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Predictors of Student Success In Supplemental Instruction Courses at A Medium Sized Women's University

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Predictors of Student Success in Supplemental Instruction Courses at a Medium Sized Women's University

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Abstract

Supplemental Instruction (SI) is a program that seeks to improve student success by targeting classes with high failure rates, as defined with a failure percentage of 30% or more. It is organized by an administrative SI supervisor who supervises SI leaders, which are students that have successfully completed the courses that they have been assigned. The SI supervisor also collaborates with the course instructors who aid in screening the competency of the SI leaders. Improved self-confidence, teamwork, independence and course performance have been reported as benefits of SI. This project sought to explore the effect of SI on success and failure, along with gender, age and race. The type of course was also used as a factor in order to control for it as a confounding variable. In order to ascertain the effect of these variables on success, a technique called logistic regression was used. Caucasian female students who took bacteriology and did not attend SI were used as the reference group. Students were about twice as likely to succeed if they completed the required number of SI sessions and one fifth as likely to succeed if they were in a SI class and did not meet the minimum number of sessions. Hispanic students were 40% as likely to succeed, and African American students were about one third as likely to succeed when compared to Caucasian students. Students between 20 and 29 years old were half as likely to succeed, and those 30 or older were one quarter as likely to succeed when compared to teen students. Those in algebra were about three times more likely to succeed than those in bacteriology, chemistry and statistics. When the students that withdrew were removed, the chances of success were about the same, except for African American students which were one quarter as likely to succeed, and those that did not meet minimum sessions were one quarter as likely to succeed. The model explained more variation when the students that withdrew were included. As SI had a strong influence on success, it should be considered as a tool to enable retention of students in high risk courses.

Introduction

That lack of retention of students has been, and continues to be a costly challenge for institutions of higher education, is widely documented (Lang, 2002). Factors shown to contribute to this attrition include ethnicity (Lang, 2002; American Psychological Association, 2012). Supplemental Instruction (SI) is a method that has been shown to improve success in high risk courses (Arendale, 2006; Malm, Bryngfors, & Morner, 2011).Supplemental instruction is defined as an assistive program that seeks to improve academic performance via peer mediated instruction. (Arendale, 2006). Created at the University of Missouri in Kansas City in 1973, SI is used as a method of attrition prevention in high risk courses. Courses defined as high risk generally share the following traits: large classes in which students have low opportunity to communicate with instructors or other students; high volume reading assignments; unrecorded and voluntary class attendance; and infrequent examinations that focus on the higher levels of cognitive thinking as defined by Bloom's taxonomy (Arendale, 2006). A noted advantage is that SI targets high risk classes as opposed to high risk students, which prevents singling out of individuals. SI is staffed by a general chain-of-command structure, which consists of an administrative SI supervisor, who manages student SI leaders (Hurley, Jacobs, & Gilbert, 2006). The SI supervisor is responsible for identification of courses in need of SI; retention of faculty support; selection and training of SI leaders; evaluation of the quality of the SI sessions; and evaluation of the gestalt program (Hurley, Jacobs, & Gilbert, 2006). SI leaders are students that have demonstrated aptitude in the courses they have been assigned, and typically attend a SI leader training session (Arendale, 2006; Hurley, Jacobs, & Gilbert, 2006). Faculty of targeted courses are also included in the program and may be involved in the process of screening SI leaders for competency (Arendale, 2006; Hurley, Jacobs & Gilbert, 2006).

The SI model

Supplemental instruction is an eclectic teaching strategy based on several theories of learning to include behavioral and cognitive components (Hurley, Jacobs & Gilbert, 2006). One behavioral component that is used is based on positive reinforcement, where if a student uses a successful study strategy they are likely to keep using it. Incorporated into this study strategy is the setting of short term goals, where the long term goal of successfully passing a test is broken down into smaller, more manageable tasks. The SI leaders also play a role by modeling effective study strategies for students (Hurley, Jacobs & Gilbert, 2006).

