

College Enrollment and STEM Major Choice in a Rural State: A Statewide Examination of Recent High School Cohorts

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Rural students account for almost 20% of the US K-12 students, but rural context varies from state to state. This study uses a statewide longitudinal sample ($N = 3,119$) to analyze college enrollment and STEM major choice patterns of Montana's public high school graduates in the academic years of 2013-2017. The binary logistic regressions showed that Montanan graduates are more likely to enroll into a four-year institution than a two-year institution. Also, graduates enrolled at a four-year institution are more likely to consider STEM majors than students at a two-year institution. Although high school GPA and ACT STEM scores are strong predictors for both college enrollment and STEM major choice, findings for race/ethnicity, gender, and free or reduced-price lunch status varied across the two outcomes. Specifically, race/ethnicity contributes to variation in college enrollment, but not STEM major choice. Similarly, free or reduced-price lunch status in high school is predictive of college enrollment, but not STEM major choice. Although there was no difference in college enrollment type for gender, male students are more likely to select a STEM major, and this trend occurs at a rate of three times higher at a four-year institution versus a two-year institution. Our findings provide additional nuances of rural graduates, contributing to the understanding of their college enrollment and STEM major choices in the context of Montana - a large geographic, low populous state - which has received less attention than urban and high-density states.

Keywords: rural education, college access, college choice, STEM major choice, statewide longitudinal study

It is critical to understand college enrollment patterns and major choice for rural high school students in the United States (US) because they make up almost 20% of all K-12 students (Showalter et al., 2017). National trends indicate that compared to their peers from city, suburban, and town locales, college enrollment rates for students from rural areas are the lowest (Burke et al., 2015; Tieken, 2016). Despite a large national sample of rural students, findings of rural patterns in

college enrollment are often difficult to generalize to the entire US rural student population because samples do not include students from all US states or rural communities (Byun et al., 2017). Thus, this study aims to extend our understanding of rural students' college enrollment patterns and disparities in Science, Technology, Engineering, and Mathematics (STEM) major choice in Montana, where 74% of public schools are classified as rural (Eccher, 2019). In Montana, educational attainment

is an essential factor in the state's economic growth and appears to have a stronger relationship with employment growth than either population or transportation infrastructure (Wagner, 2017).

Using national data sets, Byun et al. (2017) and Koricich et al. (2018) found that rural high school graduates more frequently enrolled in a two-year institution as opposed to a four-year institution. In a state-level sample, Burke et al. (2015) reported that rural students in Indiana enrolled in a two-year institution at higher rates than non-rural students. Furthermore, rural students are more likely than non-rural students to be undermatched to colleges when considering their level of presumptive eligibility either at a state level or national sample (Burke et al., 2015; Lee et al., 2017).

Rural students and students from lower socioeconomic status (SES) levels generally earn lower standardized test scores than their non-rural and affluent peers (Burke et al., 2015). The gap in access to ACT/SAT test preparation courses between urban and rural students is widening and serves as a barrier for admission for many rural high school students (Whitaker, 2016). Additionally, there are documented gender and racial/ethnic disparities in college enrollment. Female students are less likely than male students to attend a two-year institution rather than a four-year institution (Burke et al., 2015), but gender is not a predictor for rural youths' postsecondary enrollment patterns (Byun et al., 2017). Although race/ethnicity is related to college enrollment among a sample of rural nationally representative students (Byun et al., 2017), it was not predictive for students in the state of Indiana (Burke et al., 2015). Thus, national data masks important state-level variability in two-year versus four-year institution enrollment patterns (Burke et al., 2015). Also, within rural areas, one study found that White, Black, and Latinx high school youths in rural areas had comparable levels of educational aspirations, but American Indian students in their sample had the lowest aspirations (Irvin et al., 2016).

In addition to differential patterns of college enrollment, there are disparities in college major choice. Rural students have significantly less access to Advanced Program (AP) or International

Baccalaureate (IB) math and science courses than non-rural students, but research indicates that taking advanced courses may be beneficial for academic outcomes such as test performance and college enrollment, especially for female students. Female students taking fewer advanced courses than males were less likely to choose STEM majors in college (Irvin et al., 2016; Jewett, 2019; Jiang et al., 2020). At the supply side, urban schools offered significantly more advanced and AP science courses than suburban, town, or rural schools (Jewett, 2019). Moreover, race/ethnicity is a significant predictor of college major. The odds of Asian students selecting a STEM major are 82% higher than the odds of White students, but Black and Latinx freshman students were equally likely to choose a STEM major as White students (Jewett, 2019; Moakler & Kim, 2014).

The current study extends previous research on rural students and postsecondary education patterns by incorporating two variables that represent space/place (Burke et al., 2015; Byun et al., 2017; Irvin et al., 2016; Kryst et al., 2018; Westrick et al., 2015), operationalized by both school district class (e.g., student population) and school district locale (e.g., urban, suburban, rural, etc.). Additionally, we include the racial/ethnic group of American Indian, which is often not included in research due to small sample sizes. This is problematic according to Brown (2017), as American Indian students have the highest dropout rates, lowest college enrollment rates, and lowest percentage distribution of degrees conferred of any minoritized population in the US. Moreover, to more precisely measure the differences of college enrollment and STEM major choice in both gender (female/male) and race/ethnicity (White, American Indian/Alaska Native, Latinx, and others), high school grade point average (HS GPA) and ACT subject scores were included as covariates instead of ACT composite scores in isolation (Allensworth & Clark, 2019; Jiang et al., 2018).

The following research questions guide this study:

- (1) What is the likelihood that Montana high school graduates enroll in a four-year institution?

