UTILIZING THE THEORY OF PLANNED BEHAVIOR TO EXAMINE COMPUTER SCIENCE STUDENTS WHO PERSIST OR DROPOUT IN THEIR FIRST INTRODUCTORY COURSE

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ABSTRACT

The number of STEM graduates, especially computer science graduates, continues to decline. Extant research in the area utilizes Tinto’s (1975) interactional theory of student persistence; this research applies Ajzen’s (1988) Theory of Planned Behavior to the persistence issue. Specifically, this research seeks to help explain why some computer science students elect to complete their STEM degree while others leave the major or leave the university entirely.

Keywords: Computer Science, Education, Persistence, Theory of Planned Behavior

DECLINING NUMBER OF STEM GRADUATES

The STEM workforce, while only 5% of the civilian labor force, serves to increase our standard of living, ensure our national security, and contribute to the scientific knowledge, technological innovation, and economic growth of our nation and will address critical issues such as global warming, national security, terrorism, and national competitiveness (Ellis, 2007; Hira, 2010;
Varma & Frehill, 2010). The number of STEM tertiary degrees in the US more than doubled between 1960 and 2000; however, between 2000 and 2007 the number of STEM degrees awarded has stagnated (Nada, 2007). In 1994-1995, 519,000 students (32%) obtained STEM degrees; in 2003-2004, 27% of degrees awarded (578,000 students) were in STEM (GAO, 2007).

National studies have shed light on the status of retaining STEM students. In a study of postsecondary students who entered STEM fields in 1995-1996 who earned a bachelor’s degree within six years, the National Center for Educational Statistics (NCES) found that the 64% of students graduated; but the percentage of students that received a degree in STEM only totaled 37% (NCES, 2009). The Center for Institutional Data Exchange and Analysis (C-IDEA) (2010) found that 38% of students who entered STEM bachelor’s degree programs in the 1993-1994 were STEM completers after six years. Another 18% were STEM leavers who earned a degree in another discipline (C-IDEA, 2010). The comparable national figure for bachelor’s degrees in all fields was 58.4% (NCES, 2009b). If the STEM programs could retain STEM students, then the number of STEM graduates could potentially increase by 1.5 times its current rate.

Within the STEM disciplines, computer science graduates continue to be in high demand. For example, software engineers earn $90,000 on average and anticipate workforce growth well above the average at 31% (BLS, 2012a). Similarly, computer research scientists earn, on average, over $100,000 and anticipate workforce growth of 19% (BLS, 2012b). Unfortunately, between the years of 1995-1996 and 2001, only 7% of students entered the STEM field of computer science and information systems (NCES, 2009a). Further, computer science majors had the lowest six-year graduation rate in 2001, 46.4%, of all STEM majors (NCES, 2009a). Additionally, computer science and information systems experienced the lowest percentage of students completing in the STEM field, 36.2% for the same cohort (NCES, 2009a). The question becomes, then, how does one account for the large number of students who choose to drop-out of STEM programs and who drop-out of computer science and information systems degrees, specifically. More importantly, what can the institution do to retain these students? There have been a myriad of models and theories proposed to explain to college persistence, especially in the STEM area (The American Association for the Advancement of Science, 2001; Braunsten, McGrath, & Pescatrice, 2000; Higher Education Research Institute, 2010; Reason, 2009; Terenzini and Reason, 2005; Tinto, 1975). The extant literature fails to provide a model that captures the student’s role in this decision and provides an actionable model for the institution. Braxton, Hirschy, and McClendon (2004) indicate that “no template of a successful retention program exists” (p. 81). This “hit or miss” retention effort comes at a time when university budgets are under duress and when spending resources wisely is imperative.

PURPOSE AND RESEARCH QUESTIONS

The purpose of this study is to identify variables that best model differences among students that choose to persist within a STEM discipline and students who leave the STEM discipline or the university. This research seeks to help explain why some computer science students elect to complete their STEM degree while others leave the major or leave the university entirely.
LITERATURE AND CONCEPTUAL MODEL

Comprehensive reviews of the literature regarding STEM and general student persistence in conjunction with behavior-oriented psychological theory guide our selection of factors to consider when examining STEM student persistence.