The SI leaders also play a role in the cognitive components of the SI model, where they teach students how to think critically, as well as assimilate and organize new experiences and information. Cognitive development also relies on social interaction, which occurs during discussion of a topic as relevant conflict arises and is subsequently resolved. The SI leader also plays a key role in teaching students to become independent, rather than relying on an authority figure (i.e., the instructor) for information. Students must be actively involved in their own learning and must take responsibility for their participation in SI sessions. The students also learn teamwork, as students learn to work together to achieve a common goal. They also gain confidence as they learn to actively contribute to the group's collective progress. Learning independence, teamwork, effective study strategies and contribution to group learning are skills that will increase their chances of success in future classes.

Advantages

There is much evidence supports the effectiveness of SI (Dawson, van de Meer, Skalicky & Cowley, 2014), and is effective in difficult or 'high risk' courses. The content of these courses vary, and include introductory STEM (science, technology, engineering and mathematics) classes, as well as classes in other fields such as business (Boldt, Kassis & Smith, 2015). Supplemental instruction begins during the first week of the term or semester. It is introduced to the students by the SI leaders, and fixed appointments with SI leaders are then scheduled. As all students in the classes participate and will have varying aptitudes for the respective class content, the stigma of being a high risk "remedial" student is reduced, if not eliminated (Moore & LeDee, 2006). It also promotes socialization and interaction among students of varying abilities. These two factors are seen as advantages, as the perception of being remedial, and a lack of socialization may reduce motivation and promote attrition (Moore & LeDee, 2006).

Other advantages of SI include its proactive, rather than reactive nature (Hurley, Jacobs, & Gilbert, 2006). It enables student aptitude for course content while simultaneously teaching effective study strategies. Supplemental instruction leaders attend all class sessions and are thus aware of the material taught in each class session. This removes a communication gap between the SI leaders and the students, in contrast to a tutor who does not attend the class and who may instruct based upon perception of what transpired in the classroom. Learning and instruction of study strategies is also offered within the context of course requirements.

Supplemental instruction contains a social component in that it encourages student interaction and mutual support (Hurley, Jacobs & Gilbert, 2006). This encourages social inclusion of students who may feel marginalized due to factors such as cultural or socioeconomic differences. It also provides an opportunity for the SI leader to communicate problems concerning student understanding of content to the course instructor and the SI supervisor (Arendale, 2006). The SI leaders also benefit from this program academically, and they report improved communication skills, increased self-confidence, leadership skills, and team-building strategies (Stout & McDaniel, 2006). In summary, SI improves academic performance and socialization of all students who are engaged in the SI model.

Disadvantages

The effectiveness of SI may be compromised under certain circumstances. While success varies between programs, SI may be more challenging in courses that require prerequisite skills; for example, students may experience difficulty in an advanced physics course if they do not remember calculus (Arendale, 2006). In order to be more successful, more time and planning by the SI leaders will be necessary. Supplemental instruction sessions may also be relatively longer and more frequent, in order to accommodate students without prerequisite skills. Reorganization may be needed as more advanced students may be bored by repetitive material. Supplemental instruction should also be attached to courses that are relatively difficult, as students may prefer to not attend if they find the course content to be relatively easy. SI is also ineffective in classes where students are unable to read, write, take notes, or study at the high school level. From a financial perspective, SI is also costly, and requires a large number of staff to be trained (Dawson, van der Meer, Skalicky & Cowley, 2014). In summary, SI should optimally be used in relatively difficult courses in which the students have demonstrated mastery of prerequisite coursework (Arendale, 2006).

Selection of SI as an intervention

The institution in which the study was conducted is identified as a woman's university in its mission statement, although it is coeducational. There are approximately 90% women and 10% men. The institution's student demographic has 42% Caucasian, 20% African Americans and 7.9% Asian. Its student population is 24% Hispanic, and thus approaches the status of a Hispanic serving institution. Although evidence has shown the effectiveness of SI, the authors have found no literature reporting the use of SI in an institution with similar demographics. Supplemental instruction was chosen as an intervention as part of a grant funded project that sought methods to support students in high risk courses. High risk was defined as those courses with a failure rate of ≥ 30%.