- a. How do student-level characteristics, high school academic achievements, and school space/place contribute to the likelihood that a Montana high school graduate enrolls in a four-year institution?
- (2) What is the likelihood that Montana high school graduates choose a STEM major?
- a. What student-level characteristics, high school academic achievements, and enrolled institution type contribute to variation in a STEM major choice?

Review of Literature

Rural High School Contexts

Context of space and place, particularly of rural places, is an important consideration for research whose aim is to identify college enrollment patterns and college major choices (Kryst et al., 2018; Schmitt-Wilson & Downey, 2018). Variations within the rural context are associated with student outcomes and their access to postsecondary education. Research has identified the important contextual contributions of rural schools-based specific environments and socially just instructional methods as “this student in this context” (Eppley et al., 2018, p. 37). Moreover, other factors influence college attendance issues, such as rural “brain-drain” in which college educated youths leave rural community and do not return after graduation (Kryst et al., 2018; Tieken & San Antonio, 2016), local job prospects for students with only a high school degree (Jiang et al., 2018), and a state-wide Early College program for high school students (Allen & Roberts, 2019). Since 2002, the Early College Initiative has provided high school students with opportunities to obtain college-level learning while they are in the last two years of high school with the aim to potentially decrease the financial burden of college for underserved students. The program, operating in 28 states, allows high school students to graduate with both a high school certificate and an associate degree or up to two years of college credit toward a bachelor’s degree (Allen & Roberts, 2019). Allen and Roberts’ (2019) study found that school location matters for how state programs and policies, such as the Early College program, are implemented in Ohio. The available resources,

opportunities, and constraints lead to variation in how schools can support students, such as long distance to other school districts and lack of easy transportation access to college partners. In addition to the school context, the community context, characterized by the concept that a “tight-knit social ecosystem can be a force driving students toward achievement in rural schools,” demonstrates importance, as students received appreciation and support from the community members in their small towns (Eccher, 2019, p. 13).

The effects of high school location and school type (conventionally operationalized as urban, suburban, town, and rural for location, and private vs. public for school type) are implicated in students’ college matching (Lee et al., 2017). Using the national data set ELS:2002, Lee et al. (2017) found that nearly half of rural public-school students were undermatching and rural students had undermatched disadvantages due to fewer AP/IB courses. Furthermore, rural high school contexts play an important role for rural students’ postsecondary attainment (Schmitt-Wilson & Downey, 2018; Tieken & San Antonio, 2016), particularly in Montana where educational attainment and employment growth are associated (Wagner, 2017). Our present study contributes to the understanding of college enrollment among Montanan public high school graduates, while controlling for student characteristics and pre-college scores.

Rural Students’ College Enrollment

According to the “Why Rural Matters 2015-2016” report, 87% of high school students in rural areas graduate within four years, but college preparation remains a major issue (Showalter et al., 2017). School contextual characteristics, such as college preparation program, academic achievement, grade attention, academic self-concept, and high school culture affect educational aspirations in rural communities (Corley, 2018; Irvin et al., 2016; Tieken & San Antonio, 2016). Rural high school students are less likely to attend postsecondary education than non-rural students, but when examining institution types, rural students are almost 20% more likely to attend a two-year institution versus a four-year institution (Koricich et

al., 2018). Furthermore, Koricich and colleagues (2018) found that geographic proximity to institutions is a driving factor in the choice of rural students to attend a two-year institution, whereas socioeconomic effects boosted rural students' likelihood of attending a highly selective institution.

HS GPA and ACT/SAT scores are often used as predictors of college match as academic merit factors (Lee et al., 2017), college enrollment, and college graduation (Allensworth & Clark, 2019). Undermatching occurs when highly-prepared students, measured with better high school GPA and ACT/SAT scores, choose to both apply to and attend less selective colleges – particularly low-income and/or first-generation students (Lee et al., 2017; Ovink et al., 2018). College undermatching is more common among rural students although they have similar academic qualifications measured by HS GPA and standardized test scores compared with students at urban, public schools (Eccher, 2019; Lee et al., 2017). Rural students and students with a lower SES generally tend to earn lower standardized scores than their non-rural and more affluent peers and enrolled in four-year institutions at lower rates than their higher-SES peers (Burke et al., 2015). Higher-SES students tend to have higher chances of attending academically matched colleges and universities than their low-income counterparts (Lee et al., 2017).

AP/IB courses help increase the probability of college match (Lee et al., 2017). However, students in rural areas have less academic preparation for college opportunities due to fewer AP/IB offerings, remote location, and limited SAT/ACT preparation offers (Kryst et al., 2018; Whitaker et al., 2018). Using the population data of Civil Rights Data Collection in two school years (2011-12 and 2013-14) from public high schools in the US, Price (2020) investigated whether districts and schools offer AP or IB courses as college prep curricula, who enrolled in these courses are offered, and who acquired mastery level once enrolled in AP or IB courses. Price found that, on average, 7 out of 100 high school students attend districts that do not offer AP/IB courses. Moreover, among districts offering AP/IB courses, only 30% of American students attend schools that offer AP or IB courses. Comparing with White students, less than 24% of

American Indian, 27% of Latinx, and 30% of Black students attend schools that offer AP/IB. Notably, rural schools are the least likely to equalize access to AP/IB availability against suburban schools, but students attending rural schools experience less disparity in mastery (in the case of AP exams, passing three or more college credits) among racial/ethnic disproportionality versus suburban peers.

Poverty Level: Free-Lunch High-School Student Participation

Over 48% of rural K-12 students are eligible for free or reduced-price lunch (FRL) in the US, which is often used as a proxy for low-income status (Burke et al., 2015; Eccher, 2019). In Montana specifically, many American Indian students are low-income adult learners (Brown, 2017). Food insecurity is a barrier to academic achievement and retention among college students in the US (Camelo & Elliott, 2019; Khosla et al., 2020; Payne-Sturges et al., 2018). At the college level, national data indicate that approximately 13% of two-year college students and 11% of four-year college students came from food-insecure families in 2015 (Blagg et al., 2017). Studies in 2015 and 2016 reported at least 20% of two-year college students have very low levels of food security, and two-year college students are more likely to have food security challenges than four-year students (Broton & Goldrick-Rab, 2018).

