CLASSROOM PERFORMANCE DIFFERENCES BETWEEN STUDENTS OF DIFFERING LOCALE AND SOCIOECONOMIC BACKGROUNDS

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CLASSROOM PERFORMANCE DIFFERENCES BETWEEN STUDENTS OF DIFFEREING LOCALE, RACE/ETHNICITY AND SOCIOECONOMIC BACKGROUNDS

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Abstract: Institutions are interested in the academic performance of students of different demographics, because academic performance plays a role in their persistence and graduation. Race/Ethnicity and socioeconomic status are established as predictors of student performance, with minority students and students of lower socioeconomic status performing at lower levels than majority students and those of higher socioeconomic status. One demographic that has been overlooked has been locale, i.e. from where along the rural to urban spectrum a student originates. Rural areas tend to lack the resources available in more urbanized areas, due to issues stemming from higher rates of poverty and distance from resources. This study seeks to answer three questions: 1) Is there any overall (main) effect of locale on student performance; 2) Do two-way interactions exist between locale and Community, Socioeconomic Status (CSES) or locale and race/ethnicity; and 3) Can differences in performance be attributed to an interaction between locales, race/ethnicity, and community socioeconomic status. This study used data recorded at a south central, high-research, land grant institution between 2006 and 2019 and the National Center for Education Statistics' (NCES) publically accessible Common Core of Data to test for differences in mean student grade in gatekeeper science and math courses among students of different race/ethnicity, CSES (as determined by the percentage of students enrolled in free or reduced lunch programs), and locale (as determined by the NCES locale designation of the students' high schools). The courses were evaluated independently using three-way ANOVA to determine if main and interaction effects were present among or between the demographics. Duncan's Multiple Range Tests to examine differences among the levels of each variable. Significant differences among mean student grade were found for race/ethnicity and CSES for most courses, and only in one course for locale. No two-way or three-way interactions were found for any course. These result do not support the use of locale as an indicator of the need for additional support or intervention at this institution. Efforts to increase student performance should remain focused on poorer schools and those with high levels of disaffected minority students, regardless of locale.
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CHAPTER I

INTRODUCTION

Background

Colleges, and the institutions that fund them, have long been interested in identifying disadvantaged populations (Gordon, 1966), and continue to do so (Donnelly, 2020). Belonging to these groups is an indicator of potential lower graduation rates and lower GPAs (Byun et al. 2015 in their college career. One demographic not currently considered a disadvantaged population are those from rural areas, although as described below, many characteristics of rural areas might warrant such consideration. For the purposes of this paper, rural schools and areas have the following characteristics, 1. They are centered around a small town or village community. 2. The communities are located away from urban centers. 3. The community has strong historical roots to a primary (mining, agriculture, lumber) or secondary (manufacturing) industry. Rural students are often educated in elementary and secondary schools that are economically disadvantaged, have difficulty attracting and retaining teachers qualified to teach AP and college prep classes, and have class sizes much smaller than those the students will encounter in college courses (Elder, 2014).

Significance of the Study

The literature on differences in the performances, whether measured by grades in select core subjects or degree completion, of students from differing locales, i.e. regions described in terms of where they exist on the rural to urban spectrum (Sonnenberg, 2006), is virtually nonexistent. Thus while a literature review of the challenges faced by those living in rural areas might lead to predictions about the performance of students from those areas in college courses, there is an almost complete gap in empirical studies of any effect locale of origin may have on post-secondary education. By understanding whether locale of origin may be a factor affecting student performance, institutions such as governments and universities may be better able to adjust their instructional practices and institutional resources aimed at achieving and maintaining inclusive excellence.

CHAPTER II

REVIEW OF LITERATURE

The purpose of this study is to determine if any relationship exists between a student's locale of origin and their classroom performance, and whether other demographics (race/ethnicity, socioeconomic level) interact with the effect that locale may have on performance. Locales differ in the access they provide to resources, presence of educated individuals, and limitations that rural poverty introduces to families. Because the population in this study were enrolled in college courses between 2006 and 2020, this review draws from studies performed between the early 1990's and the late 2000's, when the study's population would have been in elementary and or middle school. This selection provides a better description of the conditions that might influence this population's academic performance than papers that focused on more recent cohorts.

Defining Rural

Defining what constitutes a rural area is difficult due to the subjective nature of the term. The state of Texas alone has 43 different definitions of rural used by its various agencies (Texas Legislative Council, 2014). The rural-to-urban scale used in this study was that produced by the National Center for Education Statistics (2005) using population densities and distances from densely populated locations as parameters. This scale serves as a proxy for, yet does not consider, economic and cultural aspects of rural areas that are difficult to evaluate on a national level. This literature review describes as a few of the economic and cultural aspects of rural areas and rural schools, as put forth in Elder (2014) that stem from those areas being: 1. centered around a small town or village community, as determined by census data; 2. located away from urban centers and; 3. in possession of strong historical roots to a primary (mining, agriculture, lumber) or secondary (manufacturing) industry.

Factors of potential impact on students from rural locales

Bronfenbrenner's ecological systems theory of childhood development (Bronfenbrenner & Crouter, 1983; Bronfenbrenner & Evans, 2000) leads to predicted differences in performance from rural students. This theory places emphasis on both the more distant macrosystemic factors, like community education, employment, and poverty, and the more personal microsystemic factors, the parent-child and teacher-child relationships, in which rural students face challenges that those of other locales do not. Of these two, Bronfenbrenner and colleagues argue that the microsystemic factors have the larger effect on childhood development. In this perspective, the accumulation of challenges, such having a unstable home life or parents who are not invested in education, in each ecological setting leads to a greater chance of negative outcomes for the child (Bronfenbrenner & Morris, 1998; Sameroff & Fiese, 2000). A real world example of these challenges resulting in differences in performance is the study by Gallagher et al. (2013) that investigated student-teacher relationships in rural kindergarten and first grade students. They found that those who were perceived as having behavior problems, a microsystemic factor, had lower literacy skills.