Method

Participants

Participants were students enrolled at a medium sized woman's university, and the data was collected in order to ascertain the effectiveness of supplemental instruction in courses with high attrition. The study was retrospective, was collected from the school's office of institutional data management, and was analyzed as part of a graduate culminating project. The control group was composed of students enrolled in classes in Fall of 2013, and the experimental group was composed of students enrolled in classes in the Spring of 2014. Control groups were chosen from Fall 2013 for several reasons: firstly, there were no available classes to be used as controls for bacteriology and algebra in the spring. Secondly, instructors for chemistry were unwilling to participate in the study, and therefore the sections of willing instructors were chosen as intervention groups. Therefore, sections for all courses were randomly chosen from the fall to serve as control groups. Mandatory attendance to a minimum of four SI sessions was written into the syllabi of all intervention courses. Thus, a SI participant was defined as a student enrolled in a SI course, and a non-participant was defined as those in the control group, i.e. a course in the Fall semester. A third group was composed of those who were SI participants, but did not complete minimum sessions. There was a total of 1325 participants, and the study was approved by the local Institutional Review Board.

Descriptives

In this study four categorical independent variables were used to determine success or failure in algebra, bacteriology, chemistry, and elementary statistics. The variables were SI attendance, age, gender and ethnicity. The minimum number of SI sessions was four. This number was chosen because the mean number of examinations for the pooled courses was four in previous pilot work, thereby enabling at least one SI session per examination. Even though each course shared the characteristic of an SI course (i.e., attrition rate of 30% or higher), the type of course was added as a fifth independent variable in order to control for it as a confounding variable. Successful students earned a grade of A (≥ 90%), B (≥ 80% - < 90%), or C (≥ 70% - < 80%). Unsuccessful students earned a grade of D (≥ 60% - < 70%), F (<60%) or W (withdrawal).Students that withdrew were included in the unsuccessful category because unlike the grades of A, B & C (and like the grades of D and F), withdrawal is an unfavorable outcome. Withdrawal is costly to the student as it can increase education costs and student debt (Guided pathways to success: boosting college completion, 2012). It can also result in increased time to graduation for the withdrawing student (Nicholls & Gaede, 2014), as well as for students that are unable to enroll because of classroom spaces that are improperly allocated. From the perspective of the institution it negatively affects variables such as the 6-year graduation rate (Boldt, Kassis & Smith, 2015). Although factors vary, students often withdraw to avoid a D or F (Congos & Schoeps, 1993), and adding withdrawal to the unsuccessful outcome category is found in other studies of SI (Hensen & Shelley, 2003; Cheng & Walters, 2009). However, an analysis of the model without these students was also completed in order to ascertain changes in the model. Descriptives for the dataset with the students that withdrew are in Table 1, and descriptives without these students are in Table 2.

Table 1. Variables and their categories with students that withdrew

Variable	IV/DV	Levels	*n*
SI attendance	Independent	Attended (met minimum sessions)	689
		Attended (did not meet minimum sessions)	327
		Control	309
Age	Independent	Teens	772
		20-29	495
		30 and older	58
Gender	Independent	Male	119
		Female	1206
Race/Ethnicity	Independent	African American	298
		Hispanic	396
		Caucasian	389
		Other (included all other ethnic groups)	242
Course	Independent	Bacteriology	337
		Chemistry	337
		Statistics	312
		Algebra	339
Success	Dependent	Successful	901
		Unsuccessful	424

