STUDY OF EDUCATIONAL EQUITY IN HAWAIʻI: EXAMINING THE DISTRIBUTION OF QUALIFIED TEACHERS AND STUDENT OUTCOMES

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DEDICATION PAGE

To my parents Jack V., and Cassandra Kaleilani Johnson, my husband Jonathan, and my children, Ethan, Alana, James, Jack, and John. Mahalo for your endless love and support.

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ABSTRACT

The Study of Educational Equity in Hawai‘i (SEE-HI) explores the relationships between quality and equity variables, focusing on access to licensed mathematics teaching, learning environment, school climate, socioeconomic status, ethnicity, geographic location, math proficiency, and college enrollment in Hawai‘i’s public schools. Research indicates two mounting problems with K-12 mathematics education in the United States: 1) a lack of qualified teachers and 2) inequities in access to those teachers by students of varying socioeconomic status and ethnicity. SEE-HI examines policy-controlled variables of quality, equity, and access impacting student outcomes in forty-one public high schools in Hawai‘i. Equity is the extent to which equal opportunities and access to qualified teaching and resources are achieved. This study uses the Hawai‘i Department of Education Databook, School Status and Improvement Reports, Strive HI School Performance Reports, and the Civil Rights Data Collection to analyze access to learning opportunities and the dispersion of educational resources. The study's value is to identify schools serving higher proportions of educationally at-risk students and provide data to inform policymakers, administrators, educators, and parents. In addition, this educational equity study seeks to inform future efforts to improve access to educational opportunities and quality teaching for underserved students, families, and communities in Hawai‘i. Regardless of socioeconomic status, ethnic background, or where they live, all children deserve access to quality teaching and equity in education in Hawai‘i’s public schools.

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CHAPTER 1. INTRODUCTION

Positionality in Hawai‘i’s Education System

My education journey began on the north shore of O‘ahu, where I was born into a family of educators, specifically mathematics teachers. I am a third-generation teacher; my grandmother taught at Saint Patrick Elementary School in Honolulu and then at the Palama Settlement. Both my father and mother taught mathematics at the university level in Hawai‘i for nearly 40 years. Three of my siblings and I have taught or are teaching math in elementary and secondary schools in Hawai‘i. Based on academic years of service, we could statistically infer that teaching and access to quality education were valued in my home. Public schooling was the only reasonable option because of where we lived. Motivated by the experiences of four generations of students, parents, and teachers in Hawai‘i’s education system, advocating support for the accessibility of quality education for all children in Hawai‘i is central to my research interests.

In one of my first years teaching at Ke Kula Kaiapuni ‘O Hau‘ula, a Hawaiian immersion school on the north shore, I assisted with an intervention program to support students struggling to meet grade-level standards in reading and mathematics. One of the language arts teachers assigned a Dr. Seuss project; students were asked to write their version of Dr. Seuss’s first book, “And to Think That I Saw It on Mulberry Street.” Children were to substitute their home street for Mulberry Street and write about what they saw as they walked home from school. One student wrote, “…on my way home…I saw…homeless, strangers, trash on the road, and sidewalk, and sand, cops…trash bags on the sidewalk, broken toys, broken glass, broken slippers, paper, broken pencils…rain…and rainbows…”. I realized how critical teachers and

their influence could be in changing a student's view. In addition, this experience helped me see better the challenges students face. During my tenure at Hauʻula and Sunset Beach Elementary, I have witnessed how growth and successful student outcomes can lift children's hopes and dreams. Civil rights novelist James Baldwin claimed, "The world changes according to the way people see it, and if you can alter, even by a millimeter, the way people look at reality, then you can change it." (Baldwin, 1979).

This dissertation study of educational equity aims to engage government and education policymakers, administrators, teachers, and parents in a changed view of quality and equity in Hawaiʻi's education system that focuses on the needs of all students, teachers, schools, and communities in Hawaiʻi. My study uses multiple regression analysis, complemented by documentary photography, to examine the distribution of qualified teachers and resources in Hawaiʻi's public schools. It will explore the relationships between school quality and equity variables, focusing on access to licensed math teachers and safe and supportive learning environments, students' socioeconomic status and ethnic background, school location, math proficiency or numeracy, and college enrollment. Previously, research has identified two mounting problems with mathematics education in the United States, a lack of qualified teachers and inequitable access to those teachers by students of varying socioeconomic status and ethnicity (Akiba et al., 2007; Darling-Hammond, 2000, 2004, 2007, 2015; Dolton & Marcenaro-Gutierrez, 2011; Flores, 2007; Ingersoll et al., 2007; Ingvarson & Rowley, 2017; Kang & Hong, 2008; McKenzie et al., 2005; NCES, 2015) My study examines the extent of these problems of school quality, teacher shortages, and inequitable access to qualified teachers in secondary math education in Hawaiʻi.

Education Problems: Quality and Equity

The large body of literature on teaching quality supports McKinsey's landmark claim that "the quality of an education system cannot exceed the quality of its teachers" (Dolton & Marcenaro-Gutierrez, 2011, p. 7). McKinsey's seminal report also suggests that the only way to improve student achievement is to improve the quality of instruction (Dolton & Marcenaro-Gutierrez, 2011). In this study of quality and equity in math education, school quality refers to students' accessibility to math teachers that are licensed and state-certified in secondary math education. Teachers must have earned both professional and educational qualifications in math. In Hawai‘i, the minimum requirement to be a "fully licensed" teacher, determined by the Hawai‘i Teachers Standards Board (HTSB), is to have earned a bachelor's degree and completed a teacher education program. However, this requirement does not ensure that math teachers have an educational background in math or math education. Teachers assigned to math may have a "license" to teach by earning a college degree and completing an education program, but their degree could be in a field outside of mathematics. Out-of-field teaching in mathematics is most severe in the U.S. (Ingersoll et al., 2007). Because of persistent understaffing in Hawai‘i public schools, principals assign teachers to multiple subjects, even subjects they are unqualified to teach. This study will measure teaching quality as the percentage of licensed and state-certified math teachers who teach mathematics, identifying schools with a higher proportion of inequitable access to qualified teachers. The relationship between access to qualified math teachers and student outcomes while controlling for high school socioeconomic status, ethnicity, geographic location, student perception, and learning environment will also be evaluated.

Given Hawai‘i’s diversity in public education and the challenges of helping students from many linguistic and cultural backgrounds, this study refers to Will Jordan’s definition of equity in education. According to Jordan, equity in education is not about equal outcomes of high achievement; it is about the “fair and just distribution of learning opportunities” and resources (2010, p. 152). Jordan claims, “defining equity within the context of a diverse, multiracial, multiethnic, multilingual, and multicultural society, and one where social class strongly influences one’s life chances, is problematic” (2010, p. 142). Jordan continues, “Equity in education can be framed in terms of either equality of opportunity or equal outcomes, including the contexts in which students participate in educational experiences and the extent to which those experiences enable their academic growth” (2010, p. 171). The United States has struggled to create a system of educational equity where all children have “fair and just” opportunities to access qualified teaching and learn to their fullest potential (Jordan, 2010). Consequently, several scholars have documented the continued segregation in American schools and argued that integration was never achieved. Instead, new forms of segregation have emerged (Jordan, 2010).

After two centuries of slavery, “a century of court-sanctioned discrimination based on race, and a half century of differential access to education by race, class, language background, and geographical location, we have become accustomed in the United States to educational inequality” (Darling-Hammond, 2007, p. 318). Although initiatives have been launched with the promise of improved equity, “most states have not equalized funding and access to the key educational resources needed for learning” (Darling-Hammond, 2007, p. 318). Darling-Hammond’s research concludes that access to school resources matters, and if outcomes for low-income and minority children are going to improve, the quality of their learning opportunities must improve (2007). She argues that equalizing resources requires attention to the inequalities

at all levels among states, districts, and schools (2007). For example, instead of providing alternative routes to teacher licensing, which reduces teaching quality, investments focused on a district's capacity to hire well-qualified teachers have eliminated teacher shortages and raised student achievement (2007). When Connecticut raised teacher salaries under its Education Enhancement Act, teacher shortages evaporated within three years; most teaching fields showed surpluses, even in urban areas, and Connecticut became one of the top-performing states in 8th-grade math, science, reading, and writing, and surpassed all other states in fourth-grade reading and math performance (Darling-Hammond, 2007).

Echoing the challenges of low-income and ethnic minority students in the United States, Native Hawaiians have also experienced two hundred years of educational inequality. The socio-economic problems faced by Native Hawaiians today include education disparities, high cost of living, long-term health and well-being, underrepresentation in political and economic leadership, and over-representation in the judicial system (Roberts et al., 2018). Following the arrival of James Cook in 1778, there was a dramatic decline in the Native Hawaiian population; new diseases were brought to the islands leaving only 10%, or 53,000 Native Hawaiians (Roberts, et al., 2018). In 1893, the Hawaiian monarchy was overthrown by a group of American businessmen, supported by the U.S. government; the Queen was imprisoned in her palace, and despite considerable non-violent resistance by the Hawaiian people, Hawai‘i became a territory of the United States in 1898 (Cintina & Kana‘iaupuni, 2019). The fallout from these events was a massive displacement of Native Hawaiians from their lands and "suppression of the Native language, culture, and practices replaced by Western language, culture, and practices in all formal schooling and governance" (Cintina & Kana‘iaupuni, 2019, p. 1465).

With the colonization of Native Hawaiians and the new government's political and economic agendas impacting the quality of formal schooling and outcomes, Native Hawaiian students have struggled with longstanding achievement gaps and lower graduation and college enrollment rates than their peers (Roberts et al., 2018). According to Ka Native Hawaiian educational assessment report, "Native Hawaiians are dramatically underrepresented in postsecondary educational programs and institutions" (Roberts et al., 2018, p. 200). This underrepresentation of Native Hawaiians in university enrollment is affected by underachievement in elementary and secondary education (Roberts et al., 2018). In 2009, Hawai'i was 47th in average achievement scores in math, reading, and science, with nearly equivalent scores of the other underperforming states: New Mexico, Nevada, and Alabama (Roberts et al., 2018). Only 22% of Hawai'i's 8th-grade students were at or above the national average proficiency, with only 1% scoring at the advanced level. Hawai'i also fell below the national average in math, with 32% at or above proficiency, with 6% scoring at the advanced level (Roberts et al., 2018). In Science, 15% of Hawai'i students achieved proficiency, with 1% at the advanced level, the second-lowest performance in the country (Roberts et al., 2018).

Previous educational researchers "offer a number of explanations for race/ethnic achievement disparities, including institutional factors, like campus climate and the quality of pre-college experience" (Cintina & Kana'iaupuni, 2019, p. 1464). Cintina & Kana'iaupuni found that the quality of high school experiences differentiates student outcomes, particularly college readiness and college performance (2019). They claim that students who graduated from Hawai'i private schools performed higher on college readiness indicators than public school students indicating that the quality of the high school attended matters (2019). In his study of teaching quality and student outcomes, Heck concluded that access to qualified teachers and resources is

unequally distributed across districts and public schools in Hawai‘i (2007). Heck's findings suggest that "compared with higher socioeconomic status (SES) or White students, poor students and students of color are almost twice as likely to have teachers with less than 3 years of teaching experience…uncertified teachers or to have teachers teaching out of their preparation fields" (Heck, 2007, p. 404). The systemic inequities are higher in districts that serve low SES students and students of color where access to qualified teaching is most needed, altogether compromising the quality of the student's educational experience and learning outcomes (Heck, 2007). Heck's results showed that increasing teaching quality reduced achievement gaps significantly in math for underrepresented students or students of Hawaiian, Filipino, or Samoan ethnic/racial backgrounds and low SES (2007).

The Cost of Underfunding Education

In this knowledge-based economy, as most "industrialized countries are making massive investments in education…the United States ranks poorly on many leading indicators" (Darling-Hammond, 2007, p. 318). As a nation, we behave as if we are "unaware of" or insensitive to the substantial inequalities in educational opportunities that begin in preschool and continue through elementary and secondary education, impacting college and beyond (Darling-Hammond, 2007). Many young people, especially low-income, minority students in the U.S., "do not receive even the minimum education needed to become literate and join the labor market" (Darling-Hammond, 2007, p. 318). Today, 70% of U.S. jobs require specialized skills and training beyond high school (Darling-Hammond, 2007). As demands for an educated workforce increase, educational attainment in the U.S. is decreasing. Of the 60% of high school graduates that go to college, only 30% complete a degree; this is 17% for African American students and 11% for

Hispanic students (Darling-Hammond, 2007). In Hawai‘i, the state average for college completion is 26%, and 12.6% for Native Hawaiian students (Roberts et al., 2018). In addition, Native Hawaiian students were found to be the least likely of ethnic groups to graduate within six years from the University of Hawai‘i at Manoa and the most likely to work full-time while attending school (Roberts et al., 2018). Native Hawaiian graduates of UH-Manoa are "underrepresented in high-paying fields with high job security (e.g., architecture, engineering, and business administration)" (Roberts et al., 2018, p. 200).

The value of a college degree has increased with the growing demands of 21st-century skills. Studies show that adults with higher educational attainment have lower unemployment rates and higher median incomes than their less educated peers (Cintina & Kana‘iaupuni, 2019). For example, in 2009, young adults with a bachelor's degree earned 50% more than those with a high school diploma, 25% more than those with an associate degree, and twice as much as those without a high school diploma (Cintina & Kana‘iaupuni, 2019). Likewise, the unemployment rates for young adults with a high school diploma are twice as high as the unemployment rates for those with a college degree (Cintina & Kana‘iaupuni, 2019). In sum, "an individual holding a bachelor's degree earns about 80% more than a high school graduate, totaling more than $500,000 over a lifetime (Cintina & Kana‘iaupuni, 2019, p. 1460). Other studies have estimated the cost of educational inequalities nationwide. One study reported, "international education gaps between the U.S. and other countries cost $1.3 to $2.3 trillion in lost GDP in 2008, representing a higher recurring annual cost on the U.S. economy than the recession in that same year" (Cintina & Kana‘iaupuni, 2019, p. 1461).