Gender, Race/Ethnicity, and STEM Major

Gill and Leigh (2000) documented the shift in the gender gap in college enrollment from 1970 to 1993. In 1970, the majority of two-year and four-year enrollments in the US were male students. Conversely, in 2018, 56% of students that enrolled in post-secondary institutions were female (U.S. Department of Education, 2021). Based on an American Community Survey data set, the fraction of humanities, social sciences, and education undergraduate/college major choice declined significantly for birth cohorts during the period of 1940-1993, with much of the increase in business and economics degrees and some in STEM (Patnaik et al., 2020). The gender trends in major choice have sizeable differences in these three major categories. There is a gender gap in STEM

major choice due to women's comparative advantage in verbal skills – a proxy in university enrollment – than math skills, lower male university attendance, differences in high school course choices, and preferences for STEM (Patnaik et al., 2020). The number of female STEM bachelor's degree graduates in 2015-2016 nationally was lower than male peers (36% vs. 64%) across all racial/ethnic groups (de Brey et al., 2019). Additionally, there is a racial gap of bachelor's degree in science and engineering as underrepresented minority students received 22% of all science and engineering bachelor's degrees in 2016 (National Center for Science and Engineering Statistics, 2019). High school offerings such as engineering and engineering technology courses are important factors in students' decision to enroll in a STEM major at a four-year institution (Phelps et al., 2018).

Focusing on gifted high school students in Nebraska, ACT/SAT scores, race/ethnicity, school type (public/private), and living condition (urban, suburban, and rural) in relation to choice of STEM majors or non-STEM majors, the majority of gifted students are more likely to choose STEM majors (71%) when they enter college (Vu et al., 2019). Gender was a significant predictor in STEM major choice among these gifted students with the odds ratio of STEM majors for males being 5.124 times that of females, but race/ethnicity was not an important factor of gifted students' STEM major choice. For first-generation college students, female students are less likely to choose male-dominated majors (Wright, 2019) and to persist in STEM major completion (Mau, 2016). Weeden et al. (2020) used a national longitudinal data set and found substantial gender differences in STEM major completion. Specifically, among 2004 high school graduates who enrolled in college in the following fall, 18% of male graduates majored in the STEM/biomed field compared to 7.9% of female graduates. Interestingly, while in college, female students take more advanced courses in all major categories except STEM (Shewach et al., 2019).

Labor market data show that the set of core cognitive knowledge, skills, and abilities relating to a STEM education are now in demand – not only in traditional STEM occupations, but in nearly all job

sectors and position types (U.S. Department of Education & American Institutes for Research, 2015). A study of rural students in the Appalachian area shows that students who plan to pursue STEMM – Science, Technology, Engineering, Mathematics, and Medical – careers had higher college enrollment than those who did not have a plan to pursue STEMM (Rosecrance, 2017). In Montana, only 23% of high school graduates were interested in STEM fields compared to 43% of graduates nationally (ACT, 2019). Location of residence also impacts major choice. A longitudinal study in Canada found that rural students are less likely to enroll in both STEM and non-STEM four-year programs compared with STEM and non-STEM programs at two-year institutions (Hango et al., 2019).

Montana Context

Montana is the fourth largest state geographically in the US yet ranks 44th for population with just over a million residents as of July 2019 (U.S. Census Bureau, 2019), or 6.8 people per square mile. The population is largely White (88.9%), while 6.7% identify as American Indian or Alaska Native, and 4.1% as Hispanic or Latino (U.S. Census Bureau, 2019). The vast majority, or 96%, of school districts are considered rural (Versland et al., 2020). Additionally, more than 200 schools in Montana have less than 200 students within an attendant community and are located in a county with five or fewer people per square mile (Versland et al., 2020). Smaller school sizes have been associated with more positive educational outcomes, particularly for students at risk for underachievement due to economic disadvantage, minority status, or academic abilities (Byun et al., 2017). Thus, understanding distinct and influential features of rural education is important to meet the local community's needs, such as the teacher shortage in Montana (Versland et al., 2020) or for innovative solutions that do “not simply use a one-size-fits-all approach” (Schuler, 2020, p. 4).

The Montana University System is composed of two flagship universities, three community colleges, seven tribal colleges, and three private institutions which collectively enroll around 40,000 students. In

the fall 2020 semester, Montana freshman enrollment in a four-year institution accounted for 78% of all postsecondary enrollment and 60% were in-state students (Montana University System, 2020). In the academic year 2017-2018, the overall high school graduation rate was 86.4% in Montana, but the rate was 67.6% for American Indian students (The Montana Office of Public Instruction, 2019). Furthermore, the college enrollment rate of American Indian students to the Montana University System (excluding tribal colleges) was 25% in the academic year 2016-2017 compared to 46% of White students (The Montana Office of Public Instruction, 2018).

In response to these disparities, Montana has created programs to increase postsecondary access, particularly for historically underrepresented groups. For example, Montana provides a program (<https://www.reachhighermontana.org>) to support both high school students and parents in planning their future, such as accumulating college credits, creating a learning plan for after high school, and reference tools to prepare for college finances. Also, students in Montana between 16 and 19 years of age and/or in their junior or senior year of high school can participate in the dual enrollment program, which connects secondary and postsecondary institutions (Montana University System & Office of the Commissioner of Higher Education, 2020). Dual enrollment offers two delivery models: students can attend the Early College or the concurrent enrollment that offers college courses taught by a college-approved, state-licensed high school teacher at a high school. Furthermore, there are different support programs in Montana. For example, the BRIDGES program provides: (a) support to American Indian students wanting to transfer from four tribal colleges to a public, doctoral-granting institution; (b) the Montana Indian Student fee waivers (Brown, 2017); or other types of support such as (c) scholarships to enhance American Indian undergraduate/graduate access through National Science Foundation grants.