Table 2. Variables and their categories without students that withdrew

Variable	IV/DV	Levels	*n*
SI attendance	Independent	Attended (met minimum sessions)	669
		Attended (did not meet minimum sessions)	242
		Control	288
Age	Independent	Teens	723
		20-29	436
		30 and older	40
Gender	Independent	Male	105
		Female	1094
Race/Ethnicity	Independent	African American	267
		Hispanic	354
		Caucasian	349
		Other (included all other ethnic groups)	229
Course	Independent	Bacteriology	294
		Chemistry	311
		Statistics	283
		Algebra	311
Success	Dependent	Successful	901
		Unsuccessful	298

Data Analysis

The data were analyzed using binary logistic regression. Race, age, gender, course, and minimum number of sessions in SI were the independent variables, and success was the outcome variable, with lack of success being coded as 0, and success being coded as 1. This model was compared to one with the withdrawn students removed from the unsuccessful category. This was done in order to ascertain any differences between the models for both analyses. The software package used was R version 3.1.1 (R Core Team, 2016). In order to perform binary logistic regression in R, the add-on package *car* (companion to applied regression) must be used (Fox & Weisberg, 2011). Binary logistic regression was chosen for this analysis as it is commonly used to analyze the effect of independent variables on a dichotomous dependent variable (Field, Miles & Field, 2012; Meyers, Gamst & Guarino, 2013; Warner, 2013). The independent variables may be categorical, continuous, or a mixture of both, and it is a method commonly used to assess the effect of categorical factors upon a binary outcome (Meyers, Gamst & Guarino, 2013). It is especially useful in situations where data does not meet assumptions of analyses found in the general linear model (i.e., analysis of variance, linear regression), such as homogeneity of variance (Meyers, Gamst & Guarino, 2013). Thus logistic regression is one method that is appropriate for data where categories contain unequal group sizes. However, it should be used with large sample sizes; one recommendation is at least 30 times the number of parameters being estimated (Meyers, Gamst & Guarino, 2013). Expected frequencies should also be 5 or above for every cell (Warner, 2013). These assumptions were met even with the withdrawn students removed (n = 1,199), and therefore the data was suitable for analysis using this method.

Results and Discussion

Overall Model and Effect Sizes

The analysis showed that the overall model rejected the null hypothesis [χ^2(11, n = 1325) = 335.74, p <.001]. An analysis of deviance showed that age, course type, race and having met the minimum number of supplemental instruction sessions were predictors of success, whereas gender was not. The results are shown in Table 3.

Table 3. Analysis of deviance table with students that withdrew

	Residual Degrees of Freedom	Residual Deviance	Probability value
Null	1324	1661.2	
Race/Ethnicity	1321	1613.6	<.001
Age	1319	1567.2	<.001
Gender	1318	1566.5	>.05
Minimum SIT sessions	1316	1362.4	<.001
Course Type	1313	1325.5	<.001

When students who withdrew were removed, the overall model rejected the null hypothesis [χ^2(11, n = 1199) = 216.35, p <.001]. The results for the model with the students that withdrew are in Table 4. The overall model was the same with and without the students who withdrew.

Table 4. Analysis of deviance table without students that withdrew

	Residual Degrees of Freedom	Residual Deviance	Probability value
Null	1198	1344.6	
Race/Ethnicity	1195	1295.1	<.001
Age	1193	1270.5	<.001
Gender	1192	1269.9	>.05
Minimum SIT sessions	1190	1159.1	<.001
Course Type	1187	1128.3	<.001

Based upon the output of the chi-square test and analysis of deviance, the overall model was successful at discriminating between those that succeeded and those that did not succeed in the four SI classes. However, while attendance at SIT sessions, age, course type, and race rejected the null hypothesis that the model would not predict success or failure, gender did not. The likelihoods of each level of age, course type, race, and minimum number of sessions met are outlined in Table 5.

