Recognizing Challenges and Predicting Success in First-Generation University Students

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Abstract

Our study explores the challenges of first-generation students while also examining the factors that predict success in this population. We surveyed undergraduate students to compare the academic and social support needs of first-generation and continuing-generation students. First-generation students showed lower grades and lower critical-thinking scores compared to their peers. In addition, they reported having less faculty contact and less time for academic tasks. Academic preparedness and contact with faculty members predicted college success for first-generation students. Our results suggest that universities should continue to develop and test programs that bolster academic skills while simultaneously improving the social environment for first-generation students.

Introduction

First-generation university students are typically defined as those whose parents have not earned bachelor's degrees, in contrast with continuing-generation students, who have at least one parent with a bachelor's degree (Stebleton & Soria, 2012). The number of first-generation university students in the US has steadily increased (Engle & Tinto, 2008), comprising about 21% of the student population (Pryor, Hurtado, DeAngelo, Blake, & Tran, 2010). Low-income and ethnic minority students are frequently the first members of their families to attend a university (Bui, 2002; Engle & Tinto, 2008; Hertel, 1992; Jenkins, Miyazaki & Janosik, 2009; Jehangir, 2010). First-generation university students face many academic and social disadvantages (Stebleton & Soria, 2012; Woosley & Shepler, 2011). Only 11% of first-generation students earn a bachelor's degree after six years of higher education, compared to 55% of continuing-generation students (Engle & Tinto, 2008). Theoretical approaches have emphasized the need to improve the accessibility of campus academic and social support services in order to facilitate student integration (Tinto, 2004). The present study was initiated to examine the support needs of first-generation mathematics students when compared with their continuing-generation peers, and investigate which support systems best predict performance and persistence in first-generation students.

Literature Review

Tinto's Student Integration Model (1975) describes factors that predict performance and persistence in university students, including first-generation and underrepresented groups. He proposes that student attrition is based on individual characteristics (e.g., pre-university experiences, first-generation status) and the degree to which students are integrated into the university experience. Individual characteristics set the stage for goals and commitment to complete a degree program. Once on campus, individual characteristics interact with the university environment. There are two main domains of integration into the university environment: social integration and academic integration. Academic integration activities might include faculty–student interaction over course material, access to research experiences, use of tutoring centers, and the like. Social integration concerns the establishment of friendship with peers and mentorship with faculty and staff. Since institutions have little influence over individual characteristics, intervention programs should be focused on improving academic and social integration of first-generation university students (Tinto, 2004).

The academic challenge of mathematics courses can be formidable for first-generation students, who are less academically prepared than their continuing-generation peers (Hudley, Moschetti, Gonzalez, Su-Je, Barry, & Kelly, 2009; Pascarella, Pierson, Wolniak, & Terenzini, 2004). First-generation students are less likely to take university-level classes in high school (Warburton, Bugarin, & Nuñez, 2001), and show lower average scores on standardized pre-university entrance exams and critical-thinking assessments (Balemian & Feng, 2013; Bui, 2002; Pascarella et al., 2004; Terenzini, Springer, Yaeger, Pascarella, & Nora, 1996). When they enroll in a university, first-generation students are more likely to enroll in remedial coursework, are less confident in their academic abilities, and are less likely to ask for help from faculty than their continuing-generation peers (Jenkins et al., 2009; Riehl, 1994). Research has consistently shown that first-generation students have lower grade point averages (Huerta, Watt, & Reyes 2013; Riehl, 1994, Martinez, Sher, Krull, & Wood, 2009) and self-report being weak in math skills (Stebleton & Soria, 2012). Moreover, traditional mathematics pedagogies tend to create a sense of alienation from the mathematics curriculum (Radford, 2016). Overcoming academic obstacles is crucial since first-semester grades and self-reported confidence in math both predict higher education persistence for first-generation students (Dika & D'Amico, 2016). Thus, lack of academic integration has the potential to compromise university performance among first-generation students.

In addition to deficiencies in academic integration, evidence indicates that first-generation students have difficulty navigating the social environment of university, and tend to be dissatisfied in comparison to other students (Stebleton, Soria, & Huesman, 2014). Engle and Tinto (2008) showed that first-generation students are less likely to be engaged in the social experiences of the university. They seldom interact with faculty (Jenkins et al., 2009) and tend to rely on peers to gather academic advice (Torres, Reiser, LePeau, Davis, & Ruder, 2006). Low social engagement may contribute to a low sense of belonging in mathematics courses (Oldfield, 2007). Students report being torn between the culture of family and the culture of the university (Hsiao, 1992; Stephens, Fryberg, Markus, Johnson, & Covarrubias, 2012). When faced with obstacles, first-generation students may have few outlets for social support since their family members often lack understanding of the university environment. Perhaps as a result of this alienation, first-generation students report being more depressed, stressed, and upset in comparison to other students (Stebleton & Soria, 2012). Under both

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academic and social pressures, first-generation students may quickly find the stresses of coursework to be overwhelming.