Method

Sample

This study uses a statewide longitudinal data set of 54,634 students in the Growth and Enhancement of Montana Students (GEMS) Data Warehouse provided by the Montana Office of Public Instruction (OPI) and the Office of Commissioner of Higher Education. The study sample are Montana youths who graduated from high school between 2013-2017 and attended a postsecondary institution in Montana. Each academic year sample includes 2,000 participants randomly selected for a total sample of approximately 10,000 students over five years for this study. In Montana, more than 50% of high school graduates did not enroll to a two-year or four-year institution in the Montana University/College System within 3-16 months of high school graduation during the academic years 2016-2018. Of the 10,000 students in the data set, 6,548 were missing data for institution type and/or freshman major choice and were excluded from the analysis. Additionally, 333 students were excluded from analysis due to missing data for ACT scores and/or HS GPA. Thus, the final sample consists of 3,119 students.

Measures

Outcome Variables

We investigated two dichotomous outcome variables: (1) enrollment at a four-year versus two-year institution and (2) selection of a STEM major versus non-STEM major. We utilized the six-digit Classification of Instructional Program Codes developed by the Department of Education (Douglas & Salzman, 2019) - to create two major groups (STEM or non-STEM) similar to previous studies (Jones et al., 2019; Mau, 2016; Wiswall et al., 2014). Specifically, STEM majors include agriculture, computer science, engineering, biology, mathematics and statistics, interdisciplinary studies, health professions, and physical sciences. Non-STEM majors include professional fields such as business/management/marketing, social sciences, humanities and art, education, and vocational. STEM major analysis of participants attending two-

year and four-year institutions is based on the institution type at enrollment.

Explanatory Variables

Demographic variables include categorical variables of students' gender (female coded 0 vs. male coded 1), race/ethnicity (American Indian or Alaska Native – AI/AN, Latinx, White – reference group, and others), student-level National School Lunch Program (NSLP) status (full price vs. free or reduced-price lunch, or FRL), school district class (AA, A, B, or C) and school district locale (rural, town, or city). School district class is determined by the schools' Montana High School Sports Classification, which is a school-level variable dependent on high school student enrollment. Class AA includes schools with 779 or more students, class A includes schools with 307-778 students, class B includes schools with 108-306 students, and class C includes schools with 107 or fewer students.

According to the U.S. Department of Education (National Center for Education Statistics, 2006), rural schools were defined using the urban-centric locale codes developed by the U.S. Census Bureau. These codes involved schools' geographic proximity to an urbanized area as well as population size and density. There are three subcategories of each major locale category (city, suburban, town, and rural), including large, midsize, and small for both city and suburban; and fringe, distant, and remote for both town and rural. Schools in this study have the following locale codes: city – large, city – midsize, town – fringe, town – remote, rural – fringe, rural – distant, and rural – remote.

Continuous variables include students' high school GPA and ACT subject scores (STEM, reading, and English). The ACT STEM score (i.e., the average of students' ACT math and science scores) provided greater explanatory power and improved model fit than using both ACT math and ACT science scores. ACT STEM score represents students' combined performance on the ACT math and science tests and was introduced in the ACT STEM College Readiness Benchmark in 2015 (ACT, 2015). Additionally, HS GPA was transformed using the natural logarithm, as the original HS GPA values violated the logistic regression assumption of linearity of the logit. In the

logistic regression models, all continuous predictors have been centered according to the grand mean.

Data Analysis

As students are nested in communities, we first investigated the need for multilevel modeling using a combination of school district class and locale, as well as using each of these variables individually. Although it would have been methodologically sound to nest students within their high schools, these data are not available in the GEMS data set. There was very little variation by school district class and/or locale, thus, multilevel modeling was statistically unnecessary. Therefore, we used logistic regression statistical analysis to estimate a series of models as our outcomes were binary (Agresti, 2017) to investigate what factors contribute to enrollment at a two-year versus four-year institution and STEM major choice while controlling for additional student-level characteristics, high school academic achievements, and school space/place.

Since school district class and locale explained little to none of the variation in the outcomes, likely due to the largely rural nature of the state, we excluded these variables from the analyses and began by examining student-level characteristics (gender, NSLP status, and race/ethnicity). We then examined high school academic achievement (HS GPA, ACT math score, ACT science score, ACT reading score, ACT English score, ACT STEM score, and ACT composite score) in multiple models and found that the best fit model was provided by HS GPA, ACT STEM score, ACT reading score, and ACT English score. Next, we examined school space/place for the second research question by including institution type as a predictor of STEM major choice. Lastly, we analyzed the interactions between significant predictors in the final model of each analysis, but none were found to be statistically significant predictors of either institution type or STEM major choice.

In this study, we present two models for the first research question and three models for the second research question. The first model in each analysis included student-level characteristics. Subsequently, the second model in each analysis added HS GPA and ACT subject scores. The third

model for the second research question included the school space/place predictor of institution type. We examined Akaike information criterion (AIC) values to assess overall model fit and report findings for the best-fitting model, indicated by the lowest AIC value. In addition, we report pseudo- R^2 values for each model and use log-likelihood ratio chi-square tests (LRT) to determine whether the model with additional predictors fits the data significantly better than the model with fewer predictors. All assumptions of logistic regression were examined and confirmed in each model.