Table 5. Logistic Regression summary table with students that withdrew

	Estimate	Standard Error	Exp(*B*)	Probability value	95% CI Exp (*B*)
Intercept	1.48	0.22	4.4	<.001	
All other ethnicities	0.09	0.23	1.1	> .05	0.70 - 1.71
African American	-1.21	0.19	0.30	<.001	0.20 - 0.43
Hispanic	-0.91	0.18	0.40	<.001	0.28 - 0.58
20-29	-0.70	0.14	0.49	<.001	0.37 - 0.65
30 or older	-1.52	0.32	0.22	>.05	0.12 - 0.41
Male	-0.14	0.24	0.86	>.05	0.55 - 1.4
Did not meet minimum sessions	-1.70	0.19	0.18	<.001	0.13 - 0.27
Met minimum sessions	0.68	0.17	1.96	<.001	1.41 - 2.74
Algebra	1.14	0.21	3.13	<.001	2.09 - 4.74
Chemistry	0.25	0.19	1.28	>.05	0.89 - 1.86
Statistics	0.24	0.20	1.27	>.05	0.87 - 1.86

The likelihoods of each level of age, course type, race/ethnicity, and minimum number of sessions met are outlined in Table 6.

Table 6. Logistic Regression summary table without students that withdrew

	Estimate	Standard Error	Exp(*B*)	Probability value	95% CI Exp (*B*)
Intercept	1.96	0.25	7.1	<.001	
All other ethnicities	-0.12	0.25	0.89	> .05	0.54 - 1.47
African American	-1.42	0.21	0.24	<.001	0.16 - 0.36
Hispanic	-1.04	0.21	0.35	<.001	0.23 - 0.52
20-29	-0.66	0.16	0.52	<.001	0.38 - 0.70
30 or older	-1.11	0.39	0.33	>.05	0.16 - 0.73
Male	-0.10	0.26	0.90	>.05	0.54 - 1.53
Did not meet minimum sessions	-1.37	0.21	0.25	<.001	0.17 - 0.38
Met minimum sessions	0.65	0.18	1.91	<.001	1.33 - 2.73
Algebra	0.99	0.24	2.69	<.001	2.09 - 4.74
Chemistry	-0.01	0.21	0.99	>.05	0.66 - 1.48
Statistics	-0.04	0.21	0.96	>.05	0.63 - 1.46

The Hosmer and Lemshow criterion tests if the model is a good fit, which was the case in this study. Based upon the Cox & Snell and Nagelkerke R^2 coefficients, the model explained between 26% and 36% of the variation. These results are outlined in Table 7.

Table 7. Hosmer-Lemshow & effect sizes with students that withdrew

	Effect Size	Probability
Hosmer-Lemshow		>.05
Cox & Snell R^2	0.26	
Nagelkerke R^2	0.36	

When students were removed, the Cox & Snell and Nagelkerke R^2 coefficients decreased, with the model explaining between 17 and 24% of the variation. These results are outlined in Table 8.

Table 7. Hosmer-Lemshow & effect sizes without students that withdrew

	Effect Size	Probability
Hosmer-Lemshow		>.05
Cox & Snell R^2	0.17	
Nagelkerke R^2	0.24	

Age, race, the course, and SI attendance were predictors of success in this sample. Proportionately, there was a much higher proportion of passing students in the classes that were designated as supplemental instruction (SIT). Another observation is that those that attended SIT but did not meet the minimum standard did proportionately worse than the control group. Those students that were in the treatment group, and met minimum sessions were about twice as likely to succeed than those who were in the non-treatment groups. Incidentally, those who were in the treatment group and did not meet minimum sessions were about one fifth as likely to succeed when compared to the control group. Hispanic students were about two fifths as likely to succeed when compared to Caucasian students. African American students were about one third as likely to succeed when compared to Caucasian students. Students of all other races had the same chances when compared to Caucasian students.Students between the ages of 20 and 29 years old were about half as likely to succeed, while those 30 or older were about one fifth as likely to succeed when compared to teen students.