Work and family responsibilities provide additional challenges for first-generation students (Kuh, 2008; Stebleton & Soria, 2012). Prospero and Vohra-Gupta (2007) showed that first-generation students tend to work longer hours than other students. Perhaps because paid work leaves them with little free time, first-generation students are less likely to engage in high-impact educational opportunities such as learning communities, service learning, and study-abroad (Kuh, 2008). Since these experiences tend to promote both academic and social integration, the exclusion of first-generation students may contribute to their collegiate disadvantages. Given their low academic preparation, lack of social integration, and burdensome work and family responsibilities, it is not surprising that about one fourth (26%) of US first-generation students drop out in their first year, compared to 7% of other students (Engle & Tinto, 2008).

Given the vast research on disadvantages faced by first-generation students, it is reasonable to ask which factors predict success in this population. Research shows that high levels of support, especially in the first year, predict successful outcomes among first-generation students (Engle & Tinto, 2008). Programs aimed at providing academic preparation and social support (e.g., TRIO programs), have been effective at increasing university enrollment and graduation of first-generation students (Pitre & Pitre, 2009). Pascarella et al. (2004) found that first-generation students derive significantly greater benefits from social integration on campus than their continuing-generation peers. High school involvement and relationships with high school personnel predict greater university success (Hudley et al., 2009), while peer and family support predict higher grades (Dennis, Phinney, & Chuateco, 2005) and retention (Hudley et al., 2009). Finally, social interactions with university personnel such as professors and advisors are associated with increased confidence, a sense of belonging, and higher grades (Bers & Schuetz, 2014; Sandoval-Lucero, Maes, & Klingsmith, 2014).

Our study compared first-generation students to their continuing-generation peers in mathematics courses at a small public university. The objectives of this study were twofold. First, we sought to compare the academic and social support needs of first-generation and continuing-generation mathematics students. Second, we sought to identify the best predictors of academic success and persistence among first-generation students. Our hypotheses are as follows:

H1: First-generation students will show lower mathematics course grades and critical-thinking scores than continuing-generation students.

H2: First-generation students will show less social and academic support than continuing-generation students.

H3: Academic preparedness and social integration will be the best predictors of performance success and persistence for first-generation students.

Methods

Participants were 160 students (*M* age = 21.95, *SD* = 6.15; 54% women, 44% men, 2% did not indicate gender) recruited from Statistics and Calculus courses at a US public, open-admissions university with a total enrollment of about 3000 students. About half (46%) of participants reported being first-generation students, while 48% reported that one or both of their parents had earned a university degree (6% did not indicate). Sixty percent of students self-identified as White, 33% identified as African American, and 7% identified as another ethnicity. According to university records, international students comprise 2% of the student population.

Initially, students were given a brief description of the study, informed that their participation in the research was optional, and told that those who chose to participate would be awarded extra credit points in the class. An alternative assignment was available for those who did not wish to participate, but still wanted to earn the extra credit points. All of the students present for data collection chose to participate in the research.

Each participant received a packet containing demographic questions (e.g., age, gender), a measure of critical thinking, and a measure of student support. Participants were additionally asked to list their current cumulative grade point average (GPA; on a 4.0 scale) and their year in school (freshman, sophomore, junior, senior). Year in school was used as a measure of persistence at the university and was scored on a four-point scale with *senior* equal to four. In addition to gathering data using a survey instrument, we also collected overall course grades from mathematics course instructors. Course grades were reported on a scale ranging from 0 to 100.

To measure critical thinking abilities, we used 17 items from the Advanced Reasoning Skills Test (ARST; Aruguete, Goodboy, Jenkins, Mansson, & McCutcheon, 2012). These items were designed to assess logical reasoning. A typical item included a short description of a problem and four response options. For example, "'All Mercurians tell lies,'" means the same thing as: A. If anyone is Mercurian, then that person is a liar. B. If anyone is a liar, then that person is a Mercurian. C. There is at least one person who is a Mercurian who lies. D. People don't lie unless they are Mercurian." Critical thinking score was calculated by the number of items answered correctly on the test (range = 0-17). The mean score in our sample was 11.44 (*SD* = 3.48).

