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Predictors of Student Academic Success in the Corequisite Model

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The purpose of this study was to determine predictors of community college student academic success in corequisite English and mathematics courses. Academic success was defined dichotomously on a pass or fail basis. The population included 1,934 students enrolled in at least one corequisite English and/or mathematics course at a community college between the fall semester of 2015 and summer semester of 2018. Binary logistic regression was used to examine the following predictors: a student's sex, race, age at time of enrollment, Pell Grant recipient status, first-generation college student status, high school grade point average (HSGPA), placement test scores, academic major, time spent receiving academic tutoring; and corequisite course faculty employment status. The two strongest predictors of student academic success in corequisite English courses were: (1) HSGPA and (2) being female. The three strongest predictors of student academic success in corequisite mathematics courses were: (1) HSGPA, (2) corequisite course faculty employment status, and (3) mathematics course based on major. The strongest predictor in both logistic regression analyses was HSGPA. It is recommended that educational leaders use HSGPA as a metric for placing students in the corequisite model. Additionally, it is recommended that institutions continue to invest in faculty professional development opportunities as it relates to teaching students who are non-female, minority, economically-disadvantaged, or first-generation.

Keywords: Developmental education, Corequisite model, Remediation, Community college students, Logistic regression, Mathematics, English, Gateway courses, Predictors, High School GPA

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Developmental education (DE) has played an important role in the American higher education system by providing access to students who enter institutions academically underprepared. Recently, there have been efforts to reduce or eliminate multiple DE course sequences that oftentimes hinder students' academic progress towards credit-bearing English and mathematics courses and one such effort is the corequisite model. The corequisite model pairs an introductory college-level mathematics and/or English course, these courses are often referred to as gateway courses, with a DE course designed to provide additional academic support (California Acceleration Project [CAP], n.d.; Collins, 2013; Complete College America [CCA], 2016; Venezia & Hughes, 2013). This is significant because the ability of students to earn credits in introductory English and mathematics courses significantly improves their probability of earning a postsecondary credential (Denley, 2017).

Literature Review

Several states have passed legislation and policies aimed at increasing the utilization of the corequisite model at their public institutions (Cal. Ed. Code §78213; Denley, 2016; H.B. 2223, 2017; University System of Georgia [USG], 2018). Nonetheless, the corequisite model is not without criticism, Boylan, Brown, and Anthony (2017) mildly acknowledged the efficacy of the corequisite model with respect to gateway course success but noted that associated costs and long-term outcomes (i.e. graduation rates) have not improved. Moreover, DE practitioners are opposed to making wholesale decisions for all students assigned to DE courses because it is "easy, cheap, and fast" (Goudas, 2018, p.25). In contrast, organizations and policymakers have made decisions based primarily on the premise that increases in gateway course success rates for more students, including those assigned to DE, will lead to more students earning academic credentials, but that has yet to be determined as most policies for the scaling of the corequisite model are recent (Collins, 2013; CCA, 2016; H.B. 2223, 2017; USG, 2018; Venezia & Hughes, 2013).

Therefore, the efficacy of the corequisite model continues to be analyzed by various states. In Louisiana, 264 students at five community colleges enrolled into pilot corequisite mathematics courses (Campbell & Cintron, 2018). These students were within two points of the community colleges' minimum ACT scores to enroll directly into gateway courses without DE. This group of students was compared to two additional groups: the first group included students that had the required scores, but did not enroll in the corequisite mathematics courses, but instead completed a traditional DE mathematics course sequence; the second group included students who did not have the requisite scores and completed a traditional DE course mathematics sequence. Campbell and Cintron found relatively small differences between the success rates of the corequisite (67.80%), corequisite eligible (68.34%), and corequisite ineligible groups (66.02%). Results from the study showed that students who met the test score requirements could be successful without enrolling in a multiple DE course sequence. However, the results are limited because of the study's relatively small sample size and no demographic information was provided about the students involved. Thus, the results are not generalizable to similar community college students.