When the students that withdrew were removed, African Americans were about one quarter as likely to succeed, while those students that did not meet minimum SIT sessions were one quarter as likely to succeed. Besides the aforementioned changes, both models were identical. The major change was that the effect sizes (Cox & Snell and Nagelkerke R^2 coefficients) indicated that the model explained more variation when the withdrawn students were included (26-36%) than when they were removed (16-24%). If the model explained less variation after the students that withdrew were removed from the analysis, this means that one or more factors explained more variation in the students that withdrew than in the students that received D's and F's. Hence it was not inappropriate to include those students as members of the unsuccessful group.

Differences in Success based upon SIT Attendance

Those that attended SI and completed the minimum number of sessions were twice as likely as the control group to succeed. This is consistent with SI literature (Congos & Schoeps, 1993; Malm, Bryngfors, & Morner, 2011; Meling, Kupczynski, Mundy, & Green, 2012). Notably, those that were in the SI classes and did not complete sessions were one quarter as likely to pass as the control group. The results of this study indicate that SI improves success in bacteriology, chemistry, algebra, and statistics classes, which are consistent with those of other SI studies (Moore & LeDee, 2006; Meling, Kupczynski, Mundy & Green, 2012). As previously mentioned, SI has been recognized to alleviate attrition by enabling student growth and interpersonal communication, and is beneficial to all SI-invested students, to include the SI leaders (Stout & McDaniel, 2006). This is attained by supporting interaction and collaborative learning amongst students of all aptitude levels, which improves socialization, confidence, diversity and graduation rates. As SI is shown to improve success in high attrition courses, institutions of higher education should consider incorporating SI into appropriate courses as a method of student retention.

Differences in Success based upon Ethnicity, Age, and Course Type

In this study, the disadvantage of African American and Hispanic students was indicated; Hispanic and African American students were less likely than Caucasian students to succeed. Disparities in science, technology, engineering and mathematics (STEM) success between ethnic groups and gender has been reported (Barlow & Villarejo, 2004; American Psychological Association, Presidential Task Force on Educational Disparities, 2012; Meling, Kupczynski, Mundy & Green, 2012). Cited reasons for this disparity include social dimensions such as the overlap of socioeconomic status and ethnicity; and differing responses to educational practices (especially where the student has been exposed to a non-American system of education; American Psychological Association, Presidential Task Force on Educational Disparities, 2012). Other related reasons include psychological dimensions, linguistics, and financial reasons (American Psychological Association, Presidential Task Force on Educational Disparities, 2012).

Although the authors did not find literature that explained the disparity in success between teens and those students that were relatively older, a hypothesis is that students in their twenties and thirties are more likely to have other responsibilities, such as families and full time employment. As a result, they are less likely to have as much time to dedicate to studies and are thus less likely to succeed than teenagers who generally have less responsibilities.

Retention of the Null Hypothesis of the Effect of Gender

The null hypothesis for the effect of gender on success was retained with an odds ratio of 0.86 (95% CI: 0.55 - 1.4). One concern for this sample is that the number of females was about ten times as much as the sample of males.

Group Sizes

Equivalence of sample sizes is a requirement for methods belonging to the general linear model (t-test, analysis of variance, etc.) and is preferred. However, logistic regression is a non-linear method of analysis, and the assumption of equivalent group sizes is not required for use of this statistical method. There was a total of 1,206 females and 119 males. Using the requirement of 30 times as many participants as parameters (Meyers, Gamst & Guarino, 2013), this would have meant a minimum participant number of 150. This means that the number of males was 79% of the minimum required sample size.