Table 1*Descriptive Statistics*

Factor	Institution Type Analysis		Major Choice Analysis	
	n	%	n	%
Institution type				
two-year	635	20.4	632	20.3
four-year	2,484	79.6	2,484	79.7
Major choice				
Non-STEM			2,422	77.7
STEM			694	22.3
Gender				
Female	1,649	52.9	1,646	52.8
Male	1,470	47.1	1,470	47.2
NSLP status				
Free/reduced-price	656	21.0	654	21.0
Full price	2,463	79.0	2,462	79.0
Race/ethnicity				
AI/AN	158	5.1	158	5.1
Latinx	110	3.5	110	3.5
Other	106	3.4	106	3.4
White	2,745	88.0	2,742	88.0
School district class				
>778 students	1,599	51.3	1,598	51.3
307-778 students	612	19.6	612	19.6
108-306 students	496	15.9	495	15.9
<108 students	412	13.2	411	13.2
School district locale				
City	800	25.7	799	25.6
Town	1,227	39.3	1,227	39.4
Rural	1,092	35.0	1,090	35.0
Total	3,119	100.0	3,116	100.0
Factor	Mean	Standard Deviation	Range	
HS GPA	3.30	.55	(.65, 4.48)	
ACT STEM score	21.61	4.19	(11, 36)	
ACT reading score	22.18	5.67	(6, 36)	
ACT English score	20.30	5.38	(4, 36)	

Results**Descriptive Analysis**

The sample was 52.9% female, 5.1% American Indian/Alaska Native, 3.5% Latinx, and 88.0% White. Less than a quarter, or just 21% of students were eligible for free or reduced-price lunch. Students from rural areas accounted for 35% of all students, 79.6% of the sample enrolled in a four-year institution, and 22.3% of students chose a STEM major (Table 1).

Research Question 1

Logistic regression results for the first research question (How do student-level characteristics, high school academic achievements, and school space/place contribute to the likelihood that a Montana high school graduate enrolls in a four-year institution?) can be found in Table 2. The first model in the analysis of college type includes gender, NSLP status, and race/ethnicity as explanatory variables. Pseudo- R^2 values show that model 1 explains about 1% of the variance in students' decision to attend a four-year institution (McFadden = .009, Cox & Snell = .009, Nagelkerke = .014). Gender and race/ethnicity are not significant predictors of attending a four-year institution when controlling for all other factors in this model. However, NSLP status is a significant predictor of attending a four-year institution [$\beta = .56, p < .001, CI = (1.42, 2.15)$], as students who are not eligible for free or reduced priced lunch are predicted to be 75% more likely to attend a four-year institution when compared to students with free or reduced-price lunch (Odds Ratio/OR = 1.75).

The second model adds HS GPA, ACT STEM score, ACT reading score, and ACT English score to model 1. Model 2 fits the data significantly better than model 1 as the null hypothesis of the LRT is rejected, $\chi^2(4) = 394.53, p < .001$. Pseudo- R^2 values show that model 2 explains about 13% – 20% of the variance in student's decision to attend a four-year institution (McFadden = .134, Cox & Snell = .127, Nagelkerke = .199). NSLP status is a significant predictor of attending a four-year institution [$\beta = .24, p < .05, CI = (1.01, 1.59)$], as students from more affluent families are predicted to be 27% more likely to attend a four-year institution when compared to students with free or reduced-price lunch (OR = 1.27). Race/ethnicity (AI/AN) is a significant predictor of attending a four-year institution [$\beta = 1.16, p < .001, CI = (2.02, 5.17)$], as AI/AN students are about 3.2 times as likely to attend a four-year institution when compared to White students (OR = 3.19). Additionally, HS GPA is a significant predictor of attending a four-year institution [$\beta = 2.02, p < .001, CI = (4.34, 13.04)$]. Since the natural logarithm

of HS GPA was used as a predictor in this model, the odds ratio (OR = 7.50) represents a HS GPA increase of e or 2.72 points above the grand mean. Thus, a more useful interpretation of OR/ e shows that students with a HS GPA one point above the grand mean are predicted to be about 2.8 times as likely to attend a four-year institution (OR/ $e = 2.76$). In addition to HS GPA, ACT STEM score is a significant predictor of attending a four-year institution [$\beta = .12, p < .001, CI = (1.08, 1.17)$], as each one-point increase above the grand mean for ACT STEM score is estimated to increase students' odds of attending a four-year institution by 13% (OR = 1.13). Also, ACT English score is a significant predictor of attending a four-year institution [$\beta = .04, p < .05, CI = (1.01, 1.07)$], as each one-point increase above the grand mean for ACT English score is estimated to increase students' odds of attending a four-year institution by 4% (OR = 1.04). Exploratory models indicated that neither school district class nor locale were significant predictors or attending a four-year institution and worsened model fit.

Research Question 2

Logistic regression results for the second research question (What student-level characteristics, high school academic achievements, and enrolled institution type contribute to variation in a STEM major choice?) can be found in Table 3. The first model in the analysis of major choice includes gender, NSLP status, and race/ethnicity as explanatory variables. Pseudo- R^2 values show that model 1 explains about 5% – 8% of the variance in students' selection of a STEM major (McFadden = .051, Cox & Snell = .052, Nagelkerke = .081). NSLP status and race/ethnicity are not significant predictors of selecting a STEM major when controlling for all other factors in this model. However, gender is a significant predictor of selecting a STEM major [$\beta = 1.11, p < .001, CI = (2.55, 3.66)$], as males are predicted to be about three times as likely to major in a STEM field when compared to females (OR = 3.05).