Linda Darling-Hammond argues, "more than ever before in our nation's history, education is the ticket not only to economic success but to basic survival…lack of education is increasingly linked to crime and welfare dependency" (2004, p. 616). She claims that between "1890 and 2000, three times as many African American men were added to the nation's prison systems as were added to our colleges. In 2000, there were an estimated 791,600 African American men in prison or jail, and 603,000 in higher education (2007, p. 318). Most inmates were high school dropouts with literacy skills below labor market requirements (Darling-Hammond, 2007). According to the American Academy of Pediatrics, the "United States has the highest youth homicide and suicide rates of the twenty-six wealthiest nations in the world" (Williams, 2010, p. 115). In addition, Williams reports, "7.3 million people are incarcerated, on probation, or on parole…our nation has the highest percentage of citizens in jail compared to any other nation in the world" (2010, p. 115). State and national welfare problems are associated with underfunded policies relevant to recruiting and retaining high-quality teachers. The United States wastes over $2 billion yearly because of teacher turnover (Darling-Hammond, 2007). Another $50 billion is spent on the costs of grade retention, summer school, and prison sentences for dropouts (Darling-Hammond, 2007). Due to government negligence and underfunding public education, there are high costs for school quality failures.

Framing Structural Inequalities

For two hundred years, structural inequalities have prevented quality education opportunities in Hawai‘i's public schools for all students. Deering identifies three policy controllable inequities impacting socio-political, economic, and educational outcomes; he writes:

> Hawai‘i schools face many challenges. We have one of the nation’s highest rates of private school attendance, at about 33%, while schools in the single, statewide public school district, the Hawai‘i Department of Education (HIDOE), are seriously underfunded. Hawai‘i annually ranks in the bottom quarter of all U.S. states on cost-adjusted teacher pay and per student funding. Hawai‘i’s schools are challenged to help children from many linguistic backgrounds master Standard English while maintaining their native languages…given these social and economic challenges, it is not surprising that Hawai‘i’s public school students generally perform below their mainland U.S. counterparts in many measures of academic achievement. (2005, p. 15)

The first inequality refers to the opportunity gap in public and private education, excluding high-poverty students from well-funded private schools and compounding the challenges facing Hawai‘i’s public schools. Hawai‘i’s dual education system continues the segregation of children along the lines of race and class, positioning them down unequal paths to social and economic influence. The constant exodus of the highest-income families to private schooling leaves the “seriously underfunded” public schools with the task of educating a higher proportion or, possibly, the entire proportion of students with the highest needs. High-needs students require more academic, emotional, and behavioral support services, an impossible expense with insufficient public school resources. The second system-controlled inequality is Hawai‘i’s lowest ranking on cost-adjusted teacher pay, and the third is Hawai‘i’s lowest ranking on per-student funding and financial support of public education. All three policy-controlled disparities result from the government’s underfunding and disinterest in the quality of public schools.

David Stinson and Anita Wager explain how critical theory applies in educational research (2012). The authors claim, “In the most general sense, critical theory maintains sociopolitical critiques on social structures, practices, and ideology that systemically mask one-sided accounts of reality which aim to conceal and legitimate unequal power relations” (Stinson & Wager, 2012, p. 6-7). They found that critical theory in education, has been used “to examine schools and their functions and to explore the persistent inequities and injustices too often found in schools” (Stinson & Wager, 2012, p. 7). Samuel Bowles, suggests that “schools evolved not in pursuit of equality but in response to the developing needs of capitalism…as the importance of a skilled and educated workforce grew, so did the importance of maintaining educational inequality in order to reproduce the required class structure of capitalism from one generation to the next” (Stinson & Wager, 2012, p. 7). Another study found that “different schooling experiences not only support class division,…but also produce and reproduce these unjust divisions through the differing curricular (and pedagogical and evaluation practices) that are made available” (Stinson & Wager, 2012, p. 7). Based on these claims, the different schooling experiences in Hawai‘i by students in well-funded private schools and underfunded public schools help maintain class divisions necessary to meet the demands of Hawai‘i capitalism. Hawai‘i’s economy thrives on tourism and, previously, the sugar and pineapple industries. The variegated quality of education perpetuates class division, ensuring a steady workforce to serve Hawai‘i tourism.

Institutionalizing Segregation: Select Schools

The dissection of public and private education in Hawai‘i began with establishing “select schools” and public or “common schools.” The first of these elite schools was Punahou,

envisioned about ten years after the Protestant American missionaries arrived in 1820 (Wist, 1940). The idea behind Punahou originated from missionary parents' desire to access higher learning in Hawai‘i rather than sending their children back to New England (Wist, 1940). On July 11, 1842, Punahou, the maiden voyage of private education, began with thirty-four students, a class consisting only of children of American Protestant missionaries (Wist, 1940). Ironically, one of the original staff members was Daniel Dole, the father of Sanford Dole. Sanford became the only president of the Republic of Hawai‘i, the interim government that was organized after the overthrow of the monarchy, and the first governor of the Hawaiian Islands as an American territory (Wist. 1940). He was a crucial player in transferring political power from the Hawaiian monarchy to the U.S. during the overthrow and annexation.

Many of Hawai‘i’s government leaders and successful business owners, past and present, were educated in Punahou. Along with Dole, some recognizable names are Alexander, Castle, and Armstrong (Wist, 1940). Punahou “furnished the kind of preparation required for admission to the colleges of the United States, at a time when no such institution existed in Hawaii” (Wist, 1940, p. 105). Access to higher learning from such a prestigious institution was reserved for the children of missionary families. In his article, “The Connection of Samuel Chapman Armstrong as Both Borrower and Architect of Education in Hawai‘i”, Kalani Beyer accuses the Punahou graduate of directing Hawai‘i’s education systems down divergent paths. Beyer shares the concerns of missionary parents that led to segregated schooling; he stated: “because of their parents’ fear of contamination from Hawaiian contact during the early years, they were raised separately from Hawaiians, children and adults alike” (2007, p. 26). Armstrong believed that “higher education was not suitable for Hawaiians…and that it was the duty of the superior race to rule over the weaker dark-skinned races until they were appropriately ‘civilized’” (Beyer,

2007, p. 42). The Protestant missionary's "fear of contamination from Hawaiian contact" led to Punahou and other private schools, launching an epoch of segregated schooling in Hawai‘i along race and class that still exist today.

Public school, or "common school" curriculum, remained primarily elementary, emphasizing religion, manual training, and English language acquisition. On the other hand, Punahou provided professional business, law, and political training to prepare missionary children to become future advisors to the Hawaiian Kings and Queens. Beyer explains, "Hawaiians were no longer provided with the requisite education to produce either wealth or power to compete with haole." (2007, p. 48). The education acquired at Punahou enabled many second-generation missionary sons to become successful plantation owners, wealthy businessmen, and political activists in the Hawaiian Kingdom, which led to their involvement in overthrowing the Hawaiian monarchy (Wist, 1940). At the same time, although Hawaiians had previously been prepared to run the political economy of the kingdom, "by the early years of the twentieth century, they were almost entirely replaced by the haole sons of missionaries and planters due to lacking the required training" (Beyer, 2007, p. 46). The success of large-scale sugar production led by missionary sons Henry P. Baldwin and Samuel T. Alexander introduced another aim of the public school curriculum (Wist, 1940). Vocational training in agriculture was added to the public schools' manual training program to ensure a labor supply for the island's new economic enterprise in sugar. The wealth produced by Hawaiian sugar, grown on Hawaiian lands, has generously benefitted American Protestant missionaries' descendants.

Although interest in higher learning for missionary children began in 1830, the same concern for Hawaiian children did not surface for at least sixty years. According to Wist, "before

1890, secondary education was left entirely to the independent or private schools, which were subsidized from public funds for the purpose" (1940, p. 131). In 1850, a taxation act was passed that required a two-dollar school tax mandatory for all males to support public schools (Wist, 1940). Simultaneously, a three-dollar tax was implemented to provide for private schools (Wist, 1940). Missionaries and parents of private school children were exempt from paying the public school tax (Wist, 1940). Wist claims that "the exemption of missionaries and their servants bears witness to the continuing influence of religious leaders over governmental policy" (1940, p. 60). In addition, Wist continues, "considerable acreage was sold to procure money for educational purposes" and tax "appropriations included monies derived from sale or lease of school lands" (1940, p. 61). In other words, for over fifty years, American Protestant missionaries used Hawai‘i's public revenue and income from Hawaiian land sales and leases to subsidize secondary education provided exclusively in private schools for missionary children. The constitution of 1894 included a provision making distributing money from the public treasury to private schools illegal (Wist, 1940).

While Native Hawaiians were limited to an elementary religious education focused on agricultural training in public schools, public funds from Hawaiian lands and taxes subsidized an elite private education in business, law, and politics exclusively for children of American Protestant missionaries. Punahou, established on public lands which they claim were given to them by Hawaiian chiefs, benefitted from Native Hawaiian tax subsidies for 53 years while being exempt from paying taxes, has now become the largest private school on a single campus in the United States. Hawai‘i's "huge private school structure of the present bears witness to a concept of education for the perpetuation of leadership of certain classes" (Wist, 1940, p. 10). The 1920 federal survey explained, "Hawai‘i's public school students, for the most part,

Hawaii's nonwhite students, were often seen as nothing more than future plantation laborers" (Young, 2002, p. 407). In addition, "the basic trouble was that leading haoles did not care about the public schools. All but a handful of haole children attended private schools, a situation that seemed un-American to the mainland visitors." (Fuchs, 1961, p. 272). The shift in government interest from public to private education that began with Punahou explains the centuries of government disinterest and underfunding of Hawai'i's public schools, an un-American situation that continues today.

Institutionalizing Segregation: English Standard Schools

The challenges of educational quality and equity for Hawaiians that resulted from segregated schooling by race and class were magnified with the development of English Standard Schools, a form of segregation based on language. Eileen Tamura explains the context of another policy in Hawai'i's education history that still impacts public school students today. She writes:

> During the first half of the twentieth century, Standard English speakers in Hawai'i constituted a minority of European Americans (7.7 percent in 1920). Included among them was an oligarchy who controlled much of the territory's political and economic life. These influential Caucasians, many of whom descended from the island's American missionaries, had directed the overthrow of the Hawaiian monarchy in 1893 and then lobbied for annexation to the United States…Not only did they operate the dominant sugar cane industry through five major corporations known as the Big Five, but they also sat on board of island banks, utilities, transportation companies, and other large businesses. Below this oligarchy was an undersized middle class, also primarily

> Standard-English speaking. At the bottom was the mass of unskilled and semiskilled immigrant laborers, recruited primarily from Asia, to work in the territory's dominant sugarcane industry. (1996, p. 433)

As a result of these circumstances, most of the children entering Hawai‘i's public schools came from non-English-speaking homes (Tamura, 1996). In 1920, these students' dominant language was "pidgin English" a language that had developed on the plantation and was used as communication between native Hawaiians and Asian immigrants. Educational leaders grew concerned over the prevalence of the use of pidgin English in public schools, and the 1920 federal survey called for the elimination of what it referred to as the "jargon of the plantations and the pidgin English of the streets" (Tamura, 1996, p. 435).

In 1924, the Department of Public Instruction used the 1920 federal study to justify Central Grammar School, an experimental school in Honolulu reserved for Standard English-speaking students (Tamura, 1996). This development led to a set of English Standard Schools, operating within the framework of Hawai‘i's public education system and open only to students that could converse fluently in Standard English. From 1924-1960, English Standard Schools served primarily the middle-class white students of Honolulu, where they were strategically located. Tamura suggests that the "establishment of Standard schools was a way to separate children of different cultural and economic groups…de facto segregation by race and class", an effect still impacting today's public schools (Tamura, 1996, p. 436). During a Hawai‘i statehood hearing in 1936, the superintendent, Oren E. Long, was asked if he thought the English Standard system conformed to the ideal of American public schooling (Young, 2002). Long admitted that "the standard schools created feelings of snobbishness among their students and that, in

principle, they were un-American" (Young, 2002, p. 411). Standard schools were an elite set of schools that accepted a small portion (2% - 9%) of public school students; "attendance at these schools had become a mark of social status for people of all ethnic groups,…students attending the schools tended to feel superior to those in other public schools" (Tamura, 1996, p. 437). English Standard Schools' existence provides another example of structural inequality in Hawai‘i's education history, a form of segregation within the public school system.

Teacher Pay: Lowest in the Nation

Student performance in Hawai‘i's public education system suffers from three structural inequalities. The first is the educational segregation, by race and class, of well-funded private and underfunded public schools. Private schooling continues the stratification of children based on unequal access to quality learning opportunities and resources. The second is cost-adjusted teacher pay; "Hawai‘i has the lowest-paid teachers in the nation" (Lincoln, 2016). Once teacher salaries are adjusted for the cost of living, average teacher pay in Hawai‘i ranks at the bottom. Starting salary for a teacher with a Bachelor's degree who has not completed a state-approved education program is $35,962. Most emergency hires are in this compensation bracket. If a teacher holds a Master's degree, but has not completed an education program, starting salary is $38,838 (HIDOE, 2018d). Corey Rosenlee, the president of the Hawai‘i State Teachers Association, comments, "this problem has been going on for too long, Hawai‘i has the highest teacher turnover rate…every year nearly half of all of our new teachers are emergency hires" (Lincoln, 2016). Rosenlee continues, "In New York, with a similar cost of living, a beginning teacher can make close to $60,000…they pay their teachers well, in Hawaii, we haven't been

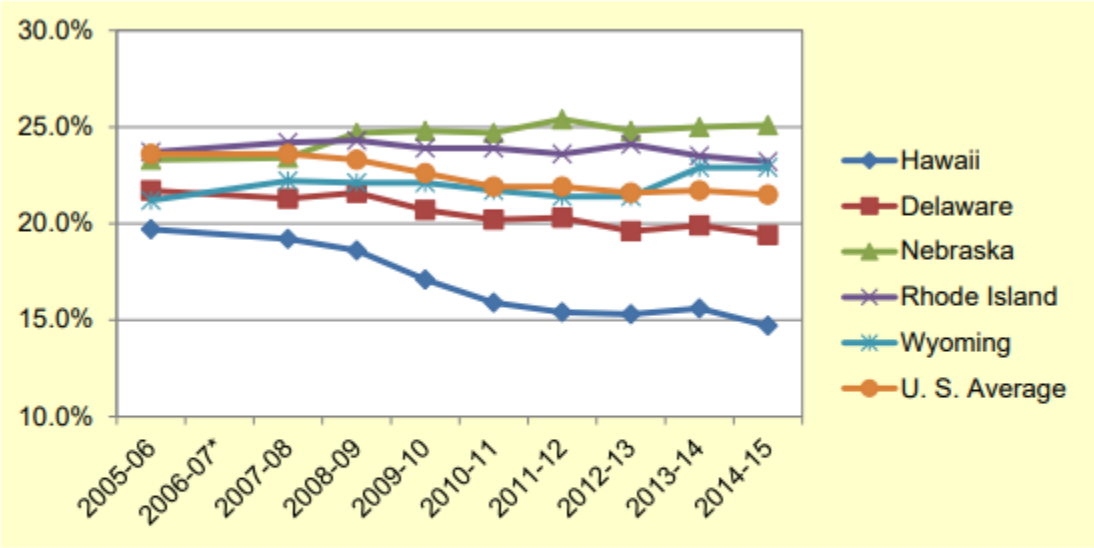
doing that, and that's why we have this high teacher turnover. That is why we can't find enough teachers for our classrooms" (Lincoln, 2016).