Additionally, Tennessee fully implemented the corequisite model at its public institutions during the fall semester of 2015 (Denley, 2016). The results for both corequisite English and mathematics were promising at Tennessee community colleges although only descriptive statistics were provided. Following full implementation of the corequisite model, mathematics course success rates improved from 12.3% with multiple course DE sequences during the 2012-2013 academic year to 54.8% with the corequisite model. Likewise, in corequisite English courses success rates improved from 30.9% with multiple course DE sequences during 2012-2013 to 61.8% with the corequisite model. Indeed, the corequisite model has shown to be effective in Tennessee, yet without student demographic information available it is difficult to determine what factors contributed to this drastic improvement in course success rates.

Likewise in California, colleges that initially implemented the corequisite model have seen marked success (CAP, n.d.). In 2016-2017, 73% of students enrolled in corequisite English at San Diego Mesa College passed the gateway course. With respect to mathematics, Cuyamaca College and Los Medanos College have both had increased success rates while closing racial equity gaps.

However, there is little extant literature with respect to what predictors are most associated with student academic success in the corequisite model. Thus, the ability of institutions to create and strengthen their DE academic support systems and processes is limited. As the corequisite model continues to be implemented nationally, it is important that practitioners and policymakers do not focus solely on course success rates. Course success rates are important, but do not provide practitioners with the details needed to develop academic interventions for students who are academically unsuccessful in corequisite courses. This study adds to the current literature by identifying predictors that are associated with students' academic success in the corequisite model. This is important because institutions have a responsibility to provide and improve student support structures for the corequisite model as it continues to emerge as the primary form of DE. Thus, the present study sought to answer the following question at a small, public, rural two-year college in the southeastern United States, "What are the best predictors of student academic success in the corequisite model?"

Theoretical Framework

Astin's Input-Environment-Outcome (I-E-O) model can be used to assess the impact higher education environments have on student outcomes (Astin & Antonio, 2012). Astin posited that outcomes are always based on student inputs. However, Astin notes that there is no single input that determines an outcome and that environments act as mediators between inputs and outcomes, see Figure 1. In this study the *Inputs* predictors were a student's sex, race, age at time of enrollment, Pell grant recipient status, first-generation college student status, high school GPA, placement test scores, and academic major. Additionally, the *Environment* predictors were corequisite model faculty employment status, student utilization of the college's academic tutoring center, and mathematics course for major. The relationship between these predictors and corequisite course success are presented in Figure 2. It should be noted that the mathematics course for major only applies to mathematics corequisite courses.