Bronfenbrenner's framework is supported by studies that have shown that the parents' education, marital status, mental health, and socioeconomic status are indicators of students' future academic success (Burchinal et al., 2002; Entwisle & Alexander, 1999). As is discussed below, rural areas present a greater number of these macrosystemic and microsystemic challenges to students, such as higher rates of poverty and less time for parent-student interaction, than other locales.

The other two factors investigated in this study, race/ethnicity and socioeconomic status are already established as factors affecting a student's performance. For example, the National Assessment of Educational Progress (NAEP) reported an achievement gap of 20 on the NAEP scale for Black students attending schools with a greater than 60 percent Black student population when student, teacher, and school characteristics are otherwise similar (Bohrnstedt et al, 2015). Titus (2006) found that students from the lower two socioeconomic status quartiles were less likely than those of the upper two to complete a bachelor's degree.

Rural Schools as Resource Poor Institutions

One possible challenge to student success, as defined as mean course grades, in secondary education is that rural schools are located in areas with higher rates of poverty than schools in other locales. During the 1990's, America saw an increase in wealth and productivity; however, this economic upturn was not felt by rural communities, probably because the increase in economic growth was in the technology sector (Regional Educational Laboratory Network, 2004). The end result of this disparity of economic growth is that 80% of rural families that have at least one parent working full time and 25% of rural families that have two or more members working full time are still living 200% below the federal poverty level (Summers, 1997).

There has been an emigration of younger educated people to suburban and urban areas and a decrease in manufacturing and smaller scale agriculture (Johnson & O'Hare, 2004). These factors combine to produce a smaller tax base from which to draw funds for use in education (Lichter et al. 2003).

One of the defining characteristics of a rural area, the low population density, also creates funding issues for rural schools. The lower population density results in higher costs associated with bussing students (Reeves, 2003) and can cause rural school districts to become less competitive for federal funding (Beeson, 2003). In rural school districts, there are 66% more students eligible for free/reduced lunch than in urban ones and per pupil spending is 25% lower than in urban school districts (Rural School and Community Trust, 2005).

Rural and Poverty Interactions

Isolated and resource-poor rural areas provide ample opportunity for factors associated with poverty to negatively interact with rurality. Familial characteristics such as parent's education level, and income, are associated with a child's future performance in schools (Burchinal et al., 2002). In rural areas, more than half of children live at 200% below the poverty line, a rate substantially higher than the 37% of urban children who do so. Emigration of highly educated people to urban and suburban areas continues to drain rural locales of funding sources (Rivers, 2005).

A trend toward non-standard work hours and working multiple jobs in rural families provides additional strain on rural families and rural children (Mather & Scopilitti, 2004). Though rural children were more likely to live in a two-parent family in the past, that rate has become more comparable to that of urban families (Dill, 1999). Single-mother households in rural areas see higher levels of poverty than their more urban counterparts, even though single mothers in rural areas work longer hours (Lichter & Jensen, 2001). These effects can be additive.

Distance from Resources in Rural Areas

The most common defining trait of rural locations is their isolated nature. This makes accessing resources like after school support programs, libraries, and sporting and academic activities more difficult.

Since the 1970's, there has been an attempt to increase funding for rural schools by combining several school districts into one. This reduces expenditures by eliminating the need for multiple campuses and staff (Lichter et al., 2003). However, later evidence has shown that this method of increasing per-student expenditures has not resulted in increased performance for rural children. A report by the Rural School and Community Trust (2005) shows evidence that children who attended the smaller community schools that consolidation eliminated, performed better than those who attended the consolidated rural schools.

Another potential negative effect stemming from the distances in rural areas are the increased commuting times for both parents and students. For students, this takes the form of longer bussing routes. In rural areas, bus routes in excess of one hour are not uncommon (Howley et al., 2001). This results in up to two hours every school day during which studying or working on schoolwork is made more difficult or impossible. This also forces the students to wake up much earlier, resulting in less sleep and negative health and behavioral outcomes (Meldrum & Restivo, 2014). With fewer than 40% of rural areas having access to public transportation, (Friedman, 2003), parents of younger students must provide transportation in instances where school bussing is not available, restricting access to extracurricular activities to those students who are unable to find transportation.

Potential Positive Factors associated with Rural locales

Rural communities also possess factors that can promote better academic performances in students. The majority of these are tied to the smaller and closer knit nature of rural communities. Rural mothers are more likely to be married upon the birth of their first child than their urban counterparts (Atkinson, 1994), providing additional support while raising the child and lessening possible financial hardships. The higher marriage rates and lower violent crime rates that characterize rural rather than urban areas (Donnermeyer, 1994) result in rural neighborhoods being a safer and more stable environment.

Teachers in rural schools are less likely to report academic issues from incoming kindergarteners (Zill, 1999). The lower frequency of academic issues may result from higher frequencies of transition activities, parental outreach, and home visits in rural schools (Lee & Burkam, 2002; Zill, 1999). Rural parents are more likely to attend school events than urban or suburban parents (Semke and Sheridan, 2012).

Prior Research on academic performance differences among locales

Little research has been conducted into the differences in academic performance among students from different locales. The most recent study focused primarily on these differences was conducted in the late 1990's using data collected in the late 1980's. That study by Fan and Chen (1999) was conducted on data from approximately 24,500 students who were in the 8th grade in 1988 with follow-ups every two years for six years. The authors found no statistically significant differences in the mean course grades of students from different locales. Considerable technological and socioeconomic changes have occurred in rural and other locales since the 1980's. Such changes could result in performance differences.

