with student interests • Use innovative pedagogical techniques • Challenge students, yet ensure tasks are attainable • Increase the level of complexity as the course progresses

Table 2. Recommendations on how to inspire students to pursue a computing major.

[Students are more likely to develop interests in a computing major when they feel confident about their capabilities to succeed, and believe that favorable consequences are likely to occur as a result of pursuing the major.]

to emerging technologies, may not only provide novel avenues for learning, but might also encourage students to be inquisitive, pique their curiosity, and further their ability to relate concepts to a broader perspective.

Regarding complexity, course material must be "just right" for student consumption. Providing content that is overly simplistic may prove unchallenging and disengaging, whereas material that is beyond the reach of students may increase frustration and stifle motivation. As such, faculty should strive to assign tasks that are challenging, yet attainable [10]. Moreover, as self-efficacy strengthens, students will feel more assured about handling tasks involving greater complexity. Consequently, course content needs to be dynamic, becoming increasingly difficult in order to maintain an optimal level of challenge.

Consistent with George and his colleagues [5], implementing these recommendations would clearly require adaptations to existing courses and programs. This will necessitate shrewd analysis on the part of program administrators to ensure the most appropriate faculty are assigned to introductory computing courses. Instructors who are personable, fair, innovative, engaging, and can serve as role models would be more likely to attract larger pools of students. Educators, however, are not the only members of the IT community that can make a difference. IT professionals can play a central role in the recruitment effort by serving as guest speakers, sponsoring on-site visits, offering internships, and so forth. Important contributions such as these would surely bolster the student learning experience and attract additional students to computing fields.

Conclusion

Academic programs are under pressure to produce qualified graduates to meet the accelerating demands of the IT industry. By understanding the factors that drive the pursuit of computing degrees from the students' perspective, the mechanisms by which students aspire to choose a computing major were identified and explained. As a result, specific strategies to enhance student recruitment were put forth. Students not only need to be exposed to intriguing, innovative, and challenging topics, but also experience success, develop expectations that their efforts will be rewarded, and enjoy the learning experience. While maximizing student enrollments might require reinvigorating a part of the curriculum, an increase in students seeking computing degrees can only help strengthen academic programs and ensure the continued maturation of the computing disciplines. **C**

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