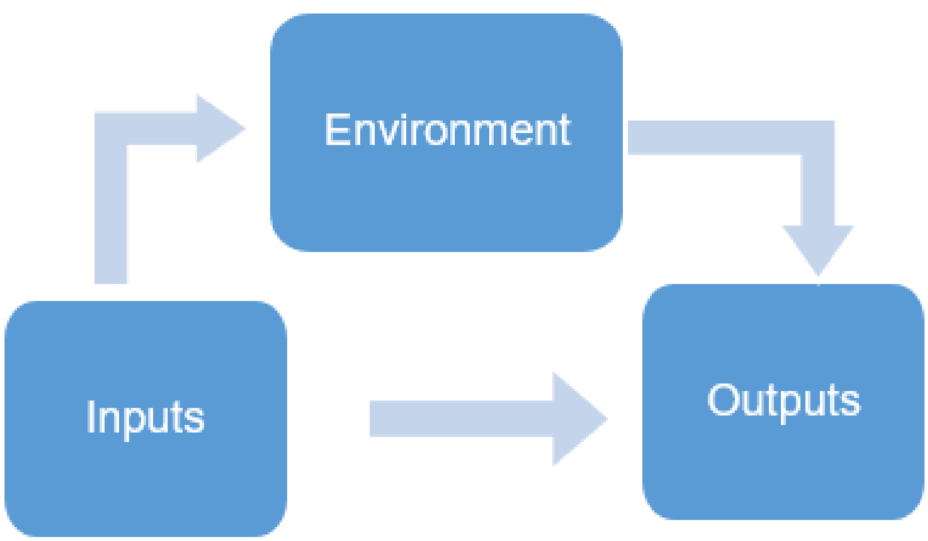

Figure 1: *Astin's Inputs-Environment-Outcome (I-E-O) Model.*

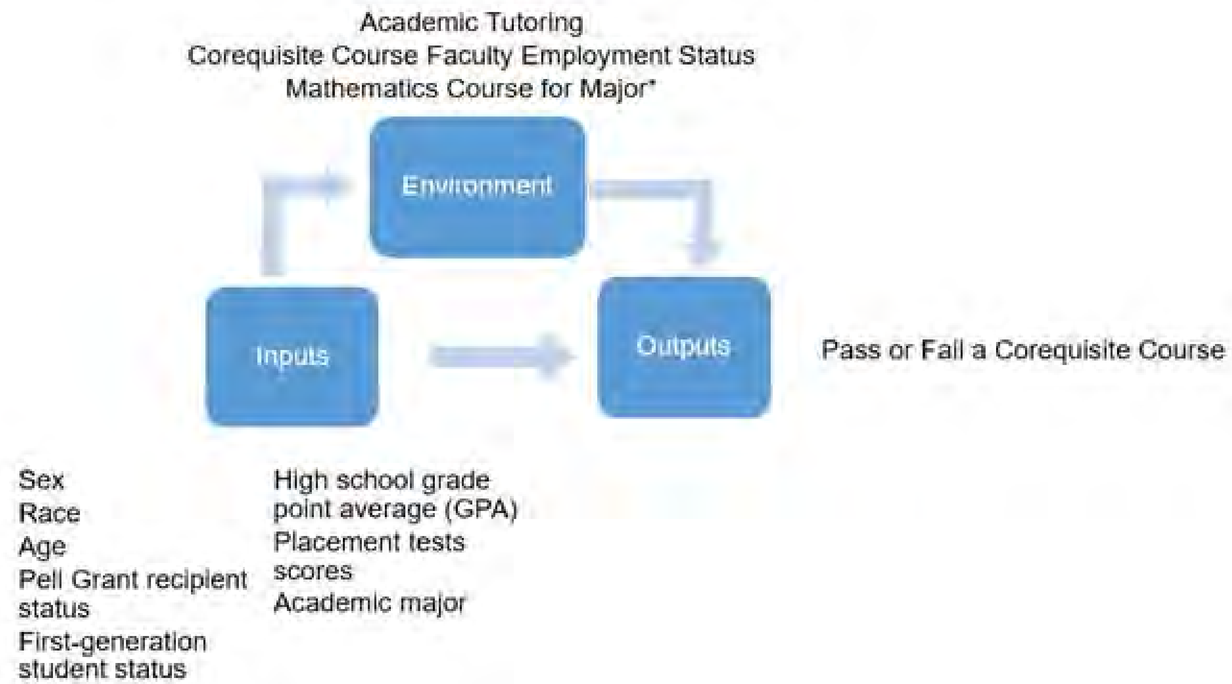

Figure 2: *Astin's Inputs-Environment-Outcome (I-E-O) Model with Predictors*.

Student Inputs

High school grade point average (HSGPA) and placement test scores are often used for predicting student academic success in college. HSGPA and placement test scores when paired are stronger predictors of gateway course success than placement test scores only (Chen, 2016; Logue, Watanabe-Rose, and Douglas, 2016; Scott-Clayton, Crosta, & Belfield, 2014; Williams & Siwatu, 2017; Xu, 2016). Second, larger percentages of minority students, particularly African-American and Hispanic, and Pell Grant recipients are placed into DE (Chen, 2016; CCA, 2016; Logue et al., 2016; Moss, Kelcey, & Showers, 2014; Wheeler & Bray, 2017; Williams & Siwatu, 2017; Wolfle, 2012; Woods, Park, Hu, & Betrand Jones, 2018). Therefore, it is important to consider how a student's race and Pell Grant recipient status impact their success in the corequisite model. Third, age is another predictor to consider in the success of students in the corequisite model (Logue et al., 2016; Moss et al., 2014; Quarles & Davis, 2017; Wolfle, 2012). Snyder, de Brey, & Dillow (2019) found approximately 61% of the first-year undergraduate students who took DE classes were between the ages of 15 and 23. Fourth, another predictor to consider in student success in the corequisite model is a student's sex. Literature indicates that being a female student has a positive effect on passing gateway courses (Chen, 2016; Moss et al., 2014; Wheeler & Bray, 2017). This is an important predictor to consider in determining whether a gender gap exists between students enrolled in corequisite courses. Fifth, literature has indicated varying degrees of success of first-generation college students with respect to mathematics and English (Chen, 2016; Crisp & Delgado, 2014; Engle & Tinto, 2008; Houston & Xu, 2016).