Table 2*Logistic Regression Models for Institution Type Analysis*

Factor	Model 1		Model 2	
	β (SE)	OR (95% CI)	β (SE)	OR (95% CI)
Constant	.93 [‡] (.10)	2.54 [‡] (2.08, 3.12)	1.35 [‡] (.12)	3.84 [‡] (3.06, 4.85)
Male	-.06 (.09)	.94 (.79, 1.13)	.03 (.10)	1.03 (.84, 1.26)
Full price lunch	.56 [‡] (.11)	1.75 [‡] (1.42, 2.15)	.24* (.12)	1.27* (1.01, 1.59)
AI/AN	.43 (.22)	1.53 (1.01, 2.40)	1.16 [‡] (.24)	3.19 [‡] (2.02, 5.17)
Latinx	.04 (.24)	1.04 (.67, 1.69)	.29 (.26)	1.33 (.82, 2.25)
Other	.27 (.26)	1.31 (.81, 2.24)	.45 (.28)	1.57 (.93, 2.78)
HS GPA (ln)			2.02 [‡] (.28)	7.50 [‡] (4.34, 13.04)
ACT STEM			.12 [‡] (.02)	1.13 [‡] (1.08, 1.17)
ACT reading			.02 (.01)	1.02 (.99, 1.05)
ACT English			.04* (.02)	1.04* (1.01, 1.07)
AIC	3,135.63		2,749.10	

Note. * = $p < .05$, † = $p < .01$, ‡ = $p < .001$

The second model adds HS GPA, ACT STEM score, ACT reading score, and ACT English score to model 1. Model 2 fits the data significantly better than model 1 as the null hypothesis of the LRT is rejected, $\chi^2(4) = 344.28$, $p < .001$. Pseudo- R^2 values show that model 2 explains about 15% – 23% of the variance in a student's selection of a STEM major (McFadden = .155, Cox & Snell = .151, Nagelkerke = .232). NSLP status, race/ethnicity, ACT reading score, and ACT English score are not significant predictors of selecting a STEM major when controlling for all other factors in this model. Males are predicted to be about 3.2 (OR = 3.17) times as likely to major in a STEM field when compared to females ($[\beta = 1.15, p < .001, CI = (2.59, 3.89)]$). Additionally, HS GPA is a significant predictor of selecting a STEM major [$\beta = 1.93, p < .001, CI =$

(3.40, 14.47)]. Again, since the natural logarithm of GPA was used as a predictor, the odds ratio (OR = 6.92) is best interpreted with OR/e. This shows that students with a HS GPA one point above the grand mean is predicted to be about 2.5 times as likely to select a STEM major (OR/e = 2.54). Of all the ACT subject scores included, only ACT STEM score is a significant predictor of selecting a STEM major [$\beta = .18, p < .001, CI = (1.15, 1.24)]$, as each one-point increase above the grand mean for ACT STEM score is estimated to increase students' odds of majoring in a STEM field by 19% (OR = 1.19).

The third model adds institution type to model 2. Model 3 fits the data significantly better than model 2, as the null hypothesis of the LRT is rejected, $\chi^2(1) = 48.14$, $p < .001$. Pseudo- R^2 values

show that model 3 explains about 17% – 25% of the variance in a student's selection of a STEM major (McFadden = .170, Cox & Snell = .165, Nagelkerke = .252). NSLP status, race/ethnicity, ACT reading score, and ACT English score are not significant predictors of selecting a STEM major when controlling for all other factors in this model. Gender is still a significant predictor of selecting a STEM major [$\beta = 1.16, p < .001, CI = (2.60, 3.91)$] as males are predicted to be about 3.2 times as likely to major in a STEM field when compared to females (OR = 3.19). HS GPA is a significant predictor of selecting a STEM major [$\beta = 1.61, p < .001, CI = (2.44, 10.55)$], as a one-point increase above the grand mean for HS GPA is estimated to increase students' odds of selecting a STEM major by 84% (OR/e = 1.84). ACT STEM score is a significant predictor of selecting a STEM major [$\beta = .17, p < .001, CI = (1.14, 1.23)$], as each point increase above the grand mean for ACT STEM score is estimated to increase students' odds of majoring in a STEM field by 18% (OR = 1.18). Institution type is a significant predictor of selecting a STEM major [$\beta = 1.12, p < .001, CI = (2.19, 4.42)$], as students attending four-year institutions are predicted to be just about three times as likely to major in a STEM field when compared to students attending two-year institutions (OR = 3.07).

When examining interactions between significant predictors in the best-fitting model (model 3), an interaction between gender and institution type was found to be a significant predictor of STEM major choice (see Table 4 in appendix). Upon further examination, three observations had standardized deviance residuals that were more than three standard deviations away from the mean. After removing these outliers, we conducted a sensitivity analysis. Interestingly, the interaction between gender and institution type was no longer significant, but the findings of models 1, 2, and 3 remained very similar. Thus, these three observations were removed from the analysis of major choice for all models.

Although findings for the two outcomes varied, there were also similarities – especially in regard to high school academic achievement. Both HS GPA

and ACT STEM score were statistically significant predictors of both four-year institution enrollment and STEM major selection. ACT English was a significant predictor of enrolling in a four-year institution but was not useful in predicting students' major. Whereas gender was not a significant predictor in institution type, it predicted students' selection of a STEM major. Additionally, both race/ethnicity (AI/AN) and NSLP status were significant predictors only in four-year institution enrollment while enrollment at a four-year institution was a significant predictor of selecting a STEM major.