No study has analyzed college attendance rate of the national population from which the population used in this study was drawn. The more recent analysis by Byun et al. (2015) of the National Education Longitudinal Study of 1988-2000 found that rural students were more likely to attend less selective institutions, which the authors attributed to the comparatively less intense curriculum of rural schools. Rural students were more likely to delay admission to college, and were more likely to experience a discontinuous college career (Byun et al, 2015). Provasnik et al. (2007) supports this finding. They found that students in rural areas were less likely to have attended a school that offered Advanced Placement courses (69%) as compared to students in urban (93%) and suburban (96%) areas. All three groups had a similar likelihood of having attended a school with dual credit courses (76%).

Other studies have investigated performance by locale, though it was not those studies' primary focus. Byun et al. (2012), in an effort to find predictors of Bachelor's degree completion among rural students at four-year institutions, found that rural students had higher average first-year cumulative college GPAs (3.18) than their urban (3.11) or suburban (3.05) counterparts. However, using the curriculum intensity metric (Adelman 2006) they also found that rural schools had, on average, less rigorous curriculum (3.67) than urban (3.93) or suburban ones (3.80) as measured on the 5 point scale. Byun et al. (2012) drew a random sample from the National Education Longitudinal Study of 1988-2000 dataset but did not compare students from different locales within the same institution or courses. This limits direct comparisons of GPAs among students from different locales.

In addition to the lack of research into student performance, there is a lack of research into rural schools and rural schooling with regard to social aspects such as student-teacher interactions and classroom performance as measured by mean course grades and GPA. In their meta-analysis of parent-student and teacher-student involvement, Semke and Sheridan (2012), discussed later in this review, were unable to find enough studies, n=18, that met their criteria to draw a meaningful conclusion.

Research Questions

This review of the literature leads to three questions that this study seeks to answer. 1. Does locale itself (perhaps reflecting the resource-poor nature of rural schools) result in significant differences in mean course grades between rural students and those who come from other locales? 2. Does the nature of poverty in rural areas lead to an interaction between socioeconomic status and a student's locale? 3. Can any differences mean course grades among locales be explained by an unequal distribution of racial/ethnic groups and socioeconomic levels between the different locales?

INTRODUCTION

CHAPTER III

METHODOLOGY

This study analyzed data from records maintained by the university or from publicly available databases; all the variables in this study are standard demographic information or course grades.

Participants

Population

The subjects included in this study were students who had enrolled in select science and math courses at a South Central, High-Research, Land Grant Institution between 2006 and 2019. The courses included: Calculus I (MATH 2144), Chemistry I (CHEM 1314), Introductory Biology (BIOL 1114), The Chemistry of Organic Compounds (CHEM 3015), Organic Chemistry I (CHEM 3053), Frontiers of Physics (PHYS 1001), and University Physics III (PHYS 2203). These courses meet the description of gatekeeper courses (Redmond-Sanogo, 2016), and are considered to have high power to predict students' academic performance as a whole. Catalog Descriptions of the courses are found in under Course Descriptions in the Appendix. This study was determined to be Non-Human Subjects Research (IRB Approval: IRB-20-319, IRIM: Project 12917).

Data Collection

Performance and Demographics Data Sources

The data were requested from the institution's Institution Research & Information Management department (IRB Approval: IRB-20-319, IRIM: Project 12917) and acquired from the National Center for Education Statistics' publicly accessible Common Core of Data. The data requested from the Institution Research & Information Management (IRIM) department were student grade (as measure of performance) in each science and mathematics class as measured on a 4.0 scale, race/ethnicity and high school attended, which was not reported but used to link other data as described next.

These data were paired with the students' high schools' demographic data via its National Center for Education Statistics school ID code, a unique code the organization gives to all American schools. The NCES is the federal entity tasked with collecting and analyzing data from American and non-American educational institutions. The collected demographic data include: the school's public or private status, enrollment, full time equivalent teacher employment, and community socioeconomic status (CSES – defined below), and high school's locale code, used in this study to identify where along the rural to urban spectrum a school is located.

For analysis purposes, the schools were grouped, based on the percent of students enrolled in a free or reduced lunch program, into three CSES levels, low: 0%-33% enrollment, medium: 34%-66% enrollment, and high: 67%-100% enrollment. This followed the method used by Byun et al. (2012).

The locale code is based on three United States Census defined areas: Core Based Statistical Areas (CBSAs), urban areas, and Principal Cities. CBSAs are defined as a "geographic entity associated with at least one population core of 10,000 or more, plus adjacent territory that has a high degree of social and economic integration with the core, as measured by commuting ties."

(Geverdt, D. E, 2015). Urban areas are locations with dense, developed residential and commercial land as defined by the United States Census. These locations are divided into Urbanized Areas (UA), with populations greater than 50,000 people, and Urbanized Clusters (UC), with populations less than 50,000 people but greater than 2,500 people. An area cannot be considered an urban area with a population less than 2,500. Principal Cities are the largest incorporated place within a CBSA that is part of an UA. From these three definitions, the primary locales: urban, suburban, town, and rural, can be defined.

City locales are located within Principal Cities, and therefore an UA. Suburban locales are the territories within an UA, but outside of a Principal City. Towns are territories within UCs. Rural areas are territories not contained within any of the aforementioned census defined areas. The scale's subdivisions were not used for analysis, due to comparatively small sample sizes from small and midsized suburbs. The NCES Locale scale was selected because 1) of its higher granularity than other scales of rurality, 2) it adjusts for regional variability in what constitutes rural and urban spaces, and 3) it could be paired easily with student data via the NCES school ID code.

