

Purposeful Pairings: Roommate Selection Impact on STEM Majors

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Abstract

The declining number of undergraduate students declaring a major in a Science, Technology, Engineering, or Math (STEM) field is a national challenge. While many policies and practices have been researched to promote STEM retention, one area that lends itself to study is that of roommate pairings. This mixed-methods research investigates how policies impact first-year students adapting to university life, how their social-emotional needs can be met, and how intentional roommate pairing may lead to increased academic success and retention of STEM students.

Key Words: STEM, roommate pairings, first-year students, retention, student success

Introduction

The declining number of undergraduate students declaring a major in a Science, Technology, Engineering, or Math (STEM) field became a noticeable issue in the 1990s (Laws, 1999; Rask, 2010). Since then, “producing sufficient numbers of graduates who are prepared for STEM occupations has become a national priority in the United States” (Valerio, 2014, p. 1). Aulck et al. (2017) found that between “50-60% of students entering US colleges intending to major in a STEM field ultimately either graduate with a non-STEM degree or do not graduate at all,” despite being capable scholars who would be strong contributors to a STEM field. Working to retain undergraduate STEM students is clearly an undertaking institutions and policy makers who examine student success must prioritize. While many policies and practices have been researched to promote STEM retention, one area that lends itself to study is that of roommate pairings.

Literature Review

General Predictors of Student Success

Student success, and the retention of first-year students, has long been at the forefront of educational research and policies. This research is a response to increased diversity in student populations and the realization that most students who leave higher education will leave after their first-year (Trow, 2007; Crede & Niehorster, 2012; Willcoxson et al., 2011).

Astin (1984, 1985, 1991) developed one of the earliest theories related to student success. His developmental theory of student involvement identified issues that impact student retention at the post-secondary level. In 1991, Astin identified three categories of involvement that were most influential on students: their involvement with faculty, with their academic work, and their

involvement with their peers, including roommates. These three engagement aspects were also recognized in the analysis of Kuh et. al (2006).

Despite this research, many institutions of higher education continued to rely on achievement test scores to serve as predictors of student success. In fact, achievement exams “such as the American College Test (ACT) and SAT were offspring of intelligence testing and gained rapid popularity as instruments to predict academic success” (Fauria & Zellner, 2015, p. 90).

However, there have been many calls to de-emphasize the use of standardized tests and instead focus on noncognitive skills as predictors of student success (Kalsbeek, Sandlin, & Sedlacek, 2013). In fact, researchers at the Consortium of School Research “developed a model contending that factors such as academic mindset (e.g., grit, delayed gratification), learning strategies (e.g., time management, self-regulated learning), social skills (e.g., interpersonal skills, empathy), and academic behaviors (e.g., going to class, doing homework) affect academic success within a broader school and sociocultural context” (Farrington et al., 2018, p. 309).

Roommate

An important part of academic success is the sense of belonging. The sense of belonging is the “degree to which students feel they are part of a college community and are meant to be in college” (Farrington et al., 2018, p. 309). Cultivating this sense of belonging is of great importance, as students who do not feel connected rarely remain enrolled (Strayhorn, 2019). In fact, students who feel disconnected often describe college as a shopping trip in which they are “stopping by the mall to get what they need on the way to somewhere else” (Jacoby & Garland, 2004, p.65). The need to belong and feel connected is a long understood human need. Erikson’s (1968) stage theory of psychological development “asserts that young adults’ primary objective is to experience intimacy in relationships rather than isolation.” (Erb et al., 2014, p.43).

One of the greatest places in which students can feel that they belong is through peer interactions (Strayhorn, 2008; 2019). Strayhorn (2019) argues that “it is critical for college student educators to encourage positive interactions among students through conditions that really matter in college” to increase student success (p. 2).

Arguably, the most intense peer relationships for college students are the relationships with their roommates as they cohabitate leading to constant interactions. These relationships often differ from traditionally acquired friendships as most students are paired by the institution with their roommate. While many new programs work to assist roommate pairings, Lui et al. (2008) noted that during the first-year of college 50.1% female students reported that they experienced a roommate conflict either frequently or occasionally, while 44.1% of men report a frequent or occasional conflict (p. 14). These conflicts are important to note, as the American College Health Association (2011) found that 5.6% of undergraduate students reported that conflicts with their roommate negatively impacted their academic performance.