Environmental Factors

Students who enroll in appropriate mathematics DE courses for their academic major, also known as mathematics pathways, earn gateway mathematics course credits at improved rates (Huang, 2018; Zachry Rutschow & Mayer, 2018). Advocates of mathematics pathways recommend that science, technology, engineering, and mathematics (STEM) majors enroll in gateway mathematics courses that lead to calculus (Huang, 2018; Zachry Rutschow & Mayer, 2018). Whereas students whose academic majors are in humanities or social sciences should enroll in gateway mathematics courses in quantitative reasoning or statistics. Finally, institutional resources such as faculty employment status and academic tutoring are positively associated with student academic success (Berkopes & Abshire, 2016; Datray, Saxon, & Martirosyan, 2014; Laskey & Hetzel, 2011; Logue et al., 2016; Moss et al., 2014; Shulman et al., 2017; Vick, Robles-Piña, Martirosyan, & Kite, 2015).

Methods

Population

The population in this study, based on archival data, included 1,934 students who enrolled in at least one corequisite English and/or mathematics course at a community college in the southeastern United States between the fall semester of 2015 and summer semester of 2018, see Table 1. The average age of students enrolled in corequisite courses was 20.15 years (SD = 4.70) with ages that ranged from 16-58. The average high school GPA was 2.61 (SD = 0.38). Students' academic majors at time of enrollment in corequisite courses were classified as either Science, Technology, Engineering, Mathematics, or Business (STEMB) or non-STEMB (all other majors) otherwise as business majors are required to take an introductory calculus course.

Table 1. Descriptive Statistics for Students Enrolled in Corequisite Courses

Student Characteristics		***n***	**%**
Sex	Female	1,102	57.0
	Male	810	41.9
	Unknown	22	1.1
Ethnicity	American Native	8	0.4
	Asian	10	0.5
	Black	1,238	64.0
	Hispanic	24	1.2
	Multiracial	132	6.8
	Native Hawaiian	4	0.2
	Unknown	22	1.1
	White	496	25.7
Age	Younger than 18	48	2.5
	18-20	1524	78.9
	21-24	192	9.9
	25+	170	8.8
Pell Grant Recipient Status	Received	1,499	77.5
	Did not receive	435	22.5
First-Generation Student Status	Yes	585	30.3
	No	1,349	69.8
High School GPA	No GPA Available	126	6.5
	Less than 2.00	36	1.9
	2.00 – 2.49	718	37.1
	2.50 – 2.99	747	38.6
	3.00 – 3.49	271	14.0
	3.50+	36	1.9
Major	STEMB	298	15.4
	Non-STEMB	1,636	84.6

Variables

Table 2 details of how the variables from the research questions were operationalized.

Table 2. Independent and Dependent Variables by Construct

Construct	Variable	Type	Coding
Student Inputs	**Sex** – a student's self-reported sex (male, female, unknown).	Categorical	1 = Female 0 = Male or Unknown
	Race – a student's self-reported race (White, Black/African American, Hispanic, and Asian, Hawaiian/Pacific Islander, multi-racial, not-reported).	Categorical	1 = Minority (Black/African American, Hispanic, and Asian, Hawaiian/Pacific Islander, multi-racial, not-reported) 0 = White
	Age – a student's age at the time of enrollment.	Ratio	none
	Pell Grant status – whether a student received a federal Pell Grant during his or her first semester (received or did not receive).	Categorical	1= Received Pell 0 = Did not receive Pell
	First-generation student status – whether a student is the first person in his or her immediate family to attend college (yes or no).	Categorical	1= Yes 0 = No
	High school grade point average (GPA) – a student's reported high school GPA (0 to 4.0 or no-GPA).	Ratio	none
	Placement test scores – a student's scores from the COMPASS reading, writing, and algebra tests.	Interval	none
	Academic major – students' chosen major at the time of enrollment will be defined as Science, Technology, Engineering, Mathematics, or Business (STEMB) or non-STEMB (all other majors).	Categorical	1 = STEMB 0 = non-STEMB
Environmental Factors	**Faculty status** – a faculty member's reported employment status with the college (Full-time or part-time).	Categorical	1 = Full-time 0 = Part-time
	Academic tutoring – the cumulative number of hours a student received tutoring services.	Ratio	none
Corequisite English and/or Math course Outcome	Course outcome in this study will defined on a pass/fail basis.	Categorical	1 = Pass 0 = Fail

Data Sources

De-identified archival student data from Fall 2015 to Summer 2018 semesters were used for data analysis. It should be noted that students could have had multiple reading, writing, and mathematics placement test scores therefore all placement test scores were converted to z-scores and composite verbal (includes both reading and writing) and mathematics scores were created.