Data Analysis

Each course was independently evaluated using a three-way ANOVA to determine:

- the existence of any overall (main) effects of locale,
- whether two-way interactions existed between locale and CSES or locale and race/ethnicity
- whether differences in performance (mean course grade) could be attributed to an interaction between locales, race/ethnicity, and CSES

ANOVAs were conducted separately for each course because the data provided by IRIM only included the data for one course for each student record. Thus some students took more than one of the courses or even all courses, while others did not. Subsequently, Duncan's Multiple Range Tests (Duncan, 1957) were used to examine differences among the levels of each variable.

To test if any differences in mean course grades among locales could be explained by differences in the distributions (higher or lower concentrations) of disaffected demographics living in certain locales (e.g. more Black or Hispanic students living in urban areas), the data from each class were analyzed via cross tabs. To determine if students from any locale were over or underrepresented in any of the racial or socioeconomic categories, standardized residuals were examined. Standardized residuals ±1.96 were considered significant. All results were considered significant at $\alpha<0.05$.

CHAPTER IV

FINDINGS

Overview

The results of the three-way ANOVA (See Tables 1 and 2) showed that there were statistically significant differences in mean course grade by race/ethnicity, CSES, and locale as main effects. There were significant differences in the mean course grades among students from the different Race/ethnicity categories for all courses. There were significant differences in the mean course grades among students of different CSES levels for all courses except CHEM 3015. Significant differences in mean course grades among students from different locales were found only in CHEM 3053. No significant difference was found for any two-way (locale X CSES, locale X race/ethnicity, or CSES X race/ethnicity) or three-way (locale X CSES X race/ethnicity) analyses. Frontiers of Physics and University Physics III were excluded from consideration due to small sample sizes and their use of a Pass/Fail grade system. Native Hawaiians or other Pacific Islanders and Non-Resident Aliens were also excluded due to comparatively small sample sizes.

Race/Ethnicity

There was a significant difference in mean course grades found in all courses for race/ethnicity. This was most pronounced for the difference between the mean course grades of Black/African American students and students of other race/ethnicity. Duncan's New Multiple Range Test (See Tables 3 and 4) showed no overlap of mean course grades of Black/African American students and any other race/ethnicity in BIOL 1114, CHEM 1314, CHEM 3053, and MATH 2144.

American Indian and Hispanic students either grouped together or had overlap in all courses. The mean course grades of Asian, Multiracial, and White students were not statistically different in any courses except for BIOL 1114, where White students were in their own Duncan group, and CHEM 3053, where the mean course grades for of Multiracial students, Asian, and White students were not significantly different, but those for Asian were significantly different from those of White students.

Community Socioeconomic Status

There were statistically significant differences in mean course grades among students from different CSES levels for all courses except for CHEM 3015 (See Table 5). The trend was for mean course grades for students from schools with high percentages of enrollment in free or reduced lunch programs to be lower than mean course grades for students from schools with lower percentages of enrollment in free or reduced lunch programs.

Locale

There were significant differences among mean course grades for students from different locales (See Table 6) only in CHEM 3053. In CHEM 3053, Duncan's New Multiple Range Test indicated the there was a significant difference between students from Cities and those from Suburbs.

Interactions

The second research question for this study was whether interactions existed between locale, race/ethnicity, and CSES. The two-way and three way ANOVA tests performed on the selected courses did not find any significant interaction between any of the factors in either a two-way or a three-way ANOVA. The reasons become apparent when looking at the estimated marginal means.

Within courses, there was no consistent pattern of significant differences in mean course grades for races across the different locales. This was also the case for different CSES backgrounds. To illustrate this, the data from BIOL 1114 and CHEM 1314 are presented in Figures 1 and 2.

In Figure 1, mean course grades across locales exhibited different patterns among the categories of race/ethnicity. With the exception of Asian students from rural locales outperforming White students from rural locales, means for White students and Black/African American students are consistent across all locales, and higher or lower, respectively, than those of the other races/ethnicities. The mean course grades for Asian and American Indian students varied by locale, but Asian students' mean course grades were higher in cities and towns compared to suburbs and rural areas and American Indians grades higher in suburbs and rural areas and lower in cities and towns.

Comparing Figure 1 and 2 illustrates how student performance by race/ethnicity by locale differs from course to course. BIOL 1114 and CHEM 1314 were chosen to illustrate this phenomenon because they are both introductory classes in which students enroll early in their academic careers, when the influences of a student's high school environment should be strongest. BIOL 1114 is usually taken during the student's fall semester as Freshmen and CHEM 1314 is usually taken in the spring as a Freshman or in the fall as a Sophomore, because college algebra is a prerequisite. When students' mean course grades in BIOL 1114 and CHEM 1314 are compared graphically, the patterns in mean course grades are quite different. The trends in performance for White and Black/African American students are consistent though more varied when comparing locale to locale and locales between courses. The largest differences comes from the patterns for Asian and American Indian students. American Indian students from cities and towns earned higher mean course grades than those from suburbs and rural areas; Asian students from suburbs and rural areas earned higher mean grades than those from cities and towns.

Cross tabulations

The third research question in this study was whether an interaction between race/ethnicity, CSES, and locale could contribute to differences in mean course grade. Could differences in mean course grades among locales be a result of different proportions of students of different race/ethnicity attending schools different of CSES levels? If so, the effect of race might result from a lower CSES. Tables 7 and 8 contains the standardized residuals for the cross tabulation analysis of Race/Ethnicity by CSES for students enrolled in BIOL 1114 and CHEM 3015. A standardized residual greater than 1.96 or less than -1.96 showed either significant overrepresentation (if positive) or underrepresentation (if negative) The cross tabulations for all courses showed a tendency for non-White students, particularly Black/African American students, to come from schools with a higher percentage of students enrolled in free or reduced lunch programs, while White students came from schools with lower percentages of students enrolled in free or reduced lunch programs.