Department of Education Director Stephen Schatz explains that the DOE has to recruit teachers from the mainland every year because of the ongoing challenge of teacher turnovers and shortages. Many teachers come to Hawai‘i without realizing how high the cost of living is related to their salary, and they can't afford to stay. According to a teacher's union survey, 40% of Hawai‘i's public school teachers take on a second job to cover their living expenses. Union officials admit it is the "students that suffer the most from a revolving door of educators" (Lincoln, 2016). With the lowest teacher pay in the country, once adjusted for the cost of living, it is no wonder the Hawai‘i State Department of Education had 1,600 teacher openings last year. The most recent negotiations survey completed by more than 2,100 Hawai‘i state teachers reported that educators care more about higher pay than any other variable in the survey (HSTA, 2022). Teachers chose across-the-board pay increases as the most crucial option for increasing compensation in the next contract (Inefuku, 2022). Hawai‘i's trend of lowest teacher salaries and highest teacher turnover rate suggests that increasing wages will lower teacher attrition.

Public School Expenditures: Lowest in the Nation

The third structural inequality impacting student achievement in Hawai‘i is the government's lowest ranking nationally in financially supporting public education. The most recent *Digest of Education Statistics* published by the National Center for Education Statistics (NCES, 2016) reported that Hawai‘i has the lowest percentage of all states of expenditures supporting public education (K-12). The ratio is calculated by dividing the states' "Total, all general expenditures per capita by the states' elementary and secondary expenditures per capita."

Simply put, Hawai‘i ranks last in the nation for the percentage of tax dollars supporting public schools, indicating the government’s continued disregard for the success of public education (see Figure 1).



Note: *Comparisons are made with states most similar to Hawaii on measures directly related to school finance. Measures include K-12 enrollment, population, per capita income, per capita state and local revenue, and Per capita state and local expenditures. Data for SY2014-15 were the most current available at the time of publication.*

**No data available.*

Source: Digest of Education Statistics, National Center for Education Statistics, USDOE

Figure 1. Percentage of State and Local Expenditures per Capita Supporting Public Schools.

The graph shows the bottom six states for public school investment. The blue line is Hawai‘i, and the forty-four other states would have lines above Nebraska, the green line. In addition, the percentage of state expenditures supporting public schools in Hawai‘i has decreased since 2005, from 20% to 14.7%. Compared with other states, Hawai‘i is the only state that has appropriated less than 15% of total state expenditures on public schools, allocating only 14.7% of general revenue for public education (see Table 1). The state with the highest percentage is New Jersey, with 30.8%, more than double the investment of Hawai‘i (HIDOE, 2015). The key finance indicators show Hawai‘i’s investment in public school students’ success ranks 50th in the

country. Hawai‘i also ranks 50th for educational capital improvement funding. The state’s last ranking in public education investment is another example of how structural inequalities in Hawai‘i impact student access to high-quality learning opportunities and academic achievement.

Table 1. Key Finance Indicators.

	2012-13	2013-14	2014-15
Key Finance Indicators			
Per pupil expenditure*	$11,790	$12,400	$12,855
Percent state & local expenditures for public education (per capita)	15.3%	15.6%	14.7%
Rank**	50th	50th	50th

**Figures are as reported in the 2017 Digest of Education Statistics and may have been updated from previous reports. Data for SY2014-15 were the most current available at the time of publication.*

***Rank is determined by comparing the "Percent state and local expenditures for public education (per capita)" of Hawaii to that of the other 49 states.*

Sources: U.S. Census Bureau; National Center for Education Statistics.

The National Center for Education Statistics also compares per-pupil expenditure in Hawai‘i with the other forty-nine states. Based on the comparable data, Hawai‘i spent about $12,000 per pupil in public schools (HIDOE, 2016). The highest per pupil expenditure was $21,000 in the District of Columbia, and the second highest was in New York at about $19,000 (HIDOE, 2016). The cost of living in both locations is similar to the high cost of living in Hawai‘i, yet the students in Hawai‘i receive far fewer tax dollars for their education than the students in New York and D.C., almost half as much. Equity in education is not about equal outcomes of high achievement; it is about the “fair and just distribution of learning opportunities” and resources (Jordan, 2010, p. 152). Inequalities in education are sometimes difficult to measure. Still, the distribution of resources regarding per-pupil spending and government investment in public education in the United States is unequal.

Another key finance indicator is the percentage of full-time positions for teachers and administrators. As funding for public education has decreased significantly since 2005, from about 20% of tax dollars to 14.7 %, the number of State and Complex Administrator full-time positions has increased by 18% in the last three years, while the number of full-time Teacher positions only increased by 2% (see Table 2). State and Complex Area Administrators are not School Administrators or Principals. With the number of full-time positions for State and Complex Area Administrators increasing by 18%, Teacher positions increasing by only 2%, and an underfunded budget, the equitable distribution of education resources is far from being achieved.

Table 2. Staff, Full-Time Equivalent Positions.

Positions	2015-16	2016-17	2017-18
Teachers			
Classroom Teachers	11,476.9	11,499.6	11,732.4
Librarians	160.0	148.5	142.5
Counselors	634.2	634.2	652.6
Administrators			
School	667.6	693.8	711.5
State & Complex Area	275.0	301.0	324.0
Other Support Staff	9,112.6	9,039.2	9,276.5
Total	**22,326.3**	**22,316.3**	**22,839.5**

Source: Hawaii State Department of Education: Office of Strategy, Innovation and Performance; Assessment and Accountability Branch.

Unequal Educational Opportunities

Interest in equitable access to educational resources for public school students in Hawai‘i motivated an earlier study of the relationships between access to qualified teachers, socioeconomic status, and student achievement (Miller, 2016). Based on the O‘ahu Mathematics Education Study, the variable that had the strongest relationship with student achievement was the percentage of fully licensed teachers at the high school. There was a statistically significant

correlation between teaching quality and mathematics achievement in Oʻahu's public high schools (Miller, 2016). As the proportion of fully licensed teachers increased, the proportion of students below math proficiency decreased at the school level (Miller, 2016). Results from the Oʻahu equity study also indicated that schools and districts serving higher proportions of economically disadvantaged students had the least qualified teachers (Miller, 2016).

After completing the Oʻahu equity study, I began to see inequities across the state. In addition to varying access to qualified teachers by students' SES, there are observable differences in teaching and learning environments between schools and districts. Disparities in educational opportunities depending on where you live in Hawaiʻi, became more evident. Although public education is under-resourced by the state, dispersion and access to limited resources are unequal. The following figures illustrate the differences in athletic facilities between two public high schools on Oʻahu (see Figures 2 and 3).

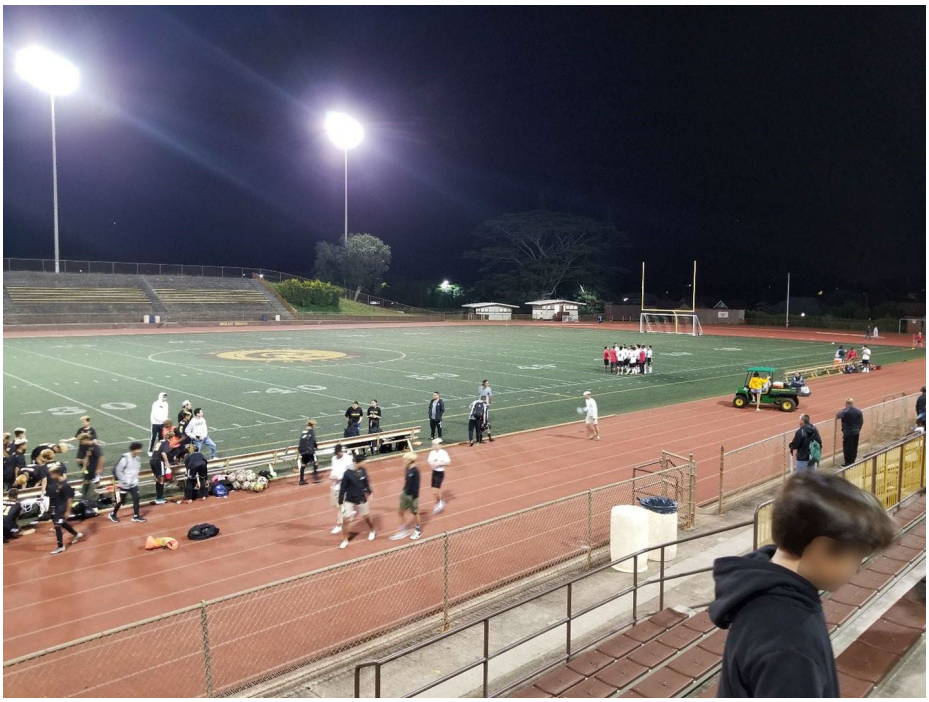


Figure 2. Castle High School Track and Field.

Figure 3. Kahuku High School Track and Field.

Equity in education is the fair and just distribution of learning opportunities and resources. Using an educational equity lens, I began seeing inequities in students' experiences during track meets, soccer games, Science Fairs, Speech, Debate, and History Day competitions. For example, the following figures show my son standing on the track following a soccer game on his home field and another game he attended at a Honolulu District school's soccer field (see Figures 4 and 5).

Figure 4. Kahuku High School Soccer Game.

Figure 5. Roosevelt High School Soccer Game.

As I began to see the differences in student opportunities, I also noticed differences in student performance. Table 3 shows English Language Arts and Mathematics proficiency scores from 2015-2019. It's difficult to see the trends by looking at the raw numbers in the table, but the graph shows what is happening. The orange line on the graph shows the decline in mathematics proficiency from 3rd-11th grade.

Table 3. 2018-2019 Hawai'i Statewide Assessment.

2015-16				2016-17			
Grade	All Schools	Department Schools Only	Charter Schools Only	Grade	All Schools	Department Schools Only	Charter Schools Only
English Language Arts/Literacy*				English Language Arts/Literacy*			
3	49.4%	49.6%	44.6%	3	48.4%	48.9%	38.7%
4	50.1%	50.7%	39.1%	4	48.4%	48.7%	42.7%
5	56.0%	56.5%	48.0%	5	53.1%	53.8%	43.6%
6	51.4%	51.7%	48.4%	6	49.3%	49.5%	47.3%
7	47.1%	47.1%	47.6%	7	49.6%	49.1%	56.1%
8	48.8%	48.6%	51.7%	8	47.1%	47.0%	48.3%
11	55.5%	55.4%	58.0%	11	56.9%	57.1%	53.3%
Mathematics*				Mathematics*			
3	53.3%	53.7%	46.6%	3	52.7%	53.3%	41.5%
4	47.0%	47.5%	38.0%	4	48.1%	48.5%	41.2%
5	42.4%	42.6%	38.3%	5	42.1%	42.6%	34.6%
6	39.4%	39.8%	33.8%	6	40.8%	41.1%	36.8%
7	37.0%	37.1%	35.6%	7	36.5%	36.4%	37.6%
8	37.6%	37.9%	34.2%	8	37.6%	38.1%	29.9%
11	30.3%	30.4%	28.3%	11	31.0%	31.4%	22.1%
Science**				Science**			
4	55.1%	56.0%	40.0%	4	56.8%	57.3%	46.3%
8	37.2%	37.4%	34.6%	8	42.0%	42.7%	33.1%
HS	33.1%	33.3%	29.2%	HS	35.9%	35.6%	43.6%
2017-18				2018-19			
Grade	All Schools	Department Schools Only	Charter Schools Only	Grade	All Schools	Department Schools Only	Charter Schools Only
English Language Arts/Literacy*				English Language Arts/Literacy*			
3	52.6%	53.0%	46.3%	3	52.3%	52.6%	48.5%
4	50.8%	51.3%	41.9%	4	51.5%	52.0%	44.0%
5	56.0%	56.2%	53.8%	5	56.7%	57.2%	49.5%
6	52.6%	52.6%	52.6%	6	52.4%	52.3%	54.0%
7	52.1%	52.0%	53.7%	7	52.8%	52.6%	56.1%
8	54.5%	54.3%	57.2%	8	51.5%	51.4%	53.2%
11	60.0%	60.1%	57.5%	11	58.7%	58.7%	60.1%
Mathematics*				Mathematics*			
3	54.2%	55.2%	39.0%	3	55.7%	56.4%	45.3%
4	47.3%	48.0%	35.4%	4	48.1%	49.0%	35.0%
5	42.9%	43.3%	36.4%	5	44.1%	44.8%	32.5%
6	41.4%	41.9%	34.7%	6	40.6%	41.1%	34.5%
7	37.1%	37.2%	36.5%	7	38.2%	38.5%	34.3%
8	38.6%	39.2%	29.8%	8	37.8%	38.4%	30.1%
11	32.0%	32.3%	23.9%	11	30.1%	30.2%	27.1%
Science**				Science**			
4	56.3%	56.9%	47.0%	4	56.7%	57.1%	50.7%
8	43.6%	43.8%	40.4%	8	40.7%	40.5%	44.5%
HS	34.6%	34.5%	38.3%	HS	34.7%	34.6%	36.2%

Note: *Achievement rates for English Language Arts/Literacy and Mathematics are based on all students tested who were administered either the SBA or HSA-Alt in that subject.

**Achievement rates for Science are based on all students tested who were administered either the HSA Science or HSA-Alt for grades 4 and 8, or the Biology I End-of-Course Exam or HSA-Alt in high school (HS). For school year 2018-19, results are based on a bridge test using NGSS.

Sources: Hawaii State Department of Education: Office of Strategy, Innovation and Performance; Data Governance and Analysis Branch.

Students were performing higher in mathematics than English Language Arts (ELA) in 3rd grade, and proficiency dropped from 56% to 30% over eight years, while ELA proficiency, the blue line, increased from 52% to nearly 60%. As ELA proficiency increases, math proficiency decreases (see Figure 6). What are the possible causes of the decline?