STEM Retention

The STEM attrition rate is reported at 50% among first-year STEM students (Aulck et al., 2017; Chen, 2013). This means that half of the students who declare a STEM major will pursue a degree in another area within their first-year of higher education or leave college entirely. This is an alarming number as there “is predicted to be a shortage of 1 million STEM-trained professionals” in the United States (Gates & Mirkin, 2012).

There are many elements and situations which contribute to this high attrition rate, including lack of preparation before entering college, “the traditional lecture-based teaching style and resulting social isolation, a lack of role models, hypercompetitive peer environments, and overall lack of student support during the first-year” (Kamen & Leri, 2019, p. 24).

Due to this attrition rate, research has been conducted to identify methods for advancing persistence in STEM higher education programs. This research has established the need to support student financially and through institutional commitments (Seymour & Hewitt, 1997; Xie, Fang, & Shaumen, 2015; Sweeder et al., 2019). Through this research three categories have emerged as imperative for student retention: “prioritizing institutional commitment to students, committing to the education of all students, and committing to integrating students within social and intellectual communities” (Sweeder et al., 2019, p.1). Part of the creation of intellectual communities is to support students in creating a STEM identity. This STEM identity involves improving connections to STEM faculty, STEM peers, and the STEM fields in general (Williams & George-Jackson, 2014).

Purpose of Study

This explanatory mixed methods study was predicated upon academic performance and housing situation of 47,878 students, then upon cases studies of nine focal students. This study sought to answer the following research questions:

1. How and why do living arrangements affect first-year STEM majors’ academic performance?
2. How and why do living arrangements affect first-year STEM majors’ overall college experience and retention?

Data Collection, Analysis and Methods

Data collection for this study consisted of a three-phased data collection approach at a public, regional comprehensive university in the Midwest. First, overall student success data from Spring 2015 through Fall 2020 was analyzed based upon GPA and persistence which suggested trends for STEM majors’ success based on their living arrangements. In total 162,498 student-

semester outcomes were considered during this period, of which 47,878 lived in a residence hall during the given semester. These students were further disaggregated by whether they lived alone, with a roommate in the same college, or with a roommate from a different college.

Second, semi-structure interviews with first-year STEM majors from different living arrangement categories were conducted. There were 560 first-year STEM students in the Fall of 2021 at the university utilized in this study. Since mathematics courses were most universally taken in the first term across STEM, this discipline was focused on. Among the mathematics courses, Precalculus and Introduction to Statistics both had 113 STEM first-time students enrolled. However, over 90% of the Introduction to Statistics course was nursing students, so Precalculus was selected as the most representative and comparable group of incoming STEM students. Those students were emailed an electronic survey and asked if they would be interested and willing to take part in an interview. Interview participants were selected in order to represent the different housing statuses of interest, starting with the first respondents to the electronic survey. These interviews focused on student's academic achievement as well as overall college experience. Finally, GPA data from those who participated in the interviews were collected to examine their alignment with the overall trends of the larger student population.

Participants

This explanatory mixed methods study was predicated upon academic performance and housing situation of 47,878 students, then upon cases studies of nine focal students. Purposeful sampling was utilized in order to capture varying student experiences. Lincoln and Guba (1985) define purposeful sampling as a group that is “representative of a population to which it is desired to generalize” (p. 200).

Each of the interviewees in this study were college freshmen enrolled at a rural, regional university. Most roommate assignments were random. Students happened to sign up for the same room and in some cases connected on social media to see if they thought this random matching would be a good fit. One exception was a participant who is a student athlete (Stacy) and as her roommate pairing was made by her coach. Another exception was the student who lived alone (Alan) as he intended to have a roommate, but the roommate never arrived at the beginning of the semester.

Participant	Major	Roommate Major	Additional Relevant Information
Sterling	Biochemistry	Chemistry	Sterling and his roommate were both honors students.
Stacy	Biochemistry	Biology	Stacy and her roommate were both student athletes.
Steve	Computer Science	Physics	Steve's roommate intends to change his major to Marketing after the semester of this study
Noreen	Engineering	Theatre Arts	
Nora	Biology	Elementary Education	
Noble	Data Science	Kinesiology	
Alan	Computer Science	N/A	Alan is a student who lives Alone.
Colbie	Biology	N/A	Colbie is a commuter student who lives with her parents.
Corrine	Engineering	N/A	Corrine is a commuter and nontraditional student.