CHAPTER V

CONCLUSION

Summary of findings

The objectives of this study were to determine whether differences in performance, as measured by mean course grades, existed between rural and non-rural students and whether there was an interaction among locale and established demographic indicators of performance, namely race/ethnicity and community socioeconomic status. In most cases, there were no significant differences among means for students of different locales. In the one course, CHEM 3053, where there were significant differences, the difference was between City and Suburban students; the means for Town and Rural students were not significantly different from either City or Suburban students. While there was a significant difference between mean course grades of City and Suburban students, the effect sizes for the differences was extremely small (< 0.02). Thus, it appears for these courses the locale from which a student originates does not affect or serve as a predictor of performance. Effect size was also small for factors that have in the past been identified as predictors of performance, i.e. race/ethnicity and CSES. This indicates that efforts to increase student performance do not need to take a student's locale into consideration.

Performance by Race and CSES within Courses

Differences among students of different races/ethnicities and whose home locales were characterized by different proportion of free/reduced lunches showed a different pattern depending on the course. There was a greater difference in the mean course grades between students in the lowest CSES level and those in the highest in introductory courses than in the upper-division courses. This may result from introductory courses acting as gatekeepers - preventing lower performing students from progressing on to the upper-division courses. This does not explain race/ethnicity. The large discrepancies in mean course grades between Black/African American students and White students found in introductory courses persisted into upper-division courses. Differences in mean scores among students of different CSES did not persist. This finding indicates that there are aspects of race/ethnicity that are independent of socioeconomic effects that drive performance differences.

Comparisons to Previous Work

Previous studies that have examined performance differences among students of different locales have used data collected at a national level (Byun, 2012, Fan and Chen 1999). Byun et. al (2012) used data taken from the National Education Longitudinal Study of 1988-2000 and the Postsecondary Education Transcript Study to predict bachelor's degree completion. They also used race/ethnicity and socioeconomic status as factors in their analysis, as well as factors such as participation in extracurricular activities and parents' levels of education, which were unavailable to this study. They used cumulative first year GPA to predict later completion of a bachelor's degree, rather than examining students' performance within individual STEM courses. Byun et al. (2012) found rural students who delayed admission to college or attended part time were less likely to complete a bachelor's degree. Low first year cumulative GPA was also found to be more strongly associated with not completing a Bachelor's degree for rural students compared to non-rural students. They also found that African American and Hispanic students were less likely to complete their bachelor's degree than white students. Byun et al. (2012) attributed this to African American and Hispanic students being more likely to come from lower socioeconomic backgrounds, which was also a strong predictor of degree completion, with students from lower socioeconomic levels being less likely to complete a degree (Titus, 2006). This study's findings are similar to what Byun et al. (2012) found - in the majority of cases locale does not influence a student's performance. Similarly, this study found differences in mean course grades for individual STEM courses for Race/Ethnicity and CSES. This would likely result in a pattern similar to that of Byun et al. (2012) for first year cumulative GPAs.

Fan and Chen (1999) also used data taken from the National Education Longitudinal Study of 1988 in their analysis to predict a student's performance in high school science, math, reading, and social studies, rather than college courses. They found no significant difference among rural, suburban, or urban students in the four high school subjects they tested. Both Byun et al. (2012) and Fan and Chen (1999) used data collected at a national level, from students who were enrolled at different universities. This makes direct comparisons between locales difficult because rural and non-rural students have different enrollment patterns. Rural students are more likely to enroll in public and nonselective colleges than non-rural students (Gibbs, 1998). Gibbs (1998) attributed the higher apparent college graduation rates of rural students (compared to urban students) to the rural students' choices of colleges, rather than to rural students' performances in their college level courses.

By comparing students who were enrolled in the same courses at the same times, this study was able to make more direct comparisons. Additionally, this study looked at more recent cohorts. The Byun et al. (2012) and Fan and Chen (1999) studies used data collected from students who graduated from high school in the late 1990's. Social and economic changes have occurred since that time that have the potential to change how locale could influence student performance.

However, this study indicates that the changes in rural areas that have occurred since the NELS of 1988 did not result in a performance difference by locale. Perhaps, technological changes play a role in providing rural schools with greater internet access to educational resources than they would have had even ten years ago.

Limitations and Future Research

Because of the way data were obtained, this study was limited to comparing students only within courses. Means grades for science courses overall science could not be calculated for other comparisons, e.g. with other universities. Within these limitations, there appears to be no achievement gap between rural students and those from other locales. The absence of significant differences in mean course grade by locale may be due in part to the population from which the data were taken. The institution under study is a Land Grant University with a heavy focus on agricultural, animal science, and agronomy research programs that have the potential to create an environment amenable to rural students. Many of the professors in these programs are of a similar background to rural students, allowing them to connect to, and educate them, easily. The institution also has the potential to be accommodating to urban students due to its geographic location. The town in which the university is located is a relatively short drive from the state's two major population centers, from which the majority of the university's urban students are drawn. For urban students, being close to their homes and support systems would reduce stress and ease transition into college. A final possible factor influencing performance of students by locale is the institution's locale designation. The NCES locale designation identifies the municipality in which the university is located as a Large Town. This places it roughly in the middle of the rural to urban scale, reducing potential stress for both urban and rural students by not forcing either to attend school at the opposite end of the spectrum. Similar future studies should compare comparable courses taught at universities in different locales in different states to mitigate the influence the university's locale may have.

The scale used by this study orders locales by size and proximity to urban centers. It serves ultimately as proxy for the economic and cultural aspects of rural life that were discussed at the beginning of the literature review. These economic and cultural aspects were: 1. They are centered around a small town or village community, as determined by census data; 2. The communities are located away from urban centers and; 3. The community has strong historical roots to a primary (mining, agriculture, lumber) or secondary (manufacturing) industry (Elder, 2014). This scale groups together communities that have different cultures, histories, and values. The small fishing villages on the coast of Maine have little in common with those in Southern New Mexico. This difference in culture and history also applies to urban areas as well. Moderately sized urban centers like Springfield, Missouri are placed within the same category as metropolises like New York and Chicago. The aforementioned limitations of placing different communities in the same category was further exacerbated by this study's merging of the NCES's scale's sub-categories that can help to differentiate among different rural communities, by adding a component of distance from urban areas, and different urban areas, by distinguishing between cities of different populations.