STEM Persistence Research

STEM persistence studies typically result from observational studies rather than from a specified persistence model and include items such as student attributes, hands-on research, and the importance of a mentor (Foltz, Gannon, & Kirschmann, 2011). In the category of student attributes, gender, race, family income level (often measured as Pell-eligible), high school curriculum, high school test scores, and class rank or grade point average (GPA) in high school influence STEM persistence (The American Association for the Advancement of Science, 2001; Braunsten, McGrath, & Pescatrice, 2000; Higher Education Research Institute, 2010).

The literature also links undergraduate research experience to STEM completion. The Boyer Commission (1998) stresses the importance of utilizing hands-on research in undergraduate education. Hunter, Laursen, and Seymour (2007) describe how undergraduate research experiences assist students in adopting the habits of mind of scientists. Other authors report the positive impact of utilizing undergraduate research experiences for STEM retention (Laursen, Hunter, Seymore, Thiry, & Melton, 2010; Lopatto, 2007; Russell, 2006). Critical to the STEM educational experience appears to be the relationship with a key faculty member or mentor (Laursen, et al., 2010; NSF, 2003). For example, Vogt (2008) studied the 40% of students who start an undergraduate engineering and computer science major and depart prior to graduation and found the lack of a relationship with a professor influences students’ attrition.

Interactional/Sociological Persistence Research

Tinto (1975) posited an interactional theory of student persistence. This sociological and interactional theory recognized the importance of what the students brought to the university in terms of personal characteristics, traits, experiences, and commitment, and coupled this with the interactions that the students have at the institution (Tinto, 1975). Specifically, Tinto emphasized the degree to which the student integrated (“fit”) academically and socially.

As Tinto revisionists, Pascarella and Terenzini (1983) further link social integration (peer relationships) and academic integration (facultymember relationships) with persistence. Braxton et al. (2004) emphasized the need for community on campus as a form of social integration and reiterated the importance of mechanisms that connect the student such as student housing. Terenzini and Reason (2005) and Reason (2009) suggest that the student’s pre-college characteristics and experiences meet with an organizational context consisting of internal structures, policies, and practices; academic curricular and co-curricular programs, and faculty culture. Within this institution, the student finds a peer environment in which the student has classroom experiences, out-of-class experiences, and curricular experiences (Terenzini & Reason, 2005; Reason, 2009). This interactional model then determines the outcome of whether or not the student persists (Terenzini & Reason, 2005; Reason, 2009).
The interactional theories and subsequent interpretations described here provide campuses with a laundry list of options to connect students to one another and their institutions; however, this line of research has yet to provide a prescriptive model for changing student behavior (Braxton, Hirschy, and McClendon, 2004). Further, the student characteristics and motivations do little to provide a predictive model of who may or may not be successful in persisting to graduation. Additionally, the theories do not provide psychological insight for why some students “fit” and others lack the “fit” to successfully integrate into an identical environment even when they have similar academic backgrounds and socioeconomic demographics.

**The Theory of Planned Behavior**

Contemporary to Tinto (1975), Fishbein and Aizen (1975) developed The Theory of Reasoned Action (TRA) to link beliefs, attitudes, and intentions to one’s behavior. Bean (1980) utilized the TRA to predict a student’s enrollment based upon his or her intent to return to school as measured in the late spring semester; Tinto (1987) later included this intention in his revised model of student departure (Braxton, 2000). Subsequent to the early TRA persistence research, the TRA model was revised as the Theory of Planned Behavior (TPB) and better addressed behaviors marked by incomplete control such as the student departure behavior (George, 2004). Unlike Tinto’s (1975) model of student departure, TPB offers a model to predict, explain, and change human behavior and suggests that behavior can be predicted by examining individual intentions to perform a specific behavior, such as departing college, and individual perceptions of control about the behavior (Ajzen, 1988; 1991; Doll and Ajzen, 1992).