Data Analysis

Descriptive statistics were computed for both datasets, see Tables 3 and 4. As predictors were being investigated and the dependent variable in this study was categorical, pass or fail, binary logistic regression was used to analyze the data (Lomax, 2007; Menard, 2010). Missing HSGPA data in this study were determined not to be missing completely at random (MCAR) therefore mean substitution was chosen to replace the small percentages of missing data for both datasets (Tabachnick & Fidell, 2013). As this study's theoretical framework included variables associated with *Student Inputs* and *Environmental Factors* block-wise entry was used to determine model fit and independent variables' effects after each block of variables was entered into each model (Osborne, 2015).

Limitations

This study's population was limited to a small, public, rural community college in the southeastern United States. Second, it cannot be understated that other confounding variables existed that were not identified and included in this study which may have impacted the results. For example, student self-advisement, participation in campus events and/or organizations, utilization of campus counseling services, and students' family dynamics.

Results

Descriptive Statistics

In this study, 776 students enrolled in corequisite English courses. The average age of these students was 19.16 years (*SD* = 2.47) with ages that ranged from 16-44. The average HSGPA was 2.57 (*SD* = 0.39). More female students (54%) passed corequisite English courses, see Table 3.

Table 3. Descriptive Statistics of Students in Corequisite English Courses by Outcome

Predictors		**Outcome**	
		Passed (%)	***Failed (%)***
Sex	Female	237 (54)	204 (46)
	Non-female	136 (41)	199 (59)
Ethnicity	Minority	291 (46)	345 (54)
	White	82 (59)	58 (41)
Age	Younger than 18	9 (56)	7 (44)
	18-20	325 (48)	355 (52)
	21-24	26 (47)	29 (53)
	25+	13 (52)	12 (48)
Pell Grant recipient status	Received	285 (46)	330 (54)
	Did not receive	88 (55)	73 (45)
First-generation student status	Yes	113 (48)	123 (52)
	No	260 (48)	280 (52)
High school GPA	No GPA Available	10 (50)	10 (50)
	Less than 2.00	6 (38)	10 (63)
	2.00 – 2.49	132 (38)	217 (62)
	2.50 – 2.99	138 (52)	128 (48)
	3.00 – 3.49	73 (68)	35 (32)
	3.50+	14 (82)	3 (18)
Major	STEMB	58 (41)	83 (59)
	Non-STEMB	315 (50)	320 (50)
Full-time faculty status	Yes	289 (49)	296 (51)
	No	84 (44)	107 (56)
Tutoring center utilization (min)	0 minutes	361 (48)	392 (52)
	1 – 60 minutes	1 (25)	3 (75)
	61 – 119 minutes	3 (60)	2 (40)
	120+ minutes	8 (57)	6 (43)

1,552 students enrolled in corequisite mathematics courses with an average age of 20.48 years (*SD* = 5.12) ranging from 16-58. The average HSGPA was 2.60 (*SD* = 0.36). More female students (43%) passed corequisite mathematics courses, see Table 4.

Table 4. Descriptive Statistics of Students in Corequisite Math Courses by Outcome

Predictors		Outcome	
		Passed (%)	**Failed (%)**
Sex	Female	377 (43)	505 (57)
	Non-female	247 (37)	423 (63)
Ethnicity	Minority	410 (36)	725 (64)
	White	214 (51)	203 (49)
Age	Younger than 18	18 (47)	20 (53)
	18-20	448 (38)	728 (62)
	21-24	76 (43)	100 (57)
	25+	82 (51)	80 (49)
Pell Grant recipient status	Received	465 (38)	750 (62)
	Did not receive	159 (47)	178 (53)
First-generation student status	Yes	174 (37)	296 (63)
	No	450 (42)	632 (58)
High school GPA	No GPA Available	43 (37)	74 (63)
	Less than 2.00	11(41)	16 (60)
	2.00 – 2.49	174 (31)	388 (69)
	2.50 – 2.99	253 (41)	367 (59)
	3.00 – 3.49	124 (60)	81 (40)
	3.50+	19 (90)	2 (10)
Major	STEMB	90 (38)	146 (62)
	Non-STEMB	534 (41)	782 (59)
Full-time faculty status	Yes	403 (35)	737 (65)
	No	221 (54)	191 (46)
Tutoring center utilization (min)	0 minutes	589 (40)	887 (60)
	1 – 60 minutes	8 (42)	11 (58)
	61 – 119 minutes	7 (47)	8 (53)
	120+ minutes	20 (48)	22 (52)