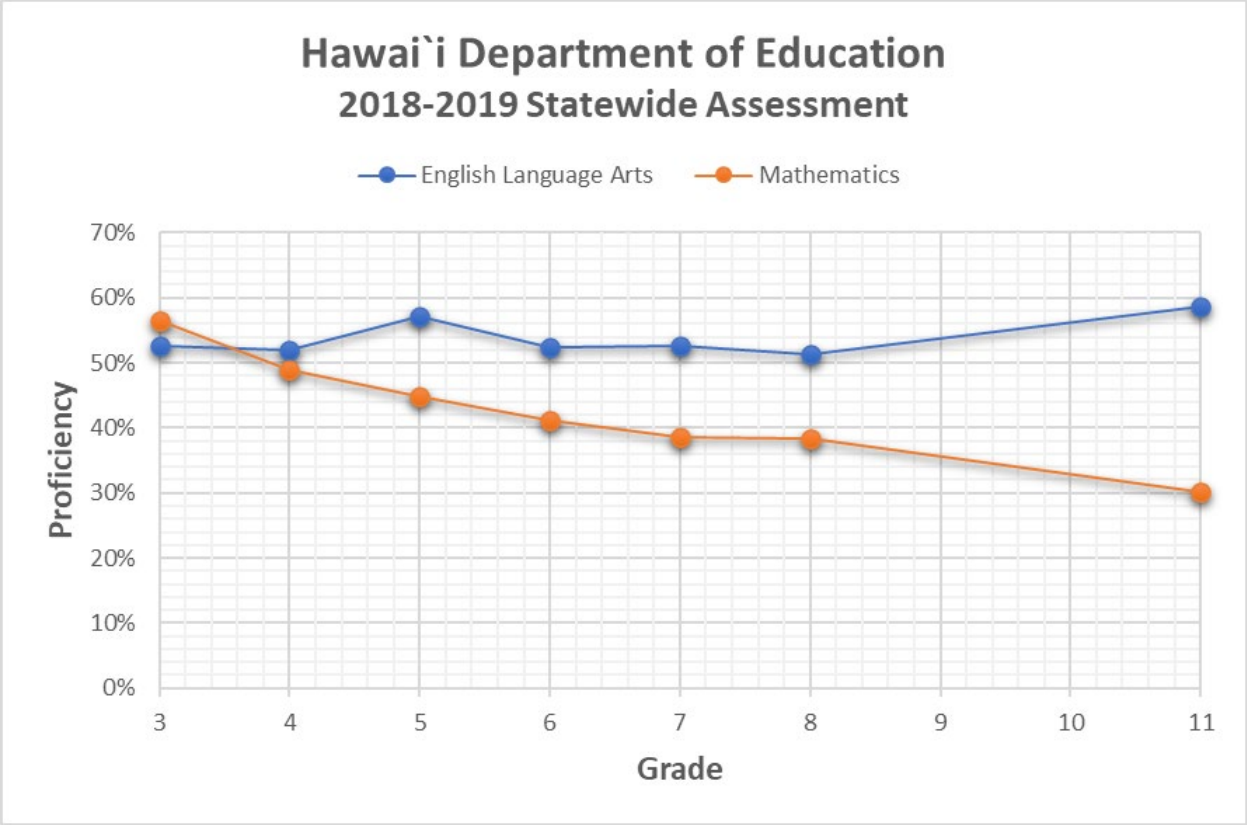


Figure 6. 2018-2019 Hawai‘i Statewide Assessment Graph.

Some variables that could explain the divergence in performance include learning environment or facilities, economic disadvantage, student perception of school, financial resource allocation, school location or area, plantation schools and critical education histories, teaching quality and licensing, and hiring and retention policies. These were a few of the many variables I considered as I read the literature and began forming the Study of Educational Equity in Hawai‘i: Examining the Distribution of Qualified Teachers and Student Outcomes.

Two-way Accountability Policy

Mathematics is a dying language in the United States and, consequently, in Hawai‘i. Numeracy levels in our country are spiraling downward. Mathematical proficiency, or the ability to understand, interpret and apply numbers and symbols to real-world problem-solving and reasoning, continues to plummet, especially in underserved, low-income, and minority schools and students. These outcomes are not surprising, given that the U.S. and Hawai‘i show the lowest investment in recruiting and retaining qualified teachers and ensuring equitable access to this resource, the only historically consistent way to improve student achievement. As a result, achievement levels in math have worsened over the last 40 years. Hawai‘i numeracy indicators in high schools are as low as 2% on O‘ahu, 5% on Maui, 7% on Hawai‘i, the Big Island, and 3% on Lanai, and our state mathematics proficiency level is 30%.

Moreover, mathematical performance is positively related to teaching salaries. Numerous studies have shown that countries that pay teachers higher salaries, relative to other professions, had higher student achievement in mathematics (Ingvarson & Rowley, 2017). Unfortunately, Hawai‘i teachers are the lowest paid in the nation. In addition, teachers in the United States are among the lowest paid in developed countries. These structural inequalities explain the persistently low numeracy levels in Hawai‘i and the United States. Federally mandated testing and teacher evaluation programs hold students and teachers accountable annually for performance. What’s missing is “whether governments can be held accountable for their own performance in ensuring that all students have the conditions and resources necessary to support their right to learn” (Darling-Hammond, 2007, p. 329). Providing equitable access to qualified teachers will require changing policies to address shortages of trained teachers and ensure that

“schools serving low-income and minority students are not disadvantaged by lower salaries and poorer working conditions in the bidding war for good teachers” (Darling-Hammond, 2007, p. 331). Meeting quality, equity, and achievement standards in Hawai‘i and the U.S. will require two-way educational accountability, assessing performance in schools and government.

CHAPTER 2. LITERATURE REVIEW

Introduction

Forty years ago, the National Commission on Excellence in Education, under the Reagan Administration, published the report A Nation at Risk, ushering in a seemingly endless stream of studies, federal mandates, and directives targeting teacher quality as a central problem in schools in the United States (Ingersoll et al., 2007). The opening pages of the report state, "The educational foundations of our society are presently being eroded by a rising tide of mediocrity that threatens our very future as a Nation and a people" (Gardner, 1983, p. 1). Since the publication, "few educational issues have received more attention…than the problem of ensuring that the nation's elementary and secondary classrooms are all staffed with quality teachers" (Ingersoll et al., 2007, p. 95). Teacher performance is tied to more than academic achievement, and school quality is often blamed for larger societal issues like economic competitiveness, juvenile delinquency, and moral and civic culture (Ingersoll et al., 2007).

Studies worldwide claim that "the quality of teachers and teaching is a vital resource…with much concern surrounding how equitably this resource is distributed within educational systems" (Ingersoll et al., 2007, p. 1). The federal government's involvement in education reform was enhanced further with the No Child Left Behind (NCLB) passage in 2002. The new federal law set an unprecedented goal to ensure that all elementary and secondary students would be taught by highly qualified teachers and added mandatory statewide testing for grades three through eight and eleventh in reading and math (Ingersoll et al., 2007). The concern over declining test scores and the U.S. economic competitiveness turned into a trillion-dollar education enterprise in products and services linked to the compliance of the new federal policy

(Burch, 2009). Congress had set aside $400 million to support the administration of NCLB, and following its passage, profits from test sales jumped from $7 million to estimates between $400 and $700 million (Fabricant & Fine, 2013). A sizable amount of tax dollars continues to be spent on testing instead of teaching.

In 2009, accountability mandates for students through high-stakes testing were followed by accountability measures for teachers in Race To The Top (RTTT). This $4 billion venture introduced a new teacher evaluation system and merit pay linked to student growth and achievement (Cooper et al., 2015). Cooper claims, "possibly no greater evidence exists of the increasing influence of the federal government on the daily operation of public schools than the Obama administration's Race to the Top (RTTT) program and its central curriculum reform initiative, the Common Core State Standards (CCSS)" (2014, p. 195). One critic "called RTTT No Child Left Behind on steroids and claimed that it was marginalizing and suffocating educators" (Cooper et al., 2015, p. 197). My study comes after exhaustive investment in accountability measures for students and teachers. It seeks accountability measures for government and education policymakers and administrators to ensure educational equity for all students, teachers, schools, and communities.

Mathematics Achievement in the United States

"Achievement gaps on international tests in math and science, between American students and their industrialized counterparts, have worsened over the last 40 years" (Ornstein, 2010, p. 424). The challenge of underachievement is shown in international PISA rankings (see Figure 7).

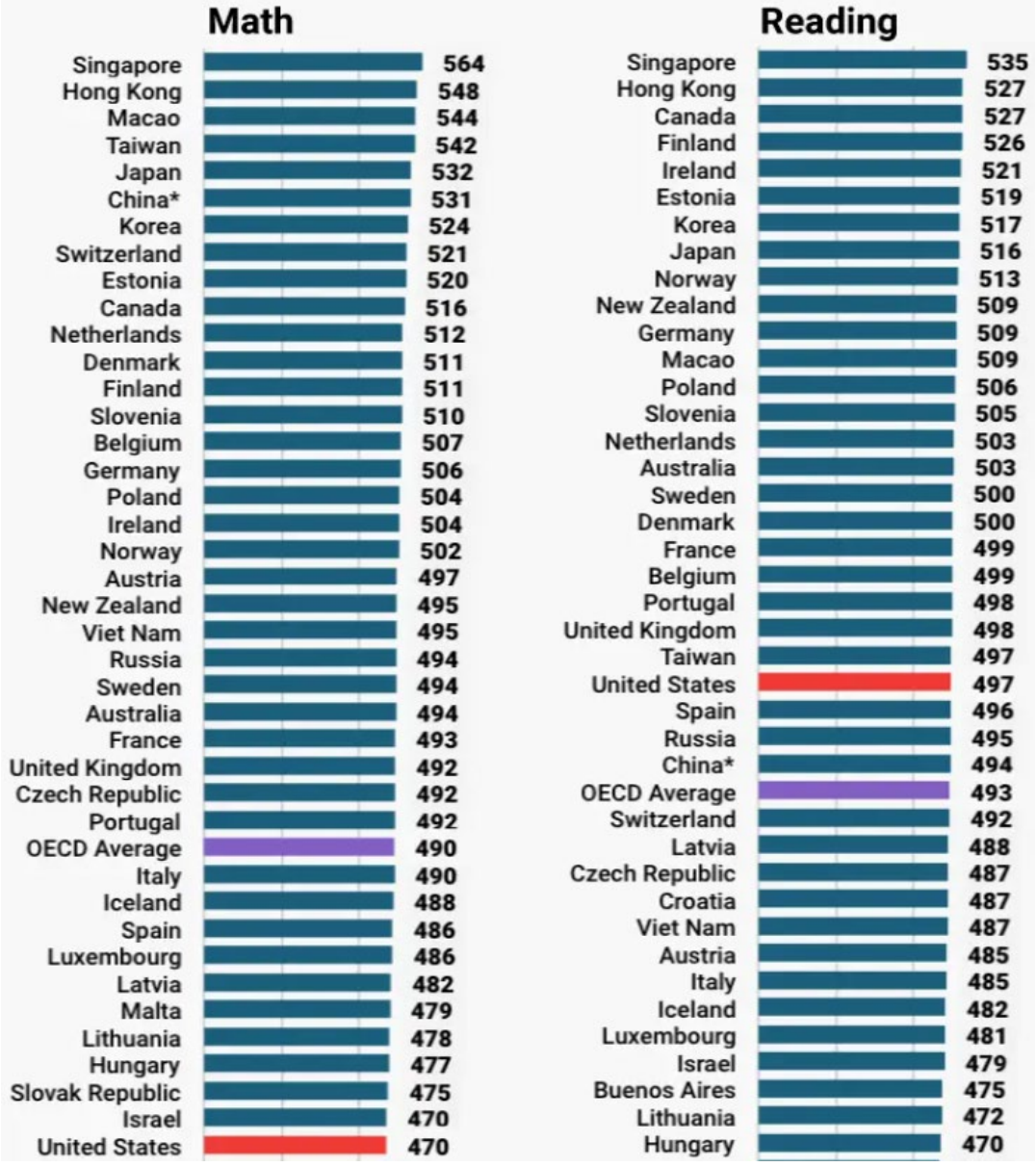


Figure 7. PISA Rankings United States 36th and Below OECD Average in Math.

In the most recent PISA results published by the Organization for Economic Co-operation and Development (OECD, 2016), the United States continues to fare poorly in mathematics performance. PISA, the Programme for International Student Assessment, is an international assessment conducted every three years that measures the competencies of

randomly selected 15-year-old students in mathematics, reading, and science. Based on results from PISA 2015, the United States ranked 36th among the participating countries and performed below the OECD average in mathematical literacy. According to PISA, a mathematically literate student demonstrates an ability to formulate, employ, and interpret mathematics, predict and explain phenomena, and recognizes the role mathematics plays in the world to make well-founded decisions needed by constructive, engaged, and reflective citizens (OECD, 2022). The Asian countries outperformed Western nations, with the top performance by Singapore indicating the equivalent of over two years of formal schooling in mathematics ahead of the United States. Despite numerous attempts at education reform and billions of dollars spent annually on assessments and programs, "our education system is in a state of depression…, and our system as a whole has not improved" (Ornstein, 2010, p. 424).

PISA testing has sparked international interest in policies that improve quality teaching and academic achievement. The OECD study "Teachers Matter: Attracting, Developing and Retaining Effective Teachers" analyzes teacher policies in 25 countries. Findings conclude that multiple factors influence student learning; however, "of those variables which are potentially open to policy influence, factors to do with teachers and teaching are the most important influences on student learning" (OECD, 2005, p. 2). In particular, the consensus is that "teacher quality is the single most important school variable influencing student achievement" (OECD, 2005, p. 2). Teacher qualifications, which include experience and subject-matter knowledge, consistently positively affect student performance. Other teacher characteristics that are vital to student learning but are more difficult to measure include "the ability to convey ideas in clear and convincing ways; to create effective learning environments for different types of students; to foster productive teacher-student relationships; to be enthusiastic and creative, and to work

effectively with colleagues and parents" (OECD, 2005, p. 2). Ironically, according to OECD data, the United States has spent more than any other country per student per point on the PISA math exam and 60% more than the average spending of the OECD countries (see Figure 8).