Exploration of Descriptive Data

The probability of success is defined as the number of participants who succeeded divided by the total number of participants, while odds of success are defined as the number of cases that succeeded divided by the number of cases that did not succeed. The odds for success are listed in Table 9. Using the female group as a reference, the probability of success was 826/1,206, which indicates a probability of .685. If we apply this probability of success to the male group, and invoke the null hypothesis that gender has no effect of success, this would mean that 82 would have succeeded, and 37 would not have succeeded. In this study, 75 males succeeded and 44 did not succeed. Therefore, from a proportional standpoint, the odds of success of males and females were similar. The difference of seven participants in the male group was insufficient to reject the null hypothesis that gender was not a predictor of success. In summary, the group size for males was 79% of the minimum required sample size, the frequencies of all expected outcomes exceeded 5, so sample size was not problematic in this study. Additionally, further exploration of the frequency data indicates a relatively small difference in numbers between the observed and expected probability and odds of male success. Therefore, the investigators feel confident in the outcome that the null hypothesis of the effect of gender on success is retained in spite of the disproportionate group sizes. Further investigation will need to be completed in order to ascertain that this was not a chance occurrence.

Unequal group sizes when using gender as a factor will continue to be a problem at women's institutions. This will be compounded in studies using statistical methods that use continuous outcome variables, where equal variances of groups are an assumption. Provided that sample sizes are large enough, logit type analyses (e.g., logistic regression, log-linear analysis) would be preferential methods in order to analyze such data.

Table 9: Observed cells and odds of success

Independent Variable	*n* (Successful)	*n* (Unsuccessful)	Odds of Success
SI Attendance			
Met Minimum Sessions	567	122	4.65
Did not meet minimum sessions	121	206	0.59
Control Group	213	96	2.22
Age			
Teens	579	193	3.00
20-29	295	200	1.48
30 or older	27	31	0.87
Gender			
Male	75	44	1.70
Female	826	380	2.17
Race/Ethnicity			
African American	167	131	1.27
Hispanic	240	146	1.64
Caucasian	292	97	3.01
Other	192	50	3.84
Course			
Bacteriology	222	115	1.93
Chemistry	225	112	2.01
Statistics	199	113	1.76
Algebra	255	84	3.04

Limitations and Considerations for Future Research

This study was non-experimental; it was closer in nature to a quasi-experimental design. The control group was taken from a different semester from the treatment group, as no data for a control group was collected in Spring of 2014. Data for students not enrolled in SI was not collected in the Spring of 2014. Thus the SIT classes are not randomized, and the possibility of introducing bias occurs. Future research could incorporate experimental designs by randomizing sections taken from the same semester, providing that enough sections are offered, and choose to participate.

Further investigation should be used to determine the effect of gender on STEM success at women's institutions, as there is evidence to support gender disparities in STEM success (Beede, et al, 2011; Eddy, Brownell & Wenderoth, 2014). Another limitation of this study is that an emphasis on the importance of attending SIT was not controlled for, and was likely inconsistent across classes. In other words, SIT attendance could have been mandatory for passing in one class and count for a smaller grade percentage in another class. Differences in this emphasis may have resulted from differing teaching styles, different classes and perhaps even different teachers. Future studies may experimentally control for this by standardizing the percentage of the grade used for SIT attendance, but this is only a solution if all instructors agree. Different teachers could be used as levels of an independent variable, but this is based on the premise that all teachers would have a similar number of sections, which is not guaranteed. A method for controlling for statistically controlling for this would be the use of a multilevel linear model (Field, Miles & Field, 2012). Results may be less reliable if one teacher has one section and another teacher has five. Finally, since two possible factors are being added, researchers should consider an appropriate increase in sample size.

Conclusion

In this study, race, age and SI attendance were predictors of success in algebra, bacteriology, chemistry and elementary statistics. This study showed that students who attended SI were twice as likely to succeed than students who were not. Caucasian students and teens were more likely to be successful than African American and Hispanic students. Students in their teens were more likely to be successful those students in their twenties or older. Students taking algebra were three times as likely to succeed than those in bacteriology, chemistry and statistics.

Recommendations

Although the model proved to be a good one (based upon effect sizes), future study designs should include more males and be randomized. As the SI model has been shown to improve the likelihood of success for all students, institutions of higher education should consider incorporating SI into their high attrition courses as a method of improving student retention. Further investigation should be done to determine the causative effect of age on success.

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