At the writing of this thesis, the 2020 COVID-19 pandemic has yet to come to an end. In this crisis many changes have been made to ensure the safety of students and staff. The most visible of these is the change to classes being conducted remotely via video conferencing or pre-recorded videos. This is an effective solution to maintain social distancing without reducing or canceling instructional time. Some of these changes in how students are taught may be kept by institutions even after the pandemic is resolved. For some, this will open access to new methods of education, but for rural areas, this switch to online video-based education may not be possible. Rural areas lag behind more urban area with access to broadband services compared to urban areas

(Cromartie, 2017). Future studies should investigate performance differences among and between locales in courses that have switched to online only, or online-intensive teaching.

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APPENDIX

Course Descriptions

BIOL 1114 – Introductory Biology. Introduction to the integration between structure and function among all levels of biological organization. Application of principles of evolution, genetics, physiology and ecology to understanding the integrated and interdependent nature of living systems through discussions emphasizing the process of science. Current issues and local research and observation and investigation in both lecture and lab. Recommended for non-science and science majors.

CHEM 1314 - Introductory Chemistry. The beginning chemistry course recommended for students in basic biological sciences (including pre-medical science and pre-veterinary sciences), physical sciences and engineering. This course covers chemical principles and their applications to the properties and transformations of matter, including periodic classification of the elements, laws of chemical combination, gas laws, atomic and molecular structure, and chemical bonding.

CHEM 3015 - Survey of Organic Chemistry. Terminal, one-semester organic chemistry lecture course covering the general principles of nomenclature, structure, bonding, methods of preparation, reactions and use of acyclic, cyclic, and aromatic compounds.

CHEM 3053 – Organic Chemistry I. This course is the first of the in-depth sequence of organic chemistry. Topics include nomenclature, structure, stereochemistry, reactivity, properties, and synthesis of organic molecules with an emphasis on reaction mechanisms. This course is required for many life and physical science majors and pre-health students.

MATH 2144 – Calculus I. An introduction to derivatives, integrals and their applications

IRB Approval: IRB-20-319, IRIM: Project 12917

Table 1:Coefficient Table for the Three Way ANOVA of the independent variables: race/ethnicity, CSES, and locale by the dependent variable: mean course grade for BIOL 1114 and CHEM 1314.

Light red shading indicates significant difference among mean course grades.

	BIOL 1114		
	F Coefficient	Significance	Effect Size (η2)
Race	20.272	0.000	0.002
Locale	0.336	0.800	-
CSES	12.671	0.000	0.000
Race X Locale	1.426	0.125	-
Race X CSES	1.088	0.367	-
CSES X Locale	0.724	0.630	-
Race X CSES X Locale	0.946	0.546	-
	CHEM 1314		
	F Coefficient	Significance	Effect Size (η2)
Race	10.525	0.000	0.001
Locale	0.101	0.959	-
CSES	3.582	0.028	0.000
Race X Locale	1.243	0.230	-
Race X CSES	1.128	0.336	-
CSES X Locale	1.478	0.181	-
Race X CSES X Locale	1.027	0.425	-

Table 2:Coefficient Table for the Three Way ANOVA of the independent variables: race/ethnicity, CSES, and locale by the dependent variable: mean course grade for CHEM 3015, CHEM 3053, and MATH 2144.

Light red shading indicates significant difference among mean course grades.

	CHEM 3015		
	F Coefficient	Significance	Effect Size (η2)
Race	4.994	0.000	0.002
Locale	2.040	0.106	-
CSES	0.666	0.514	-
Race X Locale	0.855	0.616	-
Race X CSES	1.165	0.309	-
CSES X Locale	0.697	0.652	-
Race X CSES X Locale	0.727	0.828	-
	CHEM 3053		
	F Coefficient	Significance	Effect Size (η2)
Race	3.010	0.010	0.001
Locale	3.568	0.014	0.001
CSES	3.547	0.029	0.000
Race X Locale	1.586	0.069	-
Race X CSES	0.633	0.787	-
CSES X Locale	0.259	0.956	-
Race X CSES X Locale	1.201	0.218	-
	MATH 2144		
	F Coefficient	Significance	Effect Size (η2)
Race	8.138	0.000	0.001
Locale	0.552	0.647	-
CSES	4.672	0.009	0.000
Race X Locale	0.906	0.557	-
Race X CSES	0.289	0.984	-
CSES X Locale	1.580	0.148	-
Race X CSES X Locale	1.057	0.385	-

Table 3: Duncan's Multiple Range Test for Race/Ethnicity by for BIOL 1114 and CHEM 1314. Race/Ethnicity categories are listed alphabetically.

Means with the same Duncan Group number are not significantly different from one another.

BIOL 1114			
Race/Ethnicity	N	Mean	Duncan Group
American Indian or Alaska Native	1128	1.74	2
Asian	231	2.01	3
Black or African American	934	1.27	1
Hispanic	1042	1.85	2
Multiracial	1683	2.01	3
White	12706	2.14	4
CHEM 1314			
Race/Ethnicity	N	Mean	Duncan Group
American Indian or Alaska Native	677	1.83	2
Asian	1123	2.02	3,4
Black or African American	486	1.43	1
Hispanic	694	1.91	2,3
Multiracial	8422	2.15	4
White	202	2.16	4

Table 4: Duncan's Multiple Range Test for Race/Ethnicity by for CHEM 3015, CHEM 3053, and MATH 2144. Race/Ethnicity categories are listed alphabetically.