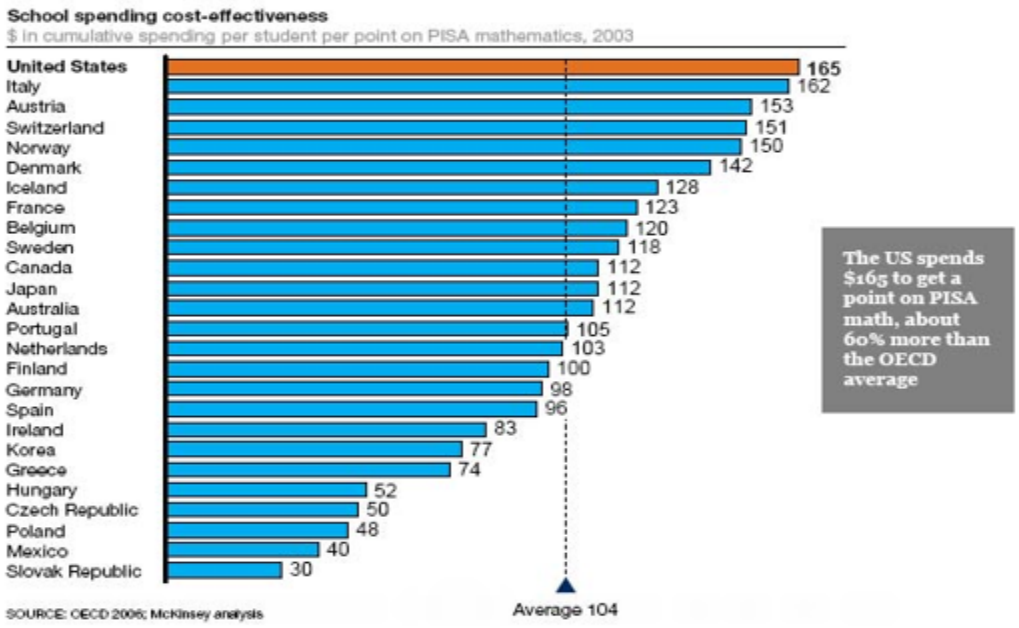


Figure 8. United States Spends More Per Point on the PISA Math Test.

Based on the trend of underperformance and overspending, education policies in the U.S. need to be reevaluated so that resources effectively address the problems of equity and access to qualified teaching in mathematics education.

Access to quality teaching has become a growing concern for many countries, especially in computer science and math, the two areas with the highest staffing difficulty (OECD, 2005). The United States is among these countries struggling to place qualified teachers in science and math. The OECD study reported that school systems respond to shortages in these areas by lowering teacher qualification requirements, assigning teachers to teach subjects they are not

qualified to teach, increasing the number of courses teachers are assigned, and increasing class sizes. OECD findings evidence that "teaching is a profession in long-term decline"; expectations and demands on teachers and schools increase while "resources have not kept pace" (2005, p. 5). As societies have become wealthier, teaching salaries relative to GDP are declining, and teaching's appeal has diminished (OECD, 2005). The OECD claims, "if teaching is not perceived as an attractive profession, and teaching does not change in fundamental ways, there is a risk that the quality of schools will decline and a downward spiral will be difficult to reverse" (2005, p. 3).

In addition to teacher shortages in hard-to-staff subjects, there are concerns about the inequitable distribution of qualified teachers among schools, particularly in disadvantaged areas (OECD, 2005). Teachers in disadvantaged areas report high workloads, poor working environments, low job satisfaction, and concern over the effects of stress on teaching effectiveness (OECD, 2005). Quality teaching and learning are determined by more than the "quality" of teachers; the learning environment conditions also contribute to effective teaching (OECD, 2005). Therefore, policy initiatives must improve employment conditions, increase teaching salaries, and recruit and retain effective teachers, primarily in hard-to-staff schools (OECD, 2005). Countries prioritizing policies to make teaching an attractive career choice by improving teachers' image and social standing have more well-qualified applicants than vacant positions (OECD, 2005). The OECD study concludes that successful educational reform requires teachers to be actively involved in policy development that emphasizes teacher quality over quantity; there is "now substantial research indicating that the quality of teachers and their teaching are the most important factors in student outcomes that are open to policy influence" (2005, p. 9).

Ingvarson and Rowley conducted a similar study of 17 countries, examining the relationship between teacher quality policies and mathematics achievement (2017). Their study, "Quality Assurance in Teacher Education and Outcomes," compares how 17 countries recruited, selected, prepared, and certified new teachers in elementary and secondary schools. They claim that "Investment in initial teacher preparation is clearly important, but there is little research to guide policymakers about how best to direct that investment to assure the quality of new teachers and sustained benefits for school systems" (2017, p. 177). There are three main categories or stages that policy and investment can be placed to assure teaching quality: first, recruitment, or making teaching an attractive career option; second, accreditation or evaluating and assessing teaching; and third, certification or governing entry into the profession (Ingvarson & Rowley, 2017). Where a country's teacher policies place emphasis can determine who is accountable for the quality of teaching. The authors claim, "If the emphasis falls on the attractiveness of teaching as a career, the accountability spotlight is more likely to fall on governments and the salaries and working conditions of teachers relative to other professions" (2017, p. 178). Governments may attempt to defer the accountability spotlight to teacher education providers by focusing on accreditation or excessive evaluations and assessments of teachers and programs (Ingvarson & Rowley, 2017).

Based on the study's teacher policy criteria, the United States received weak and low ratings in recruiting and selecting teacher education candidates. The weak rating was because the U.S. reported no legislative mechanism controlling enrollment numbers or available places for teacher education students (Ingvarson & Rowley, 2017). The U.S. also received a low rating for the attractiveness and status of teaching as a profession and a career (Ingvarson & Rowley, 2017). The study reported U.S. teaching salaries as below average GDP per capita and teaching

status as low. Governments with low ratings in the category of teacher recruitment or making teaching an attractive career option avoid the accountability spotlight by focusing policies on the accreditation of teacher programs and evaluating teachers (Ingvarson & Rowley, 2017). This policy tactic is consistent in the United States, which received the highest rating in the category of requirements for accreditation of teacher education programs, or "External evaluation and accreditation of teacher education programs by a government, statutory, or professional agency and with power to disaccredit programs" (Ingvarson & Rowley, 2017, p. 185). Singapore and the other top-performing countries in mathematics achievement are well known for effective recruitment policies. In contrast to U.S. policymakers, their governments offer a profession with high status, salaries above average GDP per capita, and attractive working conditions, ensuring a high demand for teacher education placement from their ablest graduates (Ingvarson & Rowley, 2017).

The Teacher Education and Development Study in Mathematics (TEDS-M) conducted by Ingvarson and Rowley found "a statistically significant relationship between the overall strength of quality assurance arrangements and student achievement at the national level, with correlations of 0.69 ($p < .01$), 0.76 ($p < .01$), and 0.59 ($p < .05$) with TIMSS 2011 (Grades 4 and 8) and PISA 2012, respectively" (2017, p. 187). Of the teaching quality categories measuring recruitment, accreditation, and certification in the different countries, the association with PISA math performance is strongest for recruitment and selection (0.54, $p < .01$) and certification or entry to the teaching profession (0.52, $p < .05$) (2017). According to the study, the United States received the highest rating in the accreditation category, which shows the weakest relationship with mathematical literacy. In addition, the United States received the lowest ratings in the category of recruitment, which has the strongest connection with mathematics performance. The

TEDS-M study evidences that student achievement is positively related to teaching quality. U.S. policies could be more cost-effective if they focused on improving the attractiveness of the teaching profession to high-achieving graduates by increasing salaries and improving working conditions. The research suggests, “No matter how strong accreditation and certification policies might be, they are unlikely to compensate in situations where governments do not ensure that teaching has high status and that it provides career pathways comparable in salary to other professions that attract and recruit the ablest graduates” (Ingvarson & Rowley, 2017, p. 190).

Another study of mathematics achievement in the United States analyzed data from the National Assessment of Educational Progress (NAEP). In the article “Examining Disparities in Mathematics Education: Achievement Gap or Opportunity Gap?” Alfinio Flores examines variations in student achievement and the relationship of mathematics achievement to socio-economic status and ethnic background (2007). The data reported by the NAEP indicates that 91% of African American and 87% of Latino students are not proficient in mathematics by the eighth grade (Flores, 2007). These proportions are much lower for Asian American (53%) students and White (63%) students (Flores, 2007). The findings also reveal a considerable gap between low and high-socioeconomic students. The percentage of high-poverty students below math proficiency was three times that of low-poverty students (Flores, 2007). What does the mathematics achievement gap look like in Hawai‘i? What are the most significant factors impacting math achievement, and how does the achievement gap in mathematics education correlate with socio-economic status and teaching quality in Hawai‘i’s public high schools?

Teaching Quality Matters: State Policy Effectiveness

Since the passage of the No Child Left Behind Act in 2002, there has been an ongoing debate over the long-term consequences of this mandate on the quality of public schools. One of the NCLB provisions states that every core subject teacher must meet the "highly qualified" criteria defined in the law. The mandate defines "highly qualified" teachers as teachers that "hold at least a bachelor's degree from a four-year institution; hold full state certification, and demonstrate competence in their subject area." Anne Lewis, a national education policy researcher, explains some of the challenges that have surfaced since the passage of NCLB. She writes that the U.S. Department of Education allows states to loosely define how they respond to the need for highly qualified teachers. Lewis claims, "with these competing systems and 50 different state definitions of highly qualified teaching, it is no wonder that the public is confused, and…choosing, through its policymakers, the cheapest route to placing a qualified teacher in every classroom" (Lewis, 2005). A teacher's content knowledge significantly affects student learning, yet the law does not guarantee that a state must require a bachelor's degree in the subject being taught.

Linda Darling-Hammond's study of "Teacher Quality and Student Achievement: A Review of State Policy Evidence" used data from the National Assessment of Educational Progress (NAEP), Schools and Staffing Surveys (SASS), state case studies and policy surveys of the 50 states to correlate the effects of teacher qualifications on student achievement across the country. The findings suggest that "measures of teacher preparation and certification are by far the strongest correlates of student achievement in reading and mathematics, both before and after controlling for student poverty and language status" (2000, p. 1). Her analysis concludes that

state policy efforts investing in quality teaching are necessary to improve student achievement in public education.

Despite the ongoing debate among educators over the variables that most influence student performance, research indicates that differentials in teacher effectiveness outweigh the effects of the differences in class size and heterogeneity (Darling-Hammond, 2000). Data included in Darling-Hammond's research found that students taught by fully certified mathematics teachers experienced larger achievement gains, performed at higher levels, and were less likely to drop out, be held back, or be referred to special education. Teacher effectiveness indicators included communication skills, the teacher's ability to convey ideas clearly and convincingly, subject matter knowledge, teacher education coursework, experience, and enthusiasm. These indicators, combined with mathematics teachers' ongoing professional development opportunities, positively affected student achievement (Darling-Hammond, 2000).

States that lead the country in mathematics achievement are the states that have a long history of investments in teaching quality. These states have professional teacher policies that have organized professional standards boards to enforce high standards for entering the teaching field (Darling-Hammond, 2000). As a result, they rarely hire underqualified teachers; they have the lowest percentages of "out-of-field teaching in the country and among the highest proportions of teachers holding both certification and a major in the field they teach" (Darling-Hammond, 2000, p.13). One of the states noted for exceptional gains in student achievement was North Carolina.

During the mid-1980s, North Carolina carried out the "most substantial and systemic investments in teaching…major statewide increases in teacher salaries and improvements in

teacher salary equity with intensive recruitment efforts and initiatives to improve preservice teacher education, licensing, beginning teacher mentoring and ongoing professional development" (Darling-Hammond, 2000, p.15). The 1997 Educational Excellence Act continued North Carolina's policy efforts that began in 1983. These reforms included boosting salaries, rewarding teachers for additional education, recruiting top academic high school students into teaching by subsidizing their entire college education, requiring teacher education institutions to become professionally accredited, and increasing licensing standards for teachers and administrators (Darling-Hammond, 2000). Although North Carolina served a relatively large population of high-poverty students and was near the bottom in state rankings in the 1990s, following these initiatives, N.C. posted the "largest student achievement gains in mathematics and reading of any state in the nation" (Darling-Hammond, 2000, p. 15).

In contrast, California's policy initiatives had a different outcome. In a reform effort to reduce class sizes, California hired the greatest number of underqualified teachers in the country. The consequences of the class size reduction initiative were troubling. Although California was "once among the highest-achieving states in the nation, California now ranks nationally among the bottom three states in elementary reading and mathematics achievement on the NAEP" (Darling-Hammond, 2004, p. 3). Unfortunately, minority students and high-poverty students were most affected by the influx of underqualified teachers. Most untrained and non-licensed teachers were assigned to schools with higher proportions of student poverty, determined by free or reduced lunch qualifications, minority students, and lower-performing students (see Figure 9).

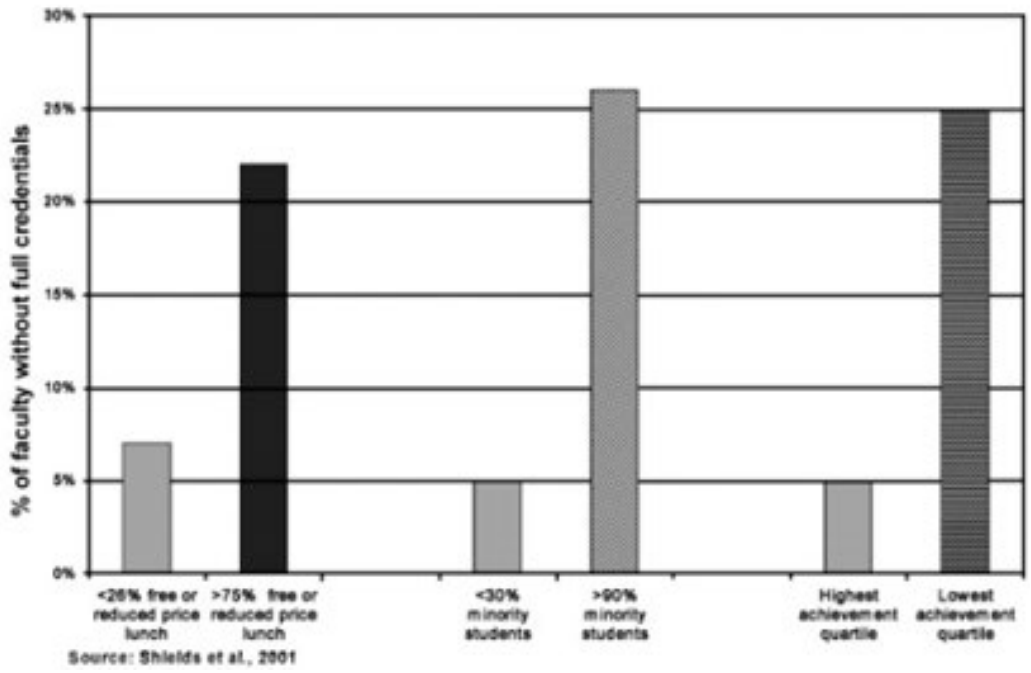


Figure 9. Distribution of Underqualified Teachers.