We measured student support using the Student Support Needs Scale (SSNS; Hardy & Aruguete, 2014). The SSNS is a 33-item self-report measure ($\alpha = .87$) assessing five student support systems: (1) *Knowledge* (6 items; $\alpha = .72$) addresses whether students have the academic preparation to perform well, (2) *Time and Energy* (6 items; $\alpha = .76$) addresses whether students have the time, energy, and financial resources to complete the tasks necessary for good performance, (3) *Motivation* (5 items; $\alpha = .73$) addresses whether students desire and consider themselves able to perform well, (4) *Personal Contact* (10 items; $\alpha = .89$) addresses the amount of interaction with faculty members including receiving performance feedback, and (5) *Tools and Environment* (6 items; $\alpha = .75$) addresses whether students have adequate resources and a helpful work environment at the institution. For each item, participants choose one of five response options ranging from "Strongly Agree" (5) to "Strongly Disagree" (1). SSNS support scores positively correlate with student success measures such as grade point average and frequency of visits to professor office hours (Hardy & Aruguete, 2014).

Results

Our first hypothesis predicted that first-generation university students would show lower mathematics grades and critical-thinking scores than other students (see Table 1). As hypothesized, overall course grades were significantly lower among first-generation students (who

Measure (Range)	First-Generation Students	Continuing-Generation Students	*t*-value	*p*	Effect size (*d*)
Grades in Math Class (0-100)	75.11 (13.81)	79.94 (11.80)	2.07	.04	-.37
Critical Thinking (0-17)	10.86 (3.09)	12.49 (3.34)	2.79	.00	-.51
Knowledge (1-5)	4.04 (.54)	4.01 (.46)	-.38	.70	.06
Time and Energy (1-5)	2.93 (.80)	3.28 (.70)	2.58	.01	-.47
Motivation (1-5)	4.32 (.57)	4.25 (.56)	-.71	.48	.12
Personal Contact (1-5)	3.64 (.65)	3.86 (.54)	2.04	.04	-.37
Tools and Environment (1-5)	3.89 (.62)	3.90 (.47)	.12	.91	-.02

Table 1. Means (and Standard Deviations)

tended to score in the mid-C range of a 4-point grading scale) than their continuing-generation peers (who tended to score in the low-B range). First-generation students also scored significantly lower than continuing-generation students on the ARST measure of critical thinking. The data show a medium effect size for the critical thinking scores, but a relatively small effect size for the grade differences.

Our second hypothesis predicted that first-generation students would show less support on the Student Support Needs Scale (SSNS) than continuing-generation students (see Table 1). Our hypothesis was supported with two of the five subscales of the SSNS. First-generation students reported having less *Time and Energy* for academic work and less *Personal Contact* with faculty members than continuing-generation students. While group differences were significant, effect sizes were small. Self-reported *Knowledge* and *Motivation* were similar for the two groups.

Finally, we analyzed our first-generation students' data in an effort to understand the best predictors of performance success (GPA and math course grades) and persistence in university (year in school). For the first analysis, we entered GPA as a dependent variable and the SSNS subscales, year in school, and critical-thinking score as independent variables in a linear regression. The independent variables explained a significant proportion of variance in GPA, $R^2 = .52$, $F\ (7, 46) = 5.09$, $p = .00$. Prior *Knowledge* ($\beta = .34$, $t = 2.49$, $p = .02$), *Time and Energy* ($\beta = .28$, $t = 2.33$, $p = .03$), and *Critical Thinking* ($\beta = .33$, $t = 2.65$, $p = .01$) significantly predicted GPA.

Using a second linear regression, we sought to understand the best predictors of math course grade. We entered final course grade as a dependent variable and GPA, SSNS subscales, year in school, and critical thinking as independent variables. The independent variables explained a significant proportion of variance in course grade, $R^2 = .59$, $F\ (8, 44) = 6.59$, $p = .00$. Only *Critical Thinking* ($\beta = .43$, $t = 3.28$, $p = .01$) and GPA ($\beta = .41$, $t = 2.59$, $p = .01$) significantly predicted course grade.

Our last regression examined the predictors of university persistence among first-generation students. For this equation, we entered the year in school (persistence) as a dependent variable and GPA, SSNS subscales, and critical-thinking score as independent variables. The independent variables explained a significant proportion of variance in persistence, $R^2 = .40$, $F\ (7, 46) = 3.76$, $p = .00$. Only *Personal Contact* with faculty members significantly predicted persistence in university among first-generation students ($\beta = -.57$, $t = 3.67$, $p = .00$).

Discussion

This study identified academic and social obstacles, as well as predictors of success, that are specific to first-generation university students enrolled in mathematics courses. Our results support the Student Integration Model (Tinto, 2004), which prescribes that low academic and social integration of students should be used as a barometer indicating the need for institutional intervention programs. Our study has several limitations including our inability to conclude cause-and-effect from a correlational design.

Our findings showed that poor academic integration is a major obstacle for first-generation university students. Our results support other studies that have also shown lower average GPAs, scores on standardized pre-university entrance exams, and critical-thinking assessments (Balemian & Feng, 2013; Bui, 2002; Huerta et al., 2013; Martinez et al., 2009; Pascarella et al., 2004; Riehl, 1994; Terenzini, et al., 1996) in first-generation students. Clearly, intervention programs for first-generation students should include an academic integration component.