Means with the same Duncan Group number are not significantly different from one another.

CHEM 3015			
Race/Ethnicity	N	Mean	Duncan Group
American Indian or Alaska Native	177	1.26	1,2,3
Asian	24	2.88	3,4
Black or African American	86	1.97	1
Hispanic	136	2.09	1,2
Multiracial	247	2.38	2,3
White	2090	2.59	3,4
CHEM 3053			
Race/Ethnicity	N	Mean	Duncan Group
American Indian or Alaska Native	304	1.9	2,3
Asian	146	1.75	2
Black or African American	215	1.35	1
Hispanic	312	1.67	2
Multiracial	482	1.89	2,3
White	3591	2.02	3
MATH 2144			
Race/Ethnicity	N	Mean	Duncan Group
American Indian or Alaska Native	568	1.67	2
Asian	306	1.92	3
Black or African American	474	1.36	1
Hispanic	773	1.74	2
Multiracial	1058	1.83	2,3
White	8517	1.98	3

Table 5: Duncan's Multiple Range Test for CSES by Course.

Means refers to mean course grade on a 0-4 point scale. Means with the same Duncan Group number are not significantly different from one another.

BIOL 1114			
Percent of Students on Free or Reduced Lunch	N	Mean	Duncan Group
Low (0-33%)	2360	2.24	3
Medium (34%-66%)	10064	2.01	2
High (67%-100%)	5300	1.70	1
CHEM 1314			
Percent of Students on Free or Reduced Lunch	N	Mean	Duncan Group
Low (0-33%)	1416	2.28	3
Medium (34%-66%)	6582	2.10	2
High (67%-100%)	3606	1.80	1
CHEM 3053			
Percent of Students on Free or Reduced Lunch	N	Mean	Duncan Group
Low (0-33%)	1577	1.78	3
Medium (34%-66%)	2882	1.90	2
High (67%-100%)	591	2.09	1
MATH 2144			
Percent of Students on Free or Reduced Lunch	N	Mean	Duncan Group
Low (0-33%)	3710	2.6	3
Medium (34%-66%)	6616	1.9	2
High (67%-100%)	1370	1.56	1

Table 6: Duncan's Multiple Range Test for Locale for CHEM 3053

Means refers to mean course grade on a 0-4 point scale. Means with the same Duncan Group number are not significantly different from one another.

CHEM 3053			
Locale	N	Mean	Duncan Group
City	946	1.84	1
Suburb	1711	2.00	2
Town	1281	1.94	1,2
Rural	1112	1.94	1,2

Table 7: Standardized Residuals resulting from crosstab comparisons of Race/Ethnicity and Percent of Students on Free or Reduced Lunch at HS of origin for BIOL 1114 and CHEM 1314.

Red shading indicates significance.

BIOL 1114			
	Percent of Students on Free or Reduced Lunch		
Race/Ethnicity	Low	Medium	High
American Indian or Alaska Native	-9	2.4	8.7
Asian	-1.6	-0.2	2.8
Black or African American	-6.4	-3.4	16.8
Hispanic	-0.6	-1.5	4.3
Multiracial	-5.8	2	4.7
White	7.1	0.2	-10.3
CHEM 1314			
	Percent of Students on Free or Reduced Lunch		
Race/Ethnicity	Low	Medium	High
American Indian or Alaska Native	-6.5	1.8	6.6
Asian	-1.7	0.2	2.5
Black or African American	-3.6	-1.8	9.7
Hispanic	-0.9	-0.9	3.6
Multiracial	-4.8	2	3.5
White	5.1	-0.4	-6.8

Table 8: Standardized Residuals resulting from crosstab comparisons of Race/Ethnicity and Percent of Students on Free or Reduced Lunch at HS of origin for CHEM 3015, CHEM 3053, and MATH 2144.

Red shading indicates significance.

CHEM 3015			
	Percent of Students on Free or Reduced Lunch		
Race/Ethnicity	Low	Medium	High
American Indian or Alaska Native	-3	1.2	1.9
Asian	-0.7	0.5	0
Black or African American	1.5	0.4	1.3
Hispanic	-1.5	0.2	2
Multiracial	-2.5	0.8	2.1
White	2.6	-7	-2
CHEM 3053			
	Percent of Students on Free or Reduced Lunch		
Race/Ethnicity	Low	Medium	High
American Indian or Alaska Native	-4.3	1.5	3.8
Asian	-1.7	0.9	1
Black or African American	-2.9	0.7	3.4
Hispanic	-1	-0.8	3.6
Multiracial	-4	1.4	3.7
White	4.2	-0.9	-4.4
MATH 2144			
	Percent of Students on Free or Reduced Lunch		
Race/Ethnicity	Low	Medium	High
American Indian or Alaska Native	-6	2.7	4.3
Asian	-3.9	1.9	2.6
Black or African American	-2.3	2.9	10.3
Hispanic	-1.9	-1.8	7.4
Multiracial	-4.4	2.9	1.3
White	5.2	-0.4	-6.5

Figure 1 Estimated Marginal Means (on 0-4 point scale) of Student's Final Grade in BIOL1114 for Race by Locale