In 2001, “students in California’s highest minority schools were still five times more likely to have an uncertified teacher than those in largely White schools” (Darling-Hammond, 2004, p. 609). California schools are still struggling with quality and equity, “thousands of students attend school in dilapidated buildings, without textbooks, materials, or qualified teachers” (Darling-Hammond, 2004, p. 1). The unequal access to quality teachers, resources, and educational opportunities in California has negatively impacted students' mathematics achievement in these schools.

A case study of nearly 900 Texas school districts found that teachers’ expertise accounted for more inter-district variation in students’ mathematics achievement than any other factor, including student socio-economic status and ethnic background (Darling-Hammond, 2000). The effects of teacher expertise variations in these schools were so significant that “after controlling

for socio-economic status, the large disparities in achievement between black and white students were almost entirely accounted for by differences in the qualifications of their teachers" (Darling-Hammond, 2000, p. 9). The analysis suggests that every dollar spent on improving teacher quality in Texas schools netted more significant gains in student achievement than other uses of school resources (Darling-Hammond, 2000). This claim was also valid across the country. State education policy reforms that invested in teaching quality through increased teacher salaries, improved working conditions, enforced licensing standards, and teacher education funding were far more successful than the alternative reforms centered on statewide testing (Darling-Hammond, 2000). Given the research, why does the United States continue to pour money into excessive national testing, evaluating, and assessing education programs and teachers rather than effectively supporting teaching quality by incentivizing the teacher profession, increasing salaries, and improving working conditions?

Inequitable Access to Teaching Quality

The Trends in International Mathematics and Science Study (TIMSS) reveals two mounting problems with K-12 mathematics education in the United States: 1) a lack of qualified teachers and 2) inequities in access to those teachers by students of varying socio-economic status (Kang & Hong, 2008). According to TIMSS, teacher quality is based on four different measures; a) full teaching certification, b) mathematics major, c) mathematics education major, and d) teaching experience of 3 years or more (Akiba et al., 2007). Like previous research, the analysis also found that countries with "better teacher quality produced higher mathematics achievement" (2007, p. 369). Although the teaching quality in the U.S. was near the international average, "the opportunity gap in students' access to qualified teachers between students of high

and low socio-economic status was among the largest in the world (Akiba et al., 2007, p. 369). My dissertation, the Study of Educational Equity in Hawai‘i, examines variables of equity and access impacting mathematics achievement among the forty-one public high schools in the State of Hawai‘i. Equity is the extent to which equal opportunities and access to qualified teaching and resources are achieved. Darling-Hammond's research concluded that "students in the highest-minority schools have only a 50% chance of being taught by a math teacher who is certified and holds a degree in the subject area(s) taught" (2004, p. 614).

In a cross-national study of 46 countries, Akiba, LeTendre, and Scribner used TIMSS achievement data and TIMSS teaching quality measures to explore the relationships between mathematics achievement and access to quality teaching. An overall measure of teaching quality for each country was based on the percentage of eighth-grade students taught by mathematics teachers that met one, some, or all of the above criteria. In the United States, only 60% of eighth graders receive mathematics instruction from a teacher that meets all the teaching quality measures; in South Korea, a top math-performing country, this percentage was 84%. Equitable access to high-quality teachers was also measured in the analysis of these countries. According to the study, "high-poverty students and ethnic minority students are twice as likely as low-poverty and majority students to be assigned novice teachers who are new to the profession" (Akiba et al., 2007). The opportunity gap between high-poverty and low-poverty students in the United States was the fourth highest among 46 countries (Akiba et al., 2007). The study suggests that the difference in opportunities to be taught by qualified teachers with subject-specific content knowledge between high-SES and low-SES students in the U.S. originates from the funding inequality between districts and schools (Akiba et al., 2007).

In a comparative study of access to teaching quality in six nations, Ingersoll and Consortium for Policy Research in Education members examine the effects of elementary and secondary teachers' qualifications on their student's achievement (2007). National Center for Education Statistics data was used to measure the percentage of secondary-level teachers in core fields teaching without education or professional qualifications. The education qualifications in the study referred to the percentage of teachers with an undergraduate or graduate major in the field. (Ingersoll et al., 2007). Professional qualification requirements included a full teaching certificate or license in the field. The study revealed major differences between systems in the extent to which teachers were teaching outside the field they were educated and trained in. The problem of teachers assigned by administrators to teach in areas that do not match their educational background was most severe in the United States (Ingersoll et al., 2007). Of the four academic fields, math has the highest percentage of out-of-field teaching, explaining U.S. underperformance on international math tests. The percentage of secondary math teachers that do not have educational qualifications or a major in math or math education in the United States is 38%, the highest percentage and dramatically higher than the percentage of out-of-field teaching in Korea, which is 2% (Ingersoll et al., 2007).

The severe problem of out-of-field teaching in the United States is even more pronounced in schools serving socio-economic disadvantaged students. The comparative data showed that teachers in high-poverty schools were more likely to be teaching out of their field of educational and professional training (Ingersoll et al., 2007). Ingersoll claims, "in the United States, the most glaring and prominent source of inadequate access to qualified teachers is not a lack of basic education or professional training of teachers, but rather the widespread practice of misassignment" (Ingersoll et al., 2007 p. 13). School-staffing decisions typically follow the top-

down command model, and teachers have little say over their assignments. Administrators determine how teachers are utilized after they are hired, and "from a managerial perspective, they find that assigning teachers to teach out of their fields often is more convenient, less expensive, and less time consuming than the alternatives (Ingersoll et al., 2007, p. 14). In contrast to the other countries in the study, the data indicate that a major source of underqualified teaching in the United States is the administrative practice of out-of-field teaching assignments, especially widespread in the United States and especially in those schools serving disadvantaged communities (Ingersoll et al., 2007, p. 16).

Another study measuring educational equity and quality in the U.S. found unequal opportunities for ethnic minority and low SES students to learn mathematics "free from bias…all students need the opportunity to learn challenging mathematics from a well-qualified teacher who will make connections to the backgrounds, needs, and cultures of all learners" (Flores, 2007, p. 37). The United States is becoming more ethnically diverse; states like Texas and California have over 50% minority student populations, yet 88% of teachers are White (Flores, 2007). Research suggests that ethnic differences can result in bias in educational opportunities. Minority students are often placed in lower tracks even when their test scores or other achievement measures are equal to or better than their peers (Flores, 2007). The data indicate that Latino and African American students were more likely to be placed in remedial mathematics classes than in regular courses, less likely to be recommended for gifted and talented programs, and less likely to be given opportunities to take advanced mathematics courses, even when academic history was controlled (Flores, 2007).

There are definite inequalities in per-student funding between schools and districts, contributing to inequities in access to qualified teachers and advanced educational learning opportunities. Because school funding in several states relies heavily on property taxes, the schools in the areas that serve wealthy families have more per-student funding than schools that serve areas with higher levels of school and community poverty. Discrepancies in school funds leave high-poverty schools consistently staffed with teachers with the least experience and the lowest salaries (Flores, 2007). Less financial resources make it challenging to recruit and retain highly qualified teachers and impossible to provide learning tools, "such as up-to-date books, science laboratories, materials for experiments, and access to technology within the classroom" (Flores, 2007, p. 36). Flores' study concludes that the problem in math education is not the achievement gap but the opportunity gap. Students from diverse backgrounds can excel if given equal educational opportunities and access to quality teachers and resources (Flores, 2007).

National Policy Effectiveness

Several studies support the need for policy in the United States to improve the social standing or status of the teaching profession. The research of Nam-Hwa Kang and Miyoung Hong focuses on how South Korea and other countries have achieved both "excellence in the teacher workforces and equity in access to qualified teachers" (2008, p. 200). The sociocultural status connected to the teaching profession is a significant factor contributing to the high achievement in mathematics in South Korea. Teaching in South Korea is regarded as an honorable profession, "in the Confucian saying 'King, teacher, and parents are equal,' meaning…that king, teacher, and parents should be respected equally for their noble jobs" (Kang & Hong, 2008, p. 201).

Another notable difference between South Korea and the U.S. is their policies ensuring equitable access for all students to be taught by qualified teachers. In the international study comparing the difference between the percentages of students of high and low SES taught by qualified teachers, low SES students in South Korea have more access to qualified teachers. In contrast, in the U.S., low SES or economically disadvantaged students have significantly less access to qualified teachers and resources (Akiba et al., 2007). In addition, because of its high social status, cultural respect for the teaching profession, competitive salaries that attract highly competent individuals, and ideal working conditions (half the teaching hours per year compared to the US), teacher turnover rates are low. As a result, teaching is a sought-after occupation in South Korea, ensuring access to quality education for all (Ingvarson & Rowley, 2017).

Improving teaching salaries is another area where policy evaluation is needed to ensure quality and equity in the United States. Numerous studies report that "high-performing countries are more likely to focus educational policy directly on recruiting academically successful students and treating teachers as professionals" (Ingvarson & Rowley, 2017, p. 179). In England, studies found a clear relationship between changes in teacher salaries and the quality of education performance among applicants to teacher education programs (Ingvarson & Rowley, 2017). Research in Australia showed that "the lack of competitiveness of teacher salaries, relative to other professions, is the main factor turning potentially good teachers away from choosing teaching as a career" (Ingvarson & Rowley, 2017, p. 179). A study of teacher pay and pupil performance in 39 countries reported a highly significant and positive effect of teacher wages on student achievement (Dolton & Marcenaro-Gutierrez, 2011). In South Korea, Finland, and Singapore, countries with the highest achievement performance on international math and reading assessments, teachers are recruited from the top 5%, 10%, and 30% of graduating

cohorts (Dolton & Marcenaro-Gutierrez, 2011). The consensus is that "the quality of an education system cannot exceed the quality of its teachers," and the way to hire quality teachers is to pay them more (Dolton & Marcenaro-Gutierrez, 2011, p. 7).

According to PISA, in Singapore, the top performing country in reading and math, recruitment policies ensure that teaching is a more attractive career option than other professions. Future teachers receive a stipend, free education, and comprehensive training (Ingvarson & Rowley, 2017). Consequently, respect for teachers, and high salaries, attract the highest-performing students to teaching, in the highest-performing nations. In contrast, teaching in the United States has been considered a less attractive line of work (Ingersoll et al., 2007). The preference to work in areas other than teaching is especially true for males since females represent the majority of teachers in the US. Historically, "female-dominated occupations have tended to have less prestige, lower pay and less authority" (Ingersoll et al., 2007, p. 10). In studies measuring occupational prestige, teachers rank well below "traditional higher-status professionals, such as physicians, scientists, engineers, architects, dentists and attorneys" (Ingersoll et al., 2007, p. 10).

Finland entered the global spotlight after the first round of international testing (PISA) results. From 2000-2009, Finland ranked #1 in every category in the assessment, and the United Nations ranked them #1 in the world in education. Finland has met the two universal educational demands, quality and equity, and better teaching and learning for all young people regardless of their socio-economic status. To be successful in these challenges is morally and economically imperative, "each person's well-being and ultimately happiness arises from knowledge, skills, and worldviews that good education provides" (Sahlberg, 2011, p. 1). Finland, like other top-

performing countries, has a highly educated teacher workforce. All K-12 teachers obtain a Master's degree, government-financed, and mathematics is a popular minor for primary school teachers, ensuring high-quality mathematics teaching during foundational stages of learning. Students in Finland do not take standardized tests, "frequent standardized student testing is not a necessary condition for improving the quality of education as has been insisted upon by many advocates of competition-based public sector policies" (Sahlberg, 2011, p. 66). Also, in contrast to the United States, the school inspection system that provided external feedback on how teachers taught was abolished in the 1990s (Sahlberg, 2011). Thus, Finland avoids two of the most costly initiatives in the U.S. by doing away with standardized testing and teacher evaluations.

One of Finland's education reform leaders said, "an educated nation cannot be created by force," acknowledging that teachers and students must be heard (Sahlberg, 2011, p. 2). Central to education culture is cultivating trust between authorities and schools; trust makes reform sustainable and supported by the teachers who implement it. (Sahlberg, 2011). Collaboration among policymakers, administrators, educators, and families is the way forward. My study is situated during the federal government's heavy-handed era in education policy with the Common Core State Standards curriculum initiative, federally mandated statewide testing in grades three through eight and eleventh, and a hyper-focus on evaluating teachers and teacher education programs. The U.S. education system has been stubbornly "moving toward authoritarianism, letting the government dictate what and how students should learn and what schools should teach," while top-performing countries are decentralizing curriculum, diversifying assessment, and encouraging local autonomy and innovation" (Sahlberg, 2010).

In 2015, President Obama signed the Every Student Succeeds Act (ESSA), the most recent version of the government's most extensive K-12 law (The Education Trust, 2016). This long overdue policy is the beginning of a new chapter to close opportunity gaps by requiring statewide accountability systems to expect more progress for the groups of students who have been behind and expect action when any group of students is consistently underperforming (The Education Trust, 2016). The law requires added resources to support teachers and leaders. It demands that states and districts report on and address inequities in the rates at which low-income students and students of color are assigned to ineffective, out-of-field, or inexperienced teachers (The Education Trust, 2016). Centralized governance in education is ideal for quickly implementing education policies, and Hawai‘i's education system has centralized governance. My dissertation study of educational equity measures the effective implementation of ESSA provisions in secondary education in Hawai‘i. My study follows a previous analysis of quality, equity, and achievement in elementary education in Hawai‘i (Heck, 2007). Backed by ESSA metrics, my study seeks to help government and education policymakers improve quality and equity in Hawaii's public schools by promoting policies that recruit and retain quality teachers and ensure equitable access to this vital resource for all children.