Social integration at the university is another major challenge for first-generation students. Our research concurs with previous studies indicating that first-generation students are getting little social support on campus (Stephens et al., 2012), and show reluctance to engage with faculty members (Jenkins et al., 2009). Stephens et al. (2012) proposed that while US universities try to welcome students with all backgrounds, they are inadvertently more likely to provide a supportive culture for continuing-generation students, who thrive in a university environment that promotes working independently, taking initiative, and pursuing one's passions. By contrast, first-generation students often come from interdependent cultures in which family support is very important and the pursuit of individual needs has been discouraged as selfish (Stephens et al., 2012). Being separated from family and feeling a low sense of belongingness on campus, first-generation students may quickly feel marginalized. Thus, social integration must be included in programs aimed at improving performance in first-generation students.

Mathematics intervention programs have demonstrated success in helping university students increase academic and social integration (Wake, 2011). For example, the University of Manchester has developed TransMaths, a research-based program designed to aid the transition into university-level mathematics courses (Pampaka, Williams, Hutcheson, Wake, Black, Davis, & Hernandez-Martinez, 2012). They advocate "connectionist" pedagogical practices that emphasize structured, applied, and interactive problems-solving, instead of "transmissionist" practices that use lecture-based techniques. The group-focused, problem-solving strategies combine the goals of academic and social integration by focusing on student-centered activities in which faculty members play a responsive and dialectic role. They have found that this approach increases student mathematical confidence and disposition toward math (Wake, 2011), which predicts persistence of study (Dika & D'Amico, 2016). Since first-generation students are often reluctant to take the initiative to engage with faculty members (Dennis et al., 2005; Engle & Tinto, 2008; Stephens et al., 2012), structured interaction that takes place during class time may increase student motivation to participate. TransMaths is one example of an intervention that addresses both academic and social challenges. This holistic approach is likely to be necessary to promote university success among first-generation students in mathematics courses.

First-generation students' work and family responsibilities can compromise their academic and social integration on campus. Our findings support previous research showing that work and family responsibilities leave little time for academics among first-generation students (Kuh, 2008; Stebleton & Soria, 2012). The low-income status of many first-generation students (Pascarella et al., 2004) may necessitate working full-time jobs, especially when parents are not able to help pay for university tuition (Prospero & Vohra-Gupta, 2007).

Increased financial aid could reduce the work hours of first-generation students. In the United States, the cost of a university education has increased by over 200% since 1995 (Mitchell, 2015). Universities can play an important role in educating students about financial aid options and assisting with the application process. First-generation students often have trouble understanding the differences between loans, grants, and scholarships (Engle, Bermeo, & O'Brien, 2006), and their parents are unlikely to be of assistance. Our university mandates financial aid counseling sessions prior to loan disbursement in an effort to clarify repayment responsibilities. Still, ongoing education is likely necessary. Scholarship outreach programs that educate students about local, national, and private funding sources could increase financial stability and give first-generation students more time to focus on academic and social integration. Our data suggests that greater time and energy for coursework will likely result in higher mathematics grades and higher GPAs.

The main limitation of our study was the correlational design, from which we cannot conclude cause-and-effect relationships. For example, we found that contact with faculty members predicted student persistence at the university. This result may indicate that faculty contact is one factor that keeps students from dropping out of higher education. Alternatively, student persistence may cause increased faculty contact, inasmuch as faculty is more likely to form relationships with students who persist in their studies. Controlled studies testing the efficacy of programs designed to increase faculty contact are needed. Longitudinal studies of persistence at the university can also provide more valid measures of persistence when compared to the *year in school* measure we used. The dichotomous classification of first-generation vs. continuing-generation students may be overly simplistic. Students may gain knowledge of the university system through non-parent mentors or other siblings, and exposure to such knowledge is clearly on a continuum. Our self-report measures

of GPA and year in school might include inaccurate data if students misrepresented themselves or did not know the answers to the questions. Finally, a possible confounding variable in our study is that first-generation students are more likely to be non-native English speakers (Bui, 2002). Future research should include a measure of English as a second language, especially where immigrant populations make up a large proportion of the student population. Despite these limitations, the similarities of our findings and those of previous research in a variety of institutions show that first-generation students are facing similar obstacles in a range of educational environments including mathematics courses.

Research has consistently shown an achievement gap between first-generation university students and their continuing-generation peers (Stephens et al., 2012). The results of our study support previous research showing that first-generation university students have academic and social disadvantages that are compounded by work and family responsibilities (Engle & Tinto, 2008). Research strongly suggests that narrowing the achievement gap will require institutions to continue to design, implement, and test holistic intervention programs that address both the social and academic challenges of first-generation students.

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