Discussion

This study builds upon the limited knowledge about college choice and STEM major choice of Montanan students, a largely rural state. The majority of students in Montana enrolled into a four-year institution in this sample compared to a two-year institution, approximately 80% vs. 20% respectively, which contrasts to previous rural-context studies either at the national level or other states (Burke et al., 2015; Byun et al., 2017; Koricich et al., 2018). Findings indicate that although enrolling in either a two-year or four-year institution in Montana did not differ between males and females, race/ethnicity is a strong predictor of the likelihood that students enroll in a four-year, in-state institution. More specifically, among students who do not leave the state for postsecondary education, American Indian/Alaska Native students in Montana are more likely to enroll to a four-year institution than White students, but there is no statistical significance between Latinx and White students. This aligns with Lee and colleagues' (2017) recent study showing no college-matching gap for American Indian students compared to White students when academic qualifications and other background conditions are held equal. Notably, NSLP status is strongly predictive for public high school students in Montana to enroll into a four-year institution as students not eligible for free or reduced-price lunch are predicted to be 27% more likely than their free or reduced-price lunch counterparts.

Table 3*Logistic Regression Models for Major Choice Analysis*

Factor	Model 1		Model 2		Model 3	
	β (SE)	OR (95% CI)	β (SE)	OR (95% CI)	β (SE)	OR (95% CI)
Constant	-2.03 [‡] (.12)	.13 [‡] (.10, .17)	-2.02 [‡] (.13)	.13 [‡] (.10, .17)	-2.93 [‡] (.21)	.05 [‡] (.03, .08)
Male	1.12 [‡] (.09)	3.05 [‡] (2.55, 3.66)	1.15 [‡] (.10)	3.17 [‡] (2.59, 3.89)	1.16 [‡] (.10)	3.19 [‡] (2.60, 3.91)
Full price lunch	.23 (.12)	1.25 (.998, 1.58)	-.10 (.13)	.91 (.71, 1.17)	-.14 (.13)	.87 (.68, 1.12)
AI/AN	-.40 (.24)	.67 (.41, 1.05)	.16 (.26)	1.17 (.70, 1.90)	.05 (.26)	1.05 (.62, 1.71)
Latinx	.03 (.24)	1.03 (.63, 1.63)	.20 (.26)	1.22 (.72, 2.00)	.16 (.26)	1.18 (.70, 1.93)
Other	-.02 (.24)	.98 (.60, 1.54)	.06 (.26)	1.06 (.63, 1.74)	.04 (.26)	1.04 (.62, 1.71)
HS GPA (ln)			1.93 [‡] (.37)	6.92 [‡] (3.40, 14.47)	1.61 [‡] (.37)	5.00 [‡] (2.44, 10.55)
ACT STEM			.18 [‡] (.02)	1.19 [‡] (1.15, 1.24)	.17 [‡] (.02)	1.18 [‡] (1.14, 1.23)
ACT reading			.01 (.01)	1.01 (.98, 1.03)	.01 (.01)	1.01 (.98, 1.03)
ACT English			-.02 (.02)	.98 (.95, 1.01)	-.03 (.02)	.97 (.95, 1.003)
Four-year institution					1.12 [‡] (.18)	3.07 [‡] (2.19, 4.42)
AIC	3,148.51		2,812.23		2,766.09	

Note. * = $p < .05$, † = $p < .01$, ‡ = $p < .001$.

As Koricich et al. (2018) found, the higher the SES of students, the greater the odds of attending postsecondary education and a four-year institution. In other words, SES has a strong, statistically significant relationship with postsecondary educational decisions. Higher-SES students also tended to have significantly higher chances of attending academically matched colleges and universities than did their lower-SES peers (Lee et al., 2017). As NSLP status is a proxy for SES, this may explain the lower college enrollment rate of this group. The findings that HS GPA, ACT STEM and ACT English scores are predictors for student enrollment in a four-year institution (Allensworth & Clark, 2019; Lee et al., 2017), particularly in a four-year institution in Montana, may be indicative of rural students considering college as increasingly

necessary for occupational prospects (Tieken, 2016; Tieken & San Antonio, 2016). Although NSLP status matters for college enrollment, it does not for STEM major choice.

There are many factors that may affect students' choice of STEM majors such as intrinsic and extrinsic motivation, after-school programs, self-efficacy, gender, interest in STEM, family background, and race/ethnicity (Vu et al., 2019). Similar with previous studies (Mau, 2016; Vu et al., 2019), gender was statistically significant in students' choice for STEM majors. Male students are about three times as likely to choose a STEM major compared to their female counterparts in this study, while the odds of male gifted students are five times higher than female gifted students in Nebraska (Vu et al., 2019). This is similar to the

pattern of gender differences in STEM major enrollment found using a national longitudinal data set (Jiang et al., 2020). High-school age is a critical stage to consider future occupations and college enrollment as well as college major choice, so the gender differences in STEM achievements at the high school level may lead to STEM major choice gaps during postsecondary education even though female students outperformed male students in STEM courses. However, race/ethnicity did not predict differences in the major choice for Montanan students like gifted Nebraska high school students. Notably, we found that the odds of selecting a STEM major at a four-year institution is three times higher than doing so at a two-year institution in this study, which is opposite to rural students in Canada as they are less likely to enroll in both STEM and non-STEM four-year programs compared with STEM and non-STEM at two-year institutions (Hango et al., 2019).

Study Limitations and Future Research

The present study has several limitations in examining high school graduates' college enrollment and STEM major choice in Montana. First, academic experiences and external factors such as teachers' expectations, advanced course-taking such as AP/IB, parental education, household incomes, school district ID are predictive for college enrollment (Byun et al., 2017; Corley, 2018; Kryst et al., 2018), but these variables are not available in this data set. Second, prior research showed that the farther rural graduates' high schools were from colleges, the more likely rural graduates were to enroll in a two-year institution or undermatch with a college (Burke et al., 2015). However, this study does not have specific information of students' high school distance to an enrolled college. Third, there is not available information about Montanan students' occupational plan in STEM fields to examine in relation to their college enrollment (Rosecrance, 2017). Fourth, we also were not able to examine students who either did not enroll in postsecondary education or enrolled in a different state, as we only have data on graduates who enrolled at an institution in Montana. Therefore, there may be ecological fallacies concerning the findings for race/ethnicity, as more White students may be leaving Montana for college

than American Indian students. Prior research supports the likelihood of an ecological fallacy in this study, as "minority students are less likely than Whites to send scores (i.e., ACT or SAT) to and attend an out-of-state institution" (Niu, 2015, p. 342). Finally, we only knew students' initial major consideration at the enrolled college, not their graduated majors.