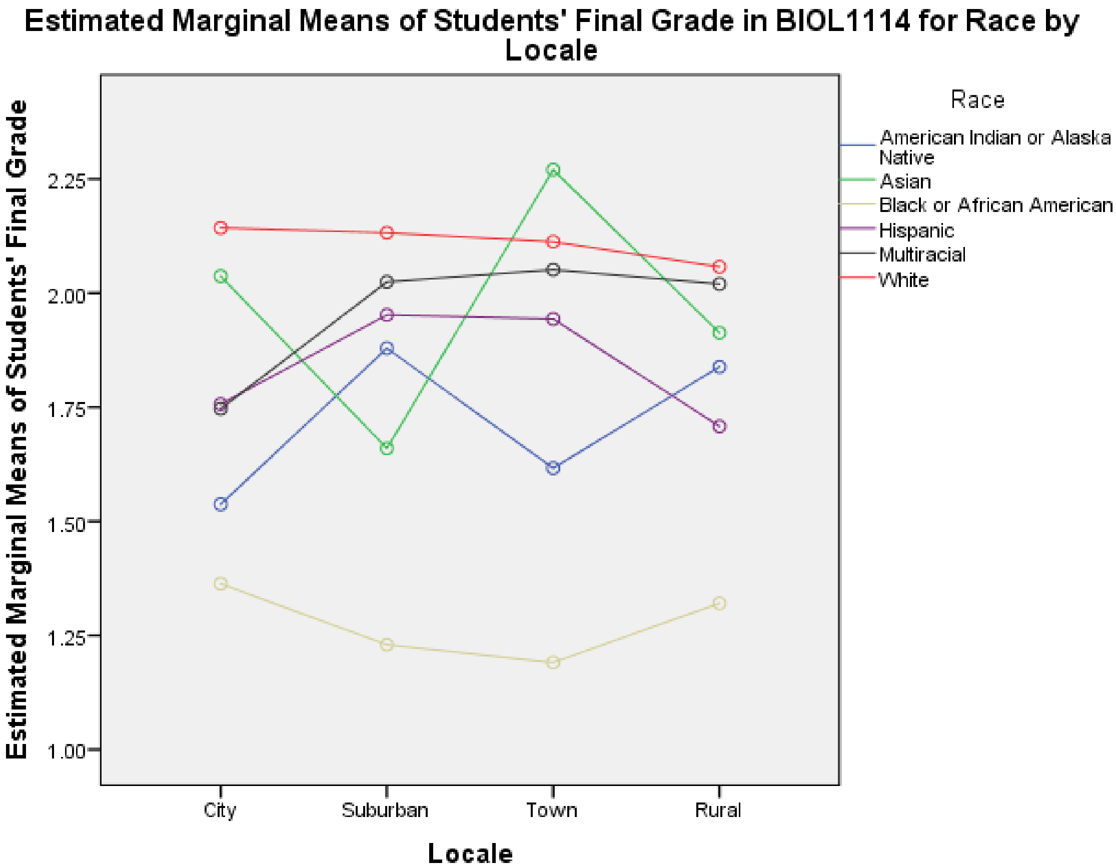
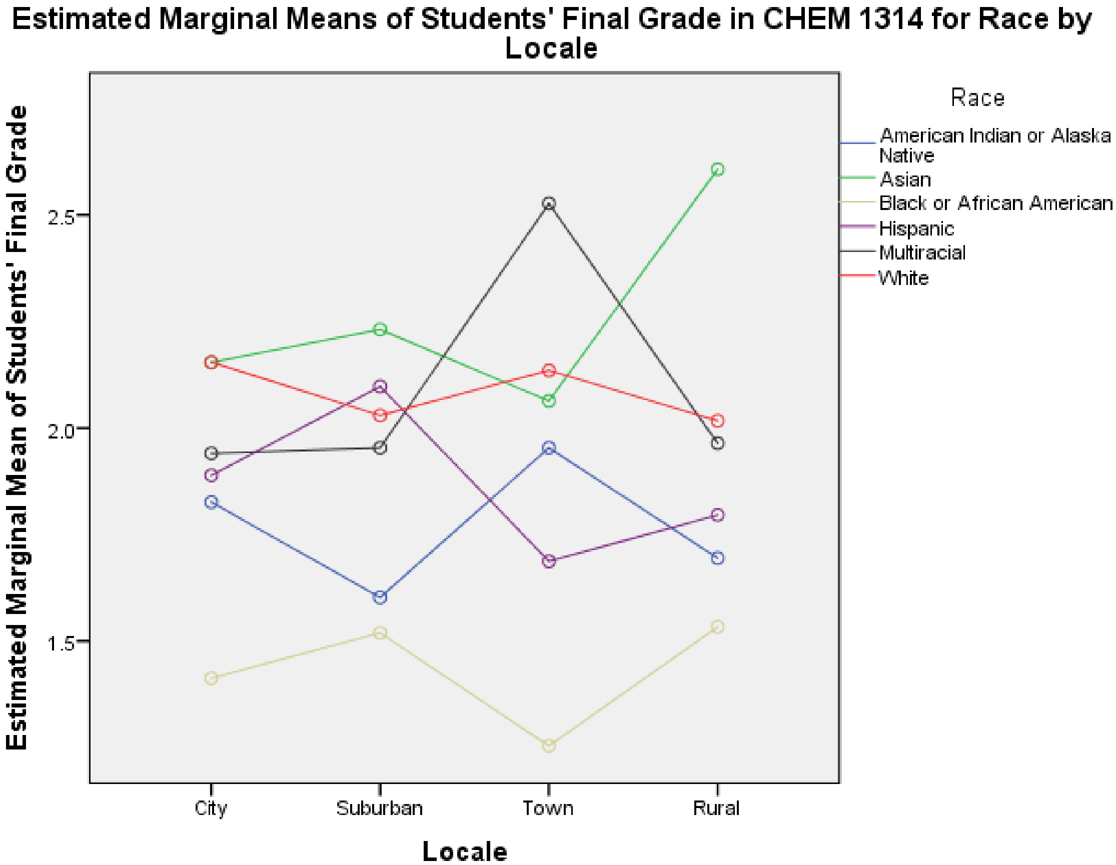


Figure 2 Estimated Marginal Means of Students' Final Grade in CHEM 1314 for Race by Locale



VITA

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