Logistic Regression Results of English Dataset

Logistic regression analysis of the student input and environmental predictors showed the final model was statistically significant, $\chi 2$ = 65.58, *df* = 11, *p* = 0.000. Of the thirteen predictors, the three strongest predictors were: sex, *OR* = 1.401; HSGPA, *OR* = 3.530; and Pell grant recipient status, *OR* = 0.750, see Table 5.

Table 5. Logistic Regression with Student Inputs and Environmental Factors – English

							95% CI	
Predictor	**B**	**SE**	**Wald**	***df***	***p***	**OR**	**Lower**	**Upper**
Minority student	-0.209	0.205	1.038	1	0.308	0.811	0.543	1.213
Female student	0.338	0.157	4.608	1	0.032*	1.401	1.030	1.907
Age	0.016	0.031	0.282	1	0.595	1.016	0.957	1.079
Pell grant recipient	-0.287	0.197	2.134	1	0.144	0.750	0.510	1.103
First-generation student	-0.093	0.167	0.311	1	0.577	0.911	0.656	1.265
High school GPA	1.261	0.219	33.096	1	0.000*	3.530	2.297	5.424
Verbal score (std.)**	0.000	0.001	0.181	1	0.670	1.000	0.998	1.003
Math score (std.)	0.040	0.084	0.224	1	0.636	1.041	0.882	1.228
Major	-0.152	0.200	0.578	1	0.447	0.859	0.580	1.272
Full-time faculty	0.197	0.177	1.239	1	0.266	1.217	0.861	1.721
Tutoring	0.001	0.002	0.151	1	0.697	1.001	0.997	1.005
Constant	-3.574	0.902	15.708	1	0.000	0.028		
Model $\chi 2$(*df*)	65.58 (11)							
Block $\chi 2$(*df*)	1.413 (2)							
% Correct Predictions	61.5							

Note. OR = Odds Ratio; CI = confidence interval; * p < 0.05; ** a composite of reading and writing scores

Logistic Regression Results of Mathematics Dataset

Logistic regression analysis of the student input and environmental predictors showed that the model was statistically significant, $\chi 2$ = 182.30, *df* = 12, *p* = 0.000. Of the thirteen predictors, the seven strongest predictors were: minority student status, OR = 0.711; Pell Grant status, *OR* = *0.*785; first-generation college student status, *OR* = 0.806;

HSGPA, *OR* = 3.812; academic major, *OR* = 0.638; faculty employment status, *OR* = 0.421; and mathematics course based on major, *OR* =0.648, see Table 6.

Table 6. Logistic Regression with Student Inputs and Environmental Factors – Math

							95% CI	
Predictor	B	SE	Wald	*df*	*p*	OR	Lower	Upper
Minority student	-0.341	0.132	6.615	1	0.010*	0.711	0.549	0.922
Female student	0.067	0.116	0.331	1	0.565	1.069	0.851	1.342
Age	0.042	0.011	14.069	1	0.000*	1.043	1.020	1.067
Pell grant recipient	-0.242	0.140	2.978	1	0.084	0.785	0.596	1.033
First-generation student	-0.216	0.125	2.995	1	0.084	0.806	0.631	1.029
High school GPA	1.338	0.171	61.012	1	0.000*	3.812	2.725	5.333
Verbal score (std.)**	0.001	0.001	2.900	1	0.089	1.001	1.000	1.002
Math score (std.)	0.182	0.062	8.555	1	0.003*	1.200	1.062	1.356
Major	-0.449	0.203	4.882	1	0.027*	0.638	0.428	0.951
Math for major	0.499	0.165	9.171	1	0.002*	1.648	1.193	2.276
Full-time faculty	-0.864	0.124	48.941	1	0.000*	0.421	0.331	0.537
Tutoring	0.001	0.001	2.843	1	0.092	1.001	1.000	1.002
Constant	-3.870	0.557	48.231	1	0.000	0.021		
Model χ2(*df*)	182.30 (12)							
Block χ2(*df*)	62.21 (3)							
% Correct Predictions	66.8							