Documentary Photography

Photography was introduced as a research method in the early 20th century when photographic equipment became accessible to researchers (Hanna, 2020). Researcher-photographers in anthropology and ethnography first used the camera to capture certain aspects of a community as "photo documentation" (Hanna, 2020). Since then, photography has been applied as a "visual," "visual ethnographic," "participatory," and "arts-based" method (Hanna, 2020). More recently, visual research has moved towards involving participants in the research

process “either through using ‘found’, researcher-produced or pre-existing photographs or through participants producing photographs themselves” (Hanna, 2020, p. 13). One of the challenges of visual research is the extent to which an image represents reality and authentically represents a person, place, or concept, given the multiple interpretations of images depending on the audience (Hanna, 2020).

Russell and Diaz claim that documentary photography has been used in social science research to “humanize findings,” significantly impacting policy changes in the last century (2011, p. 433). They suggest using visual images to complement research findings is especially salient for underserved and marginalized groups (Russell & Diaz, 2011). Caroline Wang, and Mary Ann Burris, pioneers of visual research methodology, developed “Photovoice” or “participatory photography” to foster social change (Budig et al., 2018). Photovoice involves putting the cameras in the participants’ hands and allowing them to document and reflect on their experiences through participant-led research (Budig et al., 2018). “Photo-elicitation” has also become a widely used method among participant researchers. This method uses visual images in an interview-style format to generate a description and discussion of sentiments triggered by the photograph (Hanna, 2020). Both visual research methodologies aim to empower vulnerable communities, promote critical dialogue and knowledge of important issues and concerns, and reach policymakers through reflective discussions and increased awareness generated by photographs (Budig et al., 2018).

Photographs are used extensively in educational research, particularly studies using visual arts-based methodologies (Marn & Roldn, 2010). Variations in more recent uses include “photo series, photo essay, photographic discourse, photo conclusion, and photographic

quotation" (Marn & Roldn, 2010, p. 7). In photo-educational research, the images "define the problem, describe the context, provide and interpret the data, argue a case for the findings and reveal conclusions (Marn & Roldn, 2010, p. 9). Independent photographs illustrate examples of a topic under investigation or present original data about a context or phenomenon (Marn & Roldn, 2010). "Photo series," or "samples series," is "instrumental in descriptive and comparative studies," where visual evidence is provided of similarities and differences (Marn & Roldn, 2010, p. 11). This study uses photographs to explore the educational phenomenon of quality, equity, and outcomes in Hawai'i's public schools. Study of Educational Equity in Hawai'i (SEE-HI) images are intended to document differences in resourcing at various schools and make the disparities between the most affluent and most underfunded schools visible.

CHAPTER 3. DESIGN AND ANALYSIS

Conceptualizing the Study of Educational Equity in Hawai‘i

Three previous studies have influenced the research design and methodologies of my dissertation study of education equity in Hawai‘i. First, my preliminary analysis draws on the work of Linda-Darling Hammond and her correlational findings between teacher quality and student achievement in the United States. Hammond revealed a “pattern of failed federal education programs, in which low-income, disabled, language minority and other vulnerable students are taught by the least qualified teachers and untrained aides, rather than the skilled practitioners envisioned by the Elementary and Secondary Education Act and other national laws” (2007, p. 3). Second, Ron Heck’s study using regression analysis to examine the relationship between teacher quality and student achievement in elementary schools in Hawai’i has been a valuable resource. Heck claims the “question of whether a particular school has a substantial impact on student learning is of primary importance for educational accountability” (2007, p. 400). Heck defined teacher quality as an instructional resource with variable access between schools. He found that increasing teacher quality positively affects student outcomes and can mediate inequities in learning opportunities for underrepresented groups in higher education, specifically Hawaiians, Filipinos, and Samoans (2007). Third, my research design was influenced by Russell and Diaz and their use of documentary photography to complement their work in social science research. They used visual images to humanize their findings. Photography offers another format, beyond text, for marginalized groups to “make the invisible visible, a way of bringing conflicting social problems to the surface” (2011, p. 434).

My dissertation study uses quantitative analysis to explore the relationships between equity, quality, and achievement in secondary mathematics education in Hawai‘i. Documentary photographs are added to complement the statistical research, illustrating variable distributions of quality and equity in Hawai‘i’s public schools. The study’s documentary photographs provide another way to visualize the phenomenon and enable readers to “understand the lived experiences of persons who encounter experimental programs or policy shifts” (Gamoran, 2019, p. 16). Education in the United States and Hawai‘i has undergone drastic experimental programs and policy shifts over the last 200 years. Segregated schooling, new government, abolished language and cultural practices, government negligence and insufficient funding causing teacher shortages, and inadequate resources qualify as experimental programs and policies Hawai‘i’s schools, teachers, and students have encountered. This quantitative study, supplemented with photographs, is designed to deepen understanding, enable better-informed hypotheses, and help “make sense of unexpected findings, whether in the form of rejected hypotheses or variation in effects among subgroups” (Gamoran, 2019, p. 16).

The Study of Educational Equity in Hawai‘i (SEE-HI) is a statistical analysis, complemented by an illustrative component, to help readers see disparities in the educational experiences of public high school students in Hawai‘i. Education benefits from studies that are “inherently applied,” meaning the multitude of questions about the science of learning or effective programs, policies, and practices “reflect an unrelenting quest to improve education, which stands as the primary motivation for education research” (Gamoran, 2019, p. 16). The “applied mission” of education researchers stands to gain from “designs that both test hypotheses and interpret the experience of individuals within the education system” (Gamoran, 2019, p. 16). In my study, the hypotheses will be tested using multiple regression. The hypotheses tests will

measure the relationships between qualified math teaching, mathematical proficiency or numeracy, and college enrollment. It is proposed that access to qualified math teachers is positively associated with these student achievement variables. In addition, this study's design visually explores the relationships between quality, student equity, and opportunity and the distribution of school resources. Visual representations of the allocation of resources will be gathered and used not as data but as another avenue to understand student and teacher experiences in Hawai‘i public schools relative to the study's quantitative findings.

Method

Multiple Regression Model

For this study, multiple regression is the statistical method employed to examine the relationships between quality, equity, and achievement variables in the forty-one public high schools in Hawai‘i. The Study of Educational Equity in Hawai‘i analyzes equitable access to licensed mathematics teaching in a safe and supportive learning environment, controlling for high school socioeconomic status, ethnicity, and location. In his book on multiple regression, Paul Allison explains, "Multiple regression is a statistical method for studying the relationship between a single dependent variable and one or more independent variables" (1999, p. 1). According to Allison, multiple regression is "unquestionably the most widely used statistical technique in the social sciences" (1999, p. 1).

In my study, I ask the following research questions:

- After we account for high school socioeconomic status, ethnicity, geographic location, school climate, and learning environment, what is the relationship between licensed mathematics teaching and math proficiency in Hawai‘i’s public high schools?

- After we account for high school socioeconomic status, ethnicity, geographic location, school climate, and learning environment, what is the relationship between licensed mathematics teaching and college enrollment in Hawai‘i’s public high schools?

In the first question, the single dependent variable, or test variable, is school-level math proficiency based on national proficiency standards or the Common Core Standards for Mathematics. Math proficiency is measured using the school’s percentage of eleventh-grade students that meet or exceed the proficiency standard on the Smarter Balanced Summative Assessment, a national assessment reported in the Hawai‘i Department of Education Strive HI School Performance Reports. The relationship between math proficiency and six independent school variables will be studied using statistical analysis. The regression model's six independent or control variables are high school socioeconomic status, ethnicity, location, school climate or students feeling safe and supported, learning environment, and access to licensed mathematics teaching.

Multiple regression analysis has two primary uses: causal analysis and prediction (Allison, 1999). One of the purposes of the Study of Educational Equity in Hawai‘i is to determine whether one or more of the independent variables significantly predicts the dependent

variables, high school math proficiency and college enrollment. Multiple regression is used to determine if a particular independent variable is significantly associated with the dependent variable and estimates the magnitude of that association if it exists (Allison, 1999). Multiple regression controls the overlapping influences of the independent variables on the dependent variable so that you can examine the unique relationship of each variable (Allison, 1999). One of the benefits of using this statistical method in my study is that it will explore the relationships of the principal school quality variables— access to qualified math teaching and a safe, supportive learning environment—while controlling for the other school variables. The study will examine inequities in access to licensed teaching and determine which of the school quality measures is significantly associated with math achievement.

The second research question explores the relationship between college enrollment rates, and the same six explanatory or predictor variables: high school socioeconomic status, ethnicity, location, climate, learning environment, and access to licensed mathematics teaching. For the second regression analysis, college enrollment is the dependent or outcome variable. My study examines the associations between school quality variables and college enrollment rates. College enrollment will also be derived from Strive HI School Performance Reports and measures the percentage of students enrolled in postsecondary institutions the fall after graduation. One of the main functions of multiple regression is to predict outcomes based on independent variables. My study will use multiple regression to develop an equation that predicts college enrollment rate and math proficiency based on high school SES, ethnicity, climate, location, learning environment, and access to teaching quality.

The variables used in the regression equations are quantitative variables representing school-level percentages and numeric values. Statistically controlling for a variable requires it to be measurable. As part of the analysis, regression coefficients representing slopes, and the intercepts will be calculated for each covariate. The regression coefficients can then be used in an equation to produce the best-predicted values for student achievement in math and college enrollment. Multiple regression or "Least squares regression always produces the 'best' set of linear predictions for a given set of data" (Allison, 1999, p.13). Multiple regression will hold the five other variables constant as it calculates the best-estimated relationship of each independent variable on math proficiency and college enrollment rates. The way to control for the other variables, high school SES, ethnicity, location, climate, learning environment, and teaching quality, is by including them in the regression equation.

A statistic known as the coefficient of determination or r-squared is used to gauge the accuracy of the predictions generated from the regression equation. (Allison, 1999). The coefficient of determination compares the sum of squared errors produced by the prediction equation with the sum of squared errors of a regression equation with no independent variables. R-squared is then used to explain the variation in the dependent variable caused by the explanatory variables (Allison, 1999). R-squared also measures "how well we can predict the dependent variable knowing only the independent variable" (Allison, 1999, p. 31). For example, in my regression analysis of educational equity in Hawai‘i, r-squared would determine the variation in math proficiency explained by SES, ethnicity, school location, climate, learning environment, and access to licensed math teaching. In the analysis of the second research question, r-squared would measure how well we can predict college enrollment rates knowing only the six independent school quality variables.

The accuracy and validity of the estimated regression coefficients undergo additional hypothesis testing to determine if the coefficients are statistically significant. The coefficient would be zero if the variable had no relationship (Allison, 1999). If the coefficient is not zero, then a relationship exists, and hypothesis testing validates that conclusion by calculating the probability that the actual coefficients are not zero (Allison, 1999). A low probability or *p*-value is evidence that the coefficient is not zero and validates the statistical significance of the coefficient, indicating an association between the independent and dependent variables. For example, the coefficient for teaching quality in Heck's regression model was 2.783. The interpretation of this coefficient is that as teaching quality increases by one standard deviation unit, students' math scores would increase by 3 points (Heck, 2007). If the p-value is less than .001, the interpretation is: if teaching quality has no relationship with math scores, the probability of finding a coefficient as large or larger than 2.783 is less than one in a thousand (Allison, 1999). This study's primary variable of interest is access to licensed mathematics teaching and the relationship with high-school math proficiency and college enrollment. *P*-values of the coefficients will determine if the variable is estimated to have a statistically significant relationship, highly significant, or no relationship (Allison, 1999).

Documentary Photography

In addition to multiple regression analysis, this study provides documentary photographs to complement the data and illustrate student equity and opportunities in Hawai‘i's public high schools. Based on the relationships of the variables determined through regression analyses, the study explores quality and equity variables using visual images. The variables found to be statistically significant will be the basis of the photographic exploration. According to HIDOE,

school resources are reported in two categories: certified staff and facilities. Examining the distribution of school resources, specifically access to certified math teaching in safe learning environments, is central to this study. Several regression software programs will produce graphical displays or plots to help readers visualize the regression equation and diagnose problems (Allison, 1999). As a supplement to the graphic representations of the regression models, my study includes a visual exploration of access to learning opportunities and resources through documentary photography. Schools with quality and equity findings associated with high or low student achievement are further examined using photographs.

Like previous research in education, SEE-HI explores systemic factors, environmental supports, and structural changes that could improve student achievement in Hawai‘i. (Strack et al., 2018). My study provides visual documentation of inadequacies and inequities in Hawai‘i’s public schools. It seeks educational accountability from government and education policymakers and administrators and uses images to promote awareness, knowledge, and critical dialogue to improve teaching and learning conditions for underserved students, teachers, schools, and communities (Strack et al., 2018). In my study, photographs are intended to be supplementary visual representations of the distribution of education resources and access to learning opportunities (Russell & Diaz, 2011). Based on the regression findings, I compare “found” or researcher-generated images taken from schools within each variable distribution. Schools at the top and the bottom of quality, equity, and outcome variable distributions were photographed.

This study includes a photographic representation of the statistically significant variables to examine the disparities in student access to quality and equity in Hawai‘i’s public high schools. Visual images of five learning environments were taken from each school campus: 1)

inside or outside of the administration building, 2) math classroom or classroom building, 3) library, computer lab, or other resource room, 4) cafeteria, and 5) field, band room, auditorium, or another enrichment facility. The framing and composition of the images were kept similar to allow differences in the learning environments to be more apparent to the viewer, and schools with the highest and lowest math proficiency and college enrollment are represented in the photographs. In addition to graphical displays or plots, which help readers visualize the regression models, the pictures provide another visual medium to help readers understand the distribution of resources in Hawai‘i’s public schools. The photographs let readers see what students experience visually attending these schools and the study advocates for social and structural changes to support all students' academic success.

Data

The study examines variables of quality and equity in forty-one public high schools in Hawai‘i, Maui, O‘ahu, Kaua‘i, Moloka‘i, and Lana‘i. This study analyzes the extent to which access to qualified teaching and resources in the Hawai‘i State Department of Education (HIDOE) is achieved. Data will be gathered on high schools from each of the seven districts: Hawai‘i, Maui, Kauai, Windward, Leeward, Central, and Honolulu Districts. The study identifies schools serving higher proportions of educationally at-risk students and examines the relationship between access to licensed math teaching and student performance. In addition, this educational equity study seeks to provide data to inform policymakers, administrators, educators, and parents in future initiatives to improve access to educational opportunities and quality teaching for underserved students, families, and communities in Hawai‘i. Regardless of

socioeconomic status, ethnic background, or where they live, all children deserve access to quality teaching and equity in Hawai‘i’s public schools.