**Intentions**

Intentions “are assumed to capture the motivational factors that influence a behavior” (Beck and Ajzen, 1991, p. 286), and indicate how hard individuals are willing to try to perform the behavior. Stronger intentions indicate higher probabilities of performing the behavior if the individual perceives himself or herself as capable of performing the behavior at will. TPB suggests that intentions are formed from three underlying factors: attitudes toward the behavior, subjective norms, and perceived behavioral control (Ajzen, 1988).

**Attitudes**

The first of these factors, attitudes toward the behavior, represents the individual's evaluation of the behavior and have been shown to change over time (Ajzen, 1988; Doll and Ajzen, 1992; Leonard and Cronan, 2005). In the case of student departure or persistence, attitude would be the student’s positive or negative perception of staying in college verses departing college.

**Subjective Norms**

The second factor, subjective norms, is an indication of the individual's perceived social pressure to perform (or not perform) the behavior based upon referent others (Ajzen, 1988). Subjective norms are essentially peer pressure (Doll and Ajzen, 1992). Manning (2009) suggests that there are two types of subjective norms: perceived injunctive norms and descriptive norms. Injunctive norms are “social pressures to engage in a behavior based on the perception of what other people
want you to do”, while descriptive norms are “social pressure based on the observed or inferred behaviour of others”. The initial TPB viewed subjective norms as injunctive norms; however, Ajzen and Fishbein (2005) now recommend including both types of norms. For college students, the quality of the institutions, the usefulness of the education for getting a job, and importance of attending the selected school when compared with others represent normative beliefs (Braxton, 2000). The concept of referent others includes parents, siblings, close friends, and mentors (Braxton, 2000).

**Perceived Behavioral Control**

Perceived behavioral control “refers to the perceived ease or difficulty of performing the behavior and is assumed to reflect past experience as well as anticipated impediments and obstacles” (Ajzen, 1988, pp. 133). This construct reflects individual perceptions of factors influencing the degree of control the person has over the behavior in question. Examples of these factors include items such as information, skills, abilities, emotions, compulsions, opportunity, and dependence upon others (Ajzen, 1988). Perceived behavioral control also influences behavior indirectly through intentions. Individuals who feel they have little control over a behavior often have a low intention to perform that behavior despite positive attitudes. Perceived behavioral control (PBC) also exerts a direct influence upon behavior when the person does not have complete control over that behavior and when the individual’s perceptions of control are accurate (Madden, Ellen, & Ajzen, 1992). PBC is based upon self-efficacy theory (Bandura, 1977), and both PBC and self-efficacy measure the same latent construct (Fishbein, 2007). Thus, the student’s perceived ability to succeed in college determines his or her decision to persist or depart the college education experience.

**Changing Behavior**

Although the TPB was initially designed to predict behavior (Ajzen, 1991), it can also be used to target strategies for changing behavior (Madden, Ellen, & Ajzen, 1992). With tight resources in higher education, student retention is imperative, especially within STEM disciplines. TPB offers a method to both understand and influence student decisions regarding degree completion.

**METHODOLOGY AND NEXT STEPS**

**Instrument Design**

The constructs of the TPB lend themselves to certain instrument items. These instrument items will be customized using the authors’ familiarity with both the TPB and higher education persistence literature. The instrument will be pilot tested prior to survey implementation.

**Sample**

The data for this study will come from several state-funded and faith-based private higher education institutions located in the mid-west and southern regions of the United States. Each institution offers an introductory computer science course typically taken during the student’s freshman year.
Data Collection

The data collection will occur in August, 2012 with a follow-up data collection in December, 2012. At each institution, the professors will be enlisted to give the initial survey at the class meeting following the institutional census date early in the semester. The final survey will be given at the class period prior to final exams. The surveys will be matched using a non-trackable “formula” given to the students. Attempts will be made to reach students who were absent on that date to try to distinguish them from individuals who had left the institution. A survey inducement (such as a low-end iPod) may be utilized to further encourage student participation.

Analyses

The data will be analyzed utilizing methods typical for the TPB such as structural equation modeling. The preliminary results will be presented at the conference.

REFERENCES


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