Note. OR = Odds Ratio; CI = confidence interval; * $p < 0.05$; ** a composite of reading and writing scores

Discussion

This discussion will be guided by Astin's I-E-O model which served as this study's theoretical framework and results will be placed in the context of the current literature related to the corequisite model.

Student Inputs

High school GPA. HSGPA was found to be the strongest predictor of student academic success in corequisite courses. Thus, as a student's HSGPA increased his or her odds of passing a corequisite course increased. This finding is consistent with the work of

Scott-Clayton et al. (2014) that found HSGPA was a better predictor than placement test scores of students' academic success in both introductory college-level math or English. A possible explanation for this result is that HSGPA is a composite of a student's academic performance over several years as opposed to placement test scores which are static attempts to measure student academic performance. Better predictors may result if students' overall HSGPAs are parsed down to (1) high school English courses GPA and (2) high school mathematics courses GPAs with the aim that this would provide more precision to the findings related to HSGPA in this study.

Sex. The results of this study indicate that a student being female improved the odds of being academically successful in corequisite courses. Specifically, if a student's sex was female the student's odds of passing corequisite English or mathematics courses increased. This result was consistent with prior DE research findings that female students had an increased probability of students earning college-level English credits and mathematics credit (Chen, 2016; Moss et al., 2014; Wheeler & Bray, 2017). However, a plausible explanation for this result is that approximately 57% of the present study's population was female. Nevertheless, it would be appropriate for institutional administrators, faculty, and academic support professionals to develop and implement strategies to guide non-female students to the academic support resources.

Pell grant recipient status. Pell Grant recipients comprised 77.2% of the students enrolled in corequisite courses in this study. Therefore, the corequisite model provided economically-disadvantaged students with opportunities to earn gateway course credits faster in agreement with CCA's advocacy for the use of the corequisite model (CCA, 2016). However, the findings of this study suggest that students who received Pell grants had decreased odds of being academically successful in corequisite courses. Thus, Pell grant recipients were at a disadvantage of being academically successful in both corequisite English and mathematics courses. These findings agreed with Chen's (2016) and Woods et al. (2018) finding that as a students' income level increased their probability of earning college-level English and mathematics credit improved. Therefore, institutional administrators, faculty, and academic support professionals should continue to create opportunities that support Pell Grant recipients.

First-generation college student status. This study found that first-generation college students had decreased odds of being academically successful in corequisite courses. Thus, first-generation college students are at an academic disadvantage in both corequisite English and mathematics courses. The results of the present study agreed with Houston and Xu's (2016) findings that first-generation college student status had a negative effect on student academic success in mathematics. However, the present study's findings were not in alignment with Chen's (2016) findings that parental education level does not seem to have an impact on earning college-level mathematics credit. In either case it would be appropriate for institutional administrators, faculty, and academic support professionals to create an environment where first-generation students can access the support that they need to be academically successful in corequisite courses.

Mathematics pathways. Additionally, with respect to mathematics courses (i.e., *Math for Major* variable), the findings of this study suggest that students who enrolled in an appropriate mathematics corequisite course for their academic major had increased odds of being academically successful. This result agrees with the recommendation of Huang (2018) and Zachry Rutschow (2018) that students enroll in mathematics courses based on mathematics pathways. Therefore, academic advisors should continue their efforts of advising students to enroll in appropriate mathematics courses based on academic major. A simultaneous effort should be implemented by institutional leaders to ensure that academic policy is created, revised, and implemented to reflect the positive effects of mathematics pathways.