Quantitative Results

Turning our attention to the 22,402 first-semester students at the institution during the study period, the average semester GPA was 2.81. In total, 15.4% had a semester GPA below 2.0 (which would put them on academic probation), and 12.6% discontinued (left the university the next semester with no degree). Of those first-semester students, 12,694 lived in a residence hall. Their average semester GPA was a 2.76, 16.6 % qualified for probation, and 9.8% discontinued.

Observe that the average GPAs were close, that one group had a lower level of probation, and that the other group had a lower rate of discontinuance.

Of first semester students living in a residence hall during a long semester, 1,659 lived alone and 11,009 lived with a single roommate (this number being odd highlights that we did not require that they be living with a first semester roommate). The records on the remaining 26 made it impossible to classify their roommate situation. Of the 11,009 first semester students living with a roommate, 3,001 roomed with someone from their same college. Finally, 1,103 of those were STEM students with a STEM roommate.

As Table 1. illustrates, those living on campus alone in their first semester have the lowest average GPA at 2.63, the highest rate of ending up on academic probation (19.8%), and a high rate of discontinuance (12.1%). Those living with a roommate *not from* their same college have a higher GPA (2.77), a lower rate of academic probation (16.3%), and a lower rate of discontinuance (9.3%). Those living with a roommate *from* their same college have a higher GPA (2.82), a lower rate of academic probation (15.5%), and a low rate of discontinuance (9.7%). Off-campus, first semester students are a bit of an anomaly having the best GPA and lowest probation levels, but the highest rate of discontinuance.

	GPA	Probation	Discontinued
On campus, Living alone	2.63	19.8%	12.1%
On campus, Roommate in different college	2.77	16.3%	9.3%
On campus, Roommate in same college	2.82	15.5%	9.7%
Off campus	2.88	13.5%	16.2%

Table 1. First semester college students' performance by livings situation.

We now turn our attention solely to STEM majors. As seen in Table 2., STEM first semesters students living on campus alone again have the lowest average GPA at 2.57, the highest rate of ending up on academic probation (20.8%), and a high rate of discontinuance (17.3%). Those living with a roommate *not from* their same college have a higher GPA (2.71), a lower rate of academic probation (17.5%), and a lower rate of discontinuance (9.6). Those living with a roommate *from* their same college have an even higher GPA (2.83), a lower rate of academic probation (15.5%), and a low rate of discontinuance (9.8%). Off campus first semester students now fit a much more similar pattern: lower GPA (2.69), higher probation levels (17.8%), and highest rate of discontinuance (20.3%).

	GPA	Probation	Discontinued
On campus, Living alone	2.57	20.8%	17.3%
On campus, Roommate in different college	2.71	17.5%	9.6%
On campus, STEM Roommate	2.83	15.5%	9.8%
Off campus	2.69	17.8%	20.3%

Table 2. First semester STEM college students' performance by livings situation.

Of students living in a residence hall during a long semester, 33,088 of the records are of paired rooms, 14,635 were of students living alone, and the remaining 19 students were in living situations that could not be classified. Of the 14,635 students living alone, the average semester GPA was 2.80.

It is worth noting that these trends were unique to beginning students, indicating that the dynamics at play for our most vulnerable students might be different than for all students at

large. When we consider *all* 162,498 student-semesters within the study period, their average semester GPA was a 2.90, with 2.5% having semester GPA's below 2.0, and 8.6% discontinuing. Not that their average GPA was higher than any of the subpopulations examined above. For the 47,878 student-semesters completed while living in the residence halls, the average semester GPA was a 2.79, 15.0% had semester GPA below a 2.0, and 11.6% discontinued. This appears to be a classic instance of Simpson's Paradox – there are far more students that have progressed beyond their first semester and in their first semester, and these students are both more academically successful and disproportionately live off campus.

Participants' GPA and Persistence

At the completion of the Fall 2021 semester the GPA and number of credit hours earned for each of the interview participants was collected and are summarized in Table 3. In a similar trend to the overall university data, the STEM majors who roomed with another STEM major tended to have a higher GPA than the other categories. In addition, Sterling and Stacey were two who earned some of the highest number of credit hours. For the STEM majors who had non-STEM roommates, we see Noreen was quite successful while Nora and Noble were closer to the university average for STEM students with non-STEM roommates.