As NSLP status is a strong predictor of college enrollment in Montana, it is important to understand how to support Montanan students participating in the NSLP to increase their postsecondary access when food insecurity is currently a major concern for college students (Camelo & Elliott, 2019; Khosla et al., 2020). Also, considering that American Indian students are more likely to enroll into a four-year institution compared to White students, it is imperative to provide support programs, such as a structured college preparatory instruction designed for American Indian students, as graduation for this group is lower than Whites (National Center for Education Statistics, 2019). Additionally, we recommend that policies at the state and institution levels aim to increase the enrollment of American Indian students in postsecondary education, as nationally this group has the lowest college enrollment rate (Brown, 2017).

As only 20% of all US high school graduates and 2% of underrepresented minority students met the ACT STEM Readiness Benchmark in 2018 (Committee on STEM Education of the National Science and Technology Council, 2018) and only 23% of Montana high school students reported interest in STEM fields (ACT, 2019), understanding the motivations and conditions necessary to increase Montanan students' interest in STEM and obtain STEM college readiness warrants further research. For example, researchers could investigate available professional development for STEM teachers to be role models or what STEM labor information in Montana is available for high school students to increase their STEM interest and college readiness (Kryst et al., 2018; Lee et al., 2017). Furthermore, our study indicates a striking gender disparity in STEM major choice in Montana. Therefore, future research should investigate what factors attract and engage female students to STEM majors, such as student counseling in high school

or college-level advanced course-taking (Shewach et al., 2019). Also, future studies should use data that include students' high schools to assess how Montana contextual location contributes to students' STEM major choice. Qualitative research could examine students' occupational intentions and motivations to stay or mobilize for their jobs after graduation (Hango et al., 2019) to meet the future STEM workforce in Montana or the available labor demands.

Conclusion

The findings from this study are highly relevant, as the data set included recent high school graduates from the 2013-2017 academic years. As rural context varies from state to state, this study provides a more complete picture of college enrollment patterns and major selection among students from a largely rural state who enrolled in a Montana postsecondary institution. Although our findings about gender and free or reduced-price lunch are consistent with prior research, importantly, our findings complicate trends provided in national data concerning postsecondary enrollment patterns and STEM major selection of American Indian students.

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Appendix
Logistic Regression Models for Major Choice Analysis Including Outliers

Factor	Model 1		Model 2		Model 3		Model 4	
	β (SE)	OR (95% CI)	β (SE)	OR (95% CI)	β (SE)	OR (95% CI)	β (SE)	OR (95% CI)
Constant	-2.00 [‡] (.12)	.14 [‡] (.11, .17)	-1.98 [‡] (.13)	.14 [‡] (.11, .18)	-2.83 [‡] (.20)	.06 [‡] (.04, .09)	-4.49 [‡] (.59)	.01 [‡] (.003, .04)
Male	1.10 [‡] (.09)	3.01 [‡] (2.52, 3.60)	1.14 [‡] (.10)	3.11 [‡] (2.55, 3.82)	1.14 [‡] (.10)	3.12 [‡] (2.55, 3.83)	2.90 [‡] (.61)	18.20 [‡] (6.46, 76.21)
Full price lunch	.21 (.12)	1.23 (.98, 1.55)	-.12 (.13)	.89 (.70, 1.14)	-.16 (.13)	.85 (.67, 1.10)	-.16 (.13)	.85 (.67, 1.10)
AI/AN	-.42 (.24)	.66 (.40, 1.03)	.14 (.25)	1.15 (.68, 1.86)	.03 (.26)	1.03 (.61, 1.67)	.03 (.26)	1.03 (.61, 1.67)
Latinx	.02 (.24)	1.02 (.63, 1.61)	.18 (.26)	1.20 (.71, 1.97)	.15 (.26)	1.16 (.69, 1.90)	.14 (.26)	1.15 (.68, 1.89)
Other	-.03 (.24)	.97 (.60, 1.53)	.05 (.26)	1.05 (.63, 1.72)	.03 (.26)	1.03 (.61, 1.70)	.03 (.26)	1.03 (.61, 1.68)
HS GPA (ln)			1.88 [‡] (.37)	6.56 [‡] (3.24, 13.64)	1.57 [‡] (.37)	4.81 [‡] (2.36, 10.09)	1.58 [‡] (.37)	4.84 [‡] (2.37, 10.13)
ACT STEM			.18 [‡] (.02)	1.19 [‡] (1.15, 1.24)	.17 [‡] (.02)	1.18 [‡] (1.14, 1.23)	.17 [‡] (.02)	1.18 [‡] (1.14, 1.23)
ACT reading			.01 (.01)	1.01 (.98, 1.03)	.005 (.01)	1.00 (.98, 1.03)	.01 (.01)	1.01 (.98, 1.03)
ACT English			-.02 (.02)	.98 (.95, 1.01)	-.03 (.02)	.98 (.95, 1.004)	-.03 (.02)	.97 (.95, 1.003)
Four-year institution					1.05 [‡] (.17)	2.85 [‡] (2.05, 4.06)	2.56 [‡] (.59)	12.88 [‡] (4.83, 52.47)
Male × four-year institution							-1.86 [‡] (.61)	.16 [‡] (.04, .45)
AIC	3,160.95		2,830.14		2,788.64		2,776.28	

Note. * = $p < .05$, † = $p < .01$, ‡ = $p < .001$.