Environmental Factors

Faculty employment status. In contrast to findings by Shulman et al. (2017), Townsend (2003), and Datray et al. (2014), the institution involved in this study used approximately 75% full-time faculty to teach both corequisite English and mathematics courses. This commitment by the institution increased the odds of students being academically successful in corequisite English courses in agreement with Moss et al. (2014). However, students had decreased odds of being academically successful in corequisite mathematics courses taught by full-time faculty members. One reasonable explanation based on the literature is that some instructors lack experience teaching a particular mathematics course (Logue et al., 2016). Therefore, these findings should be interpreted with caution because in this study only the employment status of faculty members was considered, and no assumptions should be made about faculty with respect to their training, instructional experience, pedagogical skill, or teaching loads which all contribute to instructor effectiveness. Nonetheless, institutional academic leaders and faculty should continue to engage in professional development activities designed to improve student academic success.

Implications for Practice

There are implications of practice for institutional administrators, faculty, and academic support professionals at the institution in this study. With respect to Astin's I-E-O model, these changes could strengthen the impact of *Environmental Factors* on student academic success in the corequisite model. As noted earlier, no single *Student Inputs* predictor works independently of *Environmental Factors* to produce an outcome (Astin & Antonio, 2012). The following implications apply to academic administrators, faculty, and academic support professionals.

The results of this study indicated that placement test scores were not stronger predictors than HSGPA of student academic success in corequisite English or mathematics courses. Therefore, the institution could consider using HSGPA to determine whether students are placed in corequisite courses. This policy would be comparable to the Massachusetts Board of Higher Education's (MBHE) policy that allows Massachusetts high school graduates to use their HSGPA to determine placement into DE mathematics (MBHE, 2016). Additionally, results from this study indicated that enrolling in mathematics courses based on mathematics pathways increased students' odds of being academically successful in corequisite mathematics courses. Therefore, institutional leaders should continue to ensure that institutional mathematics pathways policy is implemented consistently. This includes informing students who have been accepted to the institution of the respective mathematics course they will be enrolled in based on their declared academic major. Institutional leaders should work with academic advisors to ensure students are registered for mathematics courses based on mathematics pathways (Huang, 2018; Zachry Rutschow, 2018).

A second implication that institutional leaders continue to offer faculty professional development opportunities. The findings of this study showed full-time faculty increased the odds of passing corequisite English courses but decreased the odds of passing corequisite mathematics courses. Furthermore, institutional leaders could conduct research related to faculty demographics and teaching experiences to determine the subsequent impact on student success in corequisite courses and create professional development opportunities focused on improving the teaching and learning process.

Data from the present study indicated that minority, first-generation, Pell grant recipients, and being a STEM major all decreased student odds of being academically successful in corequisite courses. Thus, the major implication for faculty is that they should implement content-specific best-practices and take advantage of professional development opportunities related to working with students who are minority, first-generation, Pell grant recipients, or STEM majors. Exercising an awareness of classroom demographics and implementing best-practices should positively impact student academic success.

Finally, data from this study indicated that very few students enrolled in corequisite courses utilized the academic tutoring provided by the institution. Therefore, academic support professionals should implement strategies to increase visits to the academic tutoring center. One potential strategy is for academic support professionals to collaborate with faculty to communicate to students that free academic tutoring is available to any student who may need additional academic support.

Recommendations for Future Research

Although the present study focused solely on predictors of student academic success in corequisite courses there are opportunities for further research. For instance, the student population could be adjusted to include all students enrolled in gateway English and mathematics courses. This expanded student population would allow corequisite course enrollment to be used as an additional predictor of student academic success in gateway courses. Second, the expanded student population would provide an opportunity to determine if the predictors identified in this study are consistent with a larger population of students. Additionally, it would be interesting to replicate the study with HSGPA replaced by high school English GPA and high school mathematics GPA. This would provide better precision than the HSGPA predictor that was used in this study. Finally, more *Environmental Factors* related to faculty could be included in this study to provide more clarity on the impact of faculty on student academic success in the corequisite model. These factors could include teaching experience and faculty demographics (Logue et al., 2016; Moss et al., 2014).

Conclusion

The findings of the present study indicated that HSGPA was the best predictor of student academic success in corequisite courses. Depending on the subject matter of the corequisite course additional predictors contributed to students' academic success in these courses. In no specific order these included a student's sex, full-time faculty status, academic major, first-generation student status, and the number of times a student enrolled in a corequisite course. Viewing these predictors from the lens of Astin's I-E-O model, students' academic success in corequisite courses depends both on *Student Inputs* and *Environmental Factors*. Therefore, it is important for institutions to leverage their resources to create environments that enable their students to be successful in corequisite courses.

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