One of the most noteworthy participants to observe was Alan. Not only did Alan have the lowest GPA in this study, he also discontinued from the university for the following semester. This aligns with the high rate of discontinued students from the population of students who lived alone. Finally, both commuter students were successful, a trend that was also observed from the overall university data.

Participant	GPA	Credit hours earned
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Sterling	4.0	17
Stacey	3.94	16
Steve	3.75	12
Noreen	3.85	13
Nora	2.54	13
Noble	2.92	12
Alan	2.06	15
Colbie	4	17
Corine	3.33	9

Table 3. Participant GPA and number of credit hours earned during Fall 2021.

Qualitative Results

The nine participants in this study shared their individual experiences as college freshmen who experienced a variety of different living arrangements. Through the sharing of these experiences, several themes of recurring patterns were brought forth (Merriam, 2009).

Themes

Academic Themes

Academic-related themes emerged for each category of participants. The STEM majors who were paired with STEM majors at the same course level indicated an advantage in regard to their academic experience. However, the other categories of participants indicated some barriers.

STEM/STEM Roommates Promoted Academic Success

Sterling and his roommate shared many study habits and needs. Sterling explained that his roommate even taught him a new study skill as he stated “You know, he actually taught me how to study on a white board, which was revolutionary to me. I’ll see him with his whiteboard, just going at it.” Sterling continued to explain that “he [roommate] came home from Walmart or Target or something with another whiteboard for me.”

Steve and his roommate have also experienced strengths of the STEM/STEM roommate relationship as they are enrolled in the same pre-calculus course. This common course has been a resource to both. Steve acknowledged that “My roommate, we take pre-cal together. So, we’re like “oh, do you know how to do out this problem?” We work stuff out together.” He went on to explain that they both benefited from this commonality because they “worked together anytime he had struggles, he’d ask for me for help and reverse.”

These academic interactions and collaborations are important to note. Research has revealed that attrition among STEM students is often attributed to a student’s lack of preparation and the difficulty of adjusting to traditional teaching styles (Kamen & Leri, 2019, p. 24; Aulck et al., 2017). However, Sterling and Steve were afforded additional academic support via their roommates.

STEM/STEM Roommates Faced Challenges Due to Course Level

Despite both being STEM majors, Stacy and her roommate had different experiences and study needs. Stacy compared the two saying “She is a STEM major, but she's not on this same... not the same pathway as I am. I'm a biology major. She's a biology major, but she didn't start her major yet. She started with like entry classes; like entry freshman English. I didn't take any of those classes because I came in with all those credits, so I started in my major. So, big difference

when we first got to campus was, my first week I started with classes, exams, homework.” Stacy went on to reveal that she felt “I was loaded and she wasn't.” This difference seemed to create challenges as Stacy revealed that “Even if I want to study in my room throughout the day, someone's always in there because they're not as busy as you are.” While there is “limited evidence that a student's first-year grade performance is influenced by the observable academic characteristics of his/her roommate” (Stinebrickner & Stinebrickner, 2006, p. 1435) it is important to note that Stacy was not afforded the same positive collaborations of Sterling and Steve.

STEM/Non-STEM Roommates Faced Challenges Related to Academics

Noreen explained that one of the challenges to her roommate relationship is that they do not share study habits revealing that “I think one of the biggest things is that sometimes she'll come in and like I'll be doing homework, or something like she'll have her volume up on her phone will be loud or she'll be on speaker phone late at night.” She also revealed that they do not communicate much about their courses “I don't ever know what kind of homework she has.”

Noble revealed similar frustrations, revealing that “sometimes like I'm doing like really hard work. I just don't want anybody to talk to me. It was last night I was knocking out some hard problems for computer science that I didn't know how to do. Didn't get anywhere for two hours. But it was just like one of those moments like I just cut everyone off because I didn't want anybody in the room.”

These differences were compounded by the fact that the roommates are enrolled in different types and different levels of courses. Noble explained that “I'm taking a bunch of math basically, because I hate reading and I like science, but I like prefer math. And he's taking all his... like he

doesn't care what he takes. I don't know, it's just different I. I took a bunch of excelled classes in high school and he kind of like barely got into [this university]. Like my SAT was like 1260 and his was like 900.”

Nora reiterated these differences revealing that she feels as if her roommate “definitely has a lot less of a workload than I do so. She doesn't have to study as much. I guess she has a lot more free time than I do. I definitely have like a lot more that I have to study for and a lot more like harder material. Like chemistry, and pre-cal definitely, and biology.” Strayhorn (2019) argued that “it is critical for college student educators to encourage positive interactions among students through conditions that really matter in college” to increase student success (p. 2). Additionally, these frustrations can lead to conflicts and the American College Health Association (2011) found that 5.6% of undergraduate students reported that conflicts with their roommate negatively impacted their academic performance.

Students Without Roommates Faced Challenges

Alan, who was not assigned a roommate, explained that he felt he was at a disadvantage living alone. Alan lamented that “if you have a roommate that is doing the same thing, yeah, in the same department, yeah, it's better that way because you're going to rub minds together. Given the same homework, you're able to help each other out.”

Colbie echoed similar feelings about opportunities to study or participate with her peers. She explained that “I guess when some of the things are later in the day, sometimes I'll get home and all decide, hey I don't want to drive back up there, or it's more of a trouble to go back up there and come back.”

Corrine, who is a wife and mother of two, explained that she relies on the academic resource center for assistance with studying, but that also comes with challenges. “I’m usually here until at least five o’clock PM. Because I try to go to this tutor to kind of get extra help. Which honestly, that kind of stinks for me, because like I wish the tutoring was like earlier.” While she found additional support studying with the student instructor of one of the tutoring groups, explaining that “we meet up sometimes and we’ll go over things together, too,” this support was not consistent. Residential students often have an advantage since “they live on campus, they (residential students) have better access than their commuting peers to institutional resources for learning, including faculty members and other students” (Kuh et al., 2006, p. 51). It appears that the lack of interaction with peers and academic resources is a detriment to the participants without a roommate.

Non-Academic Theme

Lack of Social Interaction for Students Without a Roommate

Students who were commuters, or did not receive a roommate, revealed that their social interactions were often limited by their living arrangements. When asked what the most challenging aspect of his first-year college experience Alan has been replied “meeting new people, I guess.” Connecting with a community, especially other STEM students, is important to establish a sense of belonging to increase the likelihood of retention (Strayhorn, 2019). Even though Alan resided on campus, it appeared that he did not have an established connection at the university.

Corrine lamented that living at home and being a parent “is kind of hard with my family, like, I can’t, some of the stuff I can’t do.” Colbie, who lives at home with her parents and siblings,

mentioned being involved with two campus organizations and meeting people that way though she pointed out that “they weren’t freshman.” If students are unable to develop significant relationships with their peers, or faculty and staff, there will be a decreased sense of belonging and a higher chance of attrition (Strayhorn, 2019).

Discussion

The quantitative results from this study were exceedingly clear cut. Freshmen students who have roommates perform better than those who don’t and better still if their roommates are in their same college. This effect is true across colleges but exacerbated for STEM students and even demonstrates better success than off campus students (which is not true outside of STEM). The outcomes are more positive whether examining GPA, probation rates, or discontinuance.

These superior engagement numbers appear to lend themselves precisely to the experiences of the interview subjects. Alan felt he was at a distinct disadvantage because he didn’t have a roommate. Noreen, Noble, and Nora all expressed frustration and/or challenges over having a roommate with different study demands than they had. In addition, it should be noted that even the *perception* of being disadvantaged when one is in a potentially high-risk situation where engagement is critical has much the same effect as more explicit disadvantages – that is disengagement. On the other side of the equation, we also observed positive effects from STEM majors rooming with STEM majors (perhaps nuanced by Steve’s experience with a roommate who was not actually fully committed to STEM). The conclusion is clear, and arguably an extremely actionable step toward increasing STEM student engagement, belonging, and performance – STEM majors should be assigned to room with STEM majors where the assignment is feasible. Such an intervention aligns both with common sense, and both analyses within this work.

The qualitative result provides critical insights into the individual experiences of the participants. These experiences support implementing policies which pair STEM students on similar academic trajectories and timelines. These policies could assist in the retention of STEM students, aiding in filling the need for STEM degreed individuals.

Limitations and Recommendations

This study focuses on a small number of personal experiences, not a quantifiable data set. It is important that these personal experiences enabled the researchers to identify important emergent themes. However, it remains unclear if these themes are transferable to other students or other institutions of higher education.

Despite these limitations, this study adds to the literature that investigates how policies impact first-year students adapting to university life, how their social-emotional needs can be met, and how intentional roommate pairing may lead to increased academic success and retention of STEM students and other first-year student populations.

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