My study of educational equity uses Hawai‘i Department of Education Data Books, the Civil Rights Data Collection, School Status, and Improvement Reports, Strive HI School Performance Reports, and Every Student Succeeds Act data to examine the distribution of qualified teachers and educational resources (CRDC, 2017; HIDOE, 2018c, 2019a, 2019b, 2019c). Based on the data, I explore the relationships between access to teaching quality in Hawai‘i’s high schools, college enrollment, and mathematics proficiency, controlling for high school socioeconomic status, ethnicity, geographic location, school climate, and learning environment. The analysis identifies schools serving higher proportions of students struggling with math, the distribution of Hawai‘i’s educational resources, and the relationship between access to these resources and student outcomes. This study will use multiple regression analysis to determine whether access to licensed math teaching, the principal independent variable, is associated with two dependent variables: math proficiency and college enrollment. The study will evaluate the association, if there is one while controlling for the other independent variables: high school socioeconomic status, ethnicity, location, climate, and learning environment.

Dependent Variables: Student Outcomes

The two dependent or test variables are math proficiency and college enrollment. Mathematics proficiency will be based on the percentage of eleventh-grade students that meet or exceed the proficiency standard on the Smarter Balanced Summative Assessment, a national assessment reported in the DOE Strive HI school performance reports. Students in grades three through eight and eleventh are federally mandated to take a Common Core Standards-based

assessment at the end of the school year. Students receive proficiency scores between 1 and 4; a score of 1 means the proficiency standard was “Not Met,” 2 means proficiency was “Nearly Met,” and 3 and 4 indicate the student has “Met” or “Exceeded” proficiency in math. The Strive HI school performance report is an annual snapshot of schools’ progress on federally required indicators under the Every Student Succeeds Act. A second regression equation will analyze College enrollment rates in forty-one high schools in Hawai‘i.

College enrollment data is also reported in Strive HI school performance reports and measures the percentage of students enrolled in postsecondary institutions the fall after graduation. In a previous study examining the impact of teacher quality on student achievement, Heck found that Hawai‘i’s public schools are very diverse in terms of ethnicity, with nearly three-fourths, or 72.3%, of Asian or Pacific Island ancestry and 20% Caucasian. Heck identified three racial/ethnic groups, Hawaiians, Filipinos, and Samoans, “that have been consistently underrepresented in the state’s 4-year universities and lower achieving on state tests” (Heck, 2007, p. 413). Expanding on Heck’s findings of underrepresented subgroups in higher education, my study identifies schools and students in the various districts and locations around the islands that are underrepresented in higher education. My study also determines the relationship teaching quality has with high school students accessing higher education.

Determining the association of access to qualified math teaching and math proficiency and college enrollment is the primary interest of the study. Preliminary analyses suggest that there is a relationship between these three variables. For example, data from Strive HI School performance reports show Waianae High School’s achievement over four years. In the 2015-2016 school year, 13% of Waianae High School students met proficiency standards in math, and

48% enrolled in college the fall after graduation. In the 2018-2019 school year, Waianae's math proficiency was 2%, and their college enrollment rate was 40%. In four years, math proficiency dropped from 13% to 2%, and the percentage of students enrolled in college after graduation dropped from 48% to 40%. In addition, the data indicates that the percentage of fully licensed teachers dropped at Waianae from 86% in 2015 to 82% in 2019. Analyzing the preliminary data trends suggests a relationship between access to quality teaching and student outcomes.

Independent Variables

Six categories of independent variables are proposed to account for variation in math proficiency and college enrollment. The independent variables used in the regression analysis were separated into two groups. Three variables were demographic or geographic and three were policy or governance variables. In the demographic or geographic group, there is high school socioeconomic status, ethnicity, and school location. The policy or governance group includes access to qualified teaching, school climate, and learning environment.

First, teaching quality, or the principal variable of interest, will be measured using educator qualifications from the Civil Rights Data Collection. Every two years, states are required to report the number of certified teachers in core subject areas. Teaching quality is measured as the percentage of licensed or state-certified teachers who teach high school mathematics. Heck's study of teacher qualifications in Hawai‘i found that labor market conditions continue to "necessitate hiring considerable percentages of teachers who were less than fully qualified" (Heck, 2007, p. 413).

The Every Student Succeeds Act requires states to report on three teaching quality measures. Inexperienced Educators refers to the school's percentage of teachers and

administrators with one year or less experience. Emergency hires are teachers with a bachelor's degree but have not met the complete licensure requirements. They are hired on an emergency basis when there is a position that a fully licensed teacher has not filled. Fully Licensed refers to teachers who have earned at least a bachelor's degree and completed an approved teacher training program. Teachers not teaching in their field of licensure have completed a teacher education program and earned a degree, but their degree or license is not in the subject they are teaching. Teaching quality varies between schools and districts in Hawai‘i. In the state, 8% are Emergency Hires, and 20% of teachers are teaching out of their field of licensure. The Qualified Teaching variable is the school's percentage of licensed or certified teachers in secondary math education that have completed a teacher education program.

The second independent variable category is high school socioeconomic status. This measure will be based on the school's proportion of students whose families meet the income qualifications of the federally funded free or reduced-cost lunch program. Third, ethnicity is a composite variable denoting the share of the population composed of Hawaiians, Filipinos, and Pacific Islanders, underrepresented groups in higher education. Geographic location, the fourth independent variable in the regression equation, will be determined by the population density of the high school's geographic area. Each school will be categorized as a "Town" or "Country" school based on the population density of the high school's geographic boundaries. Fifth, the school climate variable will be the percentage of students reporting positively on the Tripod Student Perception Survey, a measure of how safe and supported students feel at school. The sixth and final, learning environment variable will be derived from the DOE's Hawai‘i Facilities Inspection Tool (HI-FIT). Using a scale of 1-10, 10 being the highest quality, this evaluation tool assesses the cleanliness, safety, overall condition, and functionality of Hawai‘i's schools and

rates school facilities on various components that ensure a positive environment for teaching and learning.

Preliminary Analyses

After I have acquired the data and ensured there are no data entry errors, I will rank the schools in terms of math proficiency, college enrollment, teaching quality, high school SES, ethnicity, geographic location, school climate, and learning environment measures. I will then examine the dispersion of schools on these variables and the relationships between these variables. The initial step will determine the distribution of schools in terms of access to qualified math teachers and schools serving higher proportions of students struggling with mathematics. The correlation between access to teaching quality and math proficiency will then be calculated. For the preliminary analysis, the statistical significance test will be used to determine whether the relationships, if they exist, are likely to occur by chance or whether a correlation is present. The second correlational analysis will examine the relationship between access to licensed mathematics teaching and high school SES. This analysis will measure how equitable access is to teaching quality for students of varying socioeconomic status. Correlations between the other four variables and math proficiency, along with correlations between the independent variables and finally the correlations between the independent variables and college enrollment, will then be examined.

The data for this proposed study will be stored and analyzed in Excel and SPSS. The descriptive statistics, cross plots, correlations, and regression equations will be generated and examined in SPSS. The cross plots will show whether the trend is linear. For the correlations, the statistical significance test will be used to determine whether the relationships, if they exist, are

likely to occur just by chance when no real correlation exists or whether the correlation is present and not likely to have occurred by chance alone. Once the distribution of the variables has been determined and correlations calculated, the data will be used to estimate the regression equations and determine the association between geographic/demographic and governance/policy variables and student outcomes. The regression model will determine which quality and equity variables are significantly associated with math proficiency and college enrollment. This study defines equity in education as the fair and just distribution of learning opportunities and resources. The opportunity to be taught by a well-qualified teacher is a vital resource for students. The opportunity to teach and learn in a safe, supportive environment is a valuable resource for teachers and students. Analyzing the extent to which students and teachers have equal access to these school resources is the primary focus of this study.

Hawai‘i State Department of Education

Hawai‘i is the only state with a single statewide public school district. The Hawai‘i State Department of Education is the centralized organization that governs 293 public schools, about 180,000 students, and 13,000 teachers across seven islands (HIDOE 2019b). According to the Accountability Resource Center Hawai‘i, Hawai‘i’s public school system comprises 256 Department schools and 37 charter schools, educating 85% of the total K-12 student enrollment in Hawai‘i. Charter schools serve less than 5%, and private schools serve about 33,000, or 16% of Hawai‘i students, the country's highest percentage of private school enrollment (Wong, 2014). The promise of Hawai‘i’s public school system is “high-quality” schools serving our communities by “ensuring equity, empowerment, and excellence in education for all students” (HIDOE, 2022b). This promise aligns with the mission of the U.S. Department of Education which is “to promote student achievement and preparation for global competitiveness by

fostering educational excellence and ensuring equal access" (U.S. Department of Education, n.d.). This study examines equitable access and excellence in Hawai‘i's public schools.

Hawai‘i's public schools are divided among seven districts, four on O'ahu, with three additional districts on Hawai‘i Island, Maui, and Kaua‘i. Each district is subdivided into what are called *complex areas*; there are 15 total complex areas in the state, nine on O'ahu, three on Hawai‘i Island, two on Maui, and one on Kaua‘i. These complex areas are administrative units that are made up of two or more complexes. A complex is a term assigned to a smaller division within a complex area that consists of a high school and the elementary and middle or intermediate schools that are within the attendance boundary of the high school (HIDOE, 2016). There are 41 complexes, with 41 high schools serving roughly 50,000 students in grades 9-12. This study focuses on 41 public high schools in Hawai‘i. With the complexity of statewide public school governance and 293 schools in a single district, effective policy implementation and oversight are reasonable areas of examination for improvement.

One of the independent variables is geographic location. The high school's location, whether considered a "Town" or "Country" school in the study, was determined by the population density of the school's complex. If the population density within the high school's geographic location is greater than 30,000, it is considered a "Town" school, and if less than 30,000, it is regarded as a "Country" school. This analysis examines variables of quality, equity, and outcomes in 41 high schools from Hawai‘i's seven school districts: Honolulu, Central, Leeward, Windward, Hawai'i, Maui, and Kaua‘i. The Honolulu District is divided into two complex areas: Farrington-Kaiser-Kalani Complex Area and Kaimuki-McKinley-Roosevelt Complex Area (see Figure 10). Within these complex areas, there are six complexes and seven

high schools. The Farrington Complex includes nine elementary schools, two middle schools, and Farrington High School.

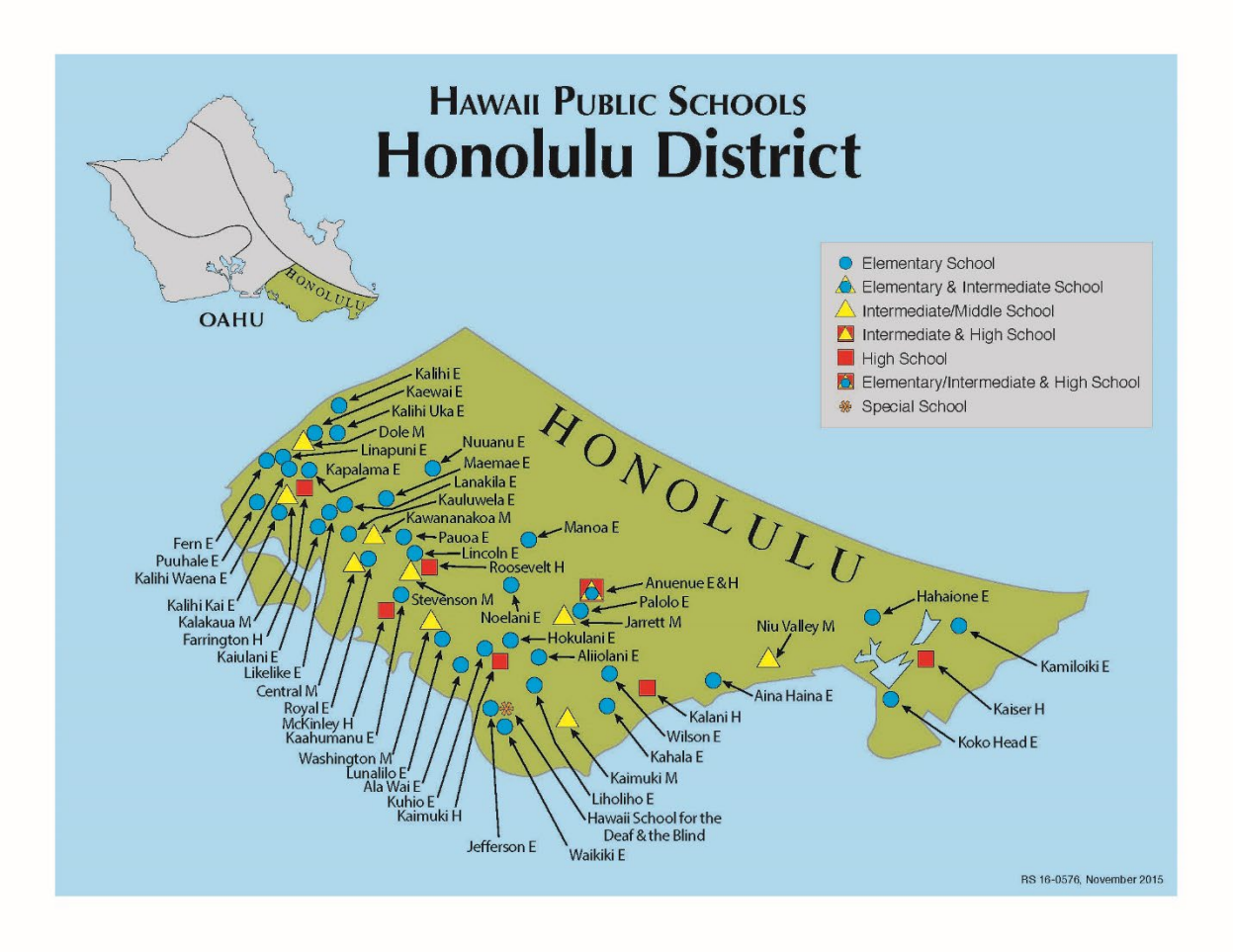


Figure 10. Honolulu District.

The high schools are indicated on the map by a red square and are in the highlighted region on the south side of the island of O'ahu. One high school in the district is not included in the analysis. Kula Kaiapuni 'O Anuenue is a public Hawaiian Immersion school, and because of the small student population, the data is unavailable to maintain student confidentiality. Farrington, Kaiser, Kalani, Kaimuki, McKinley, and Roosevelt High School are considered "Town" schools based on the population density of these six complexes.

In the Central O‘ahu school district, there are two complex areas and six complexes (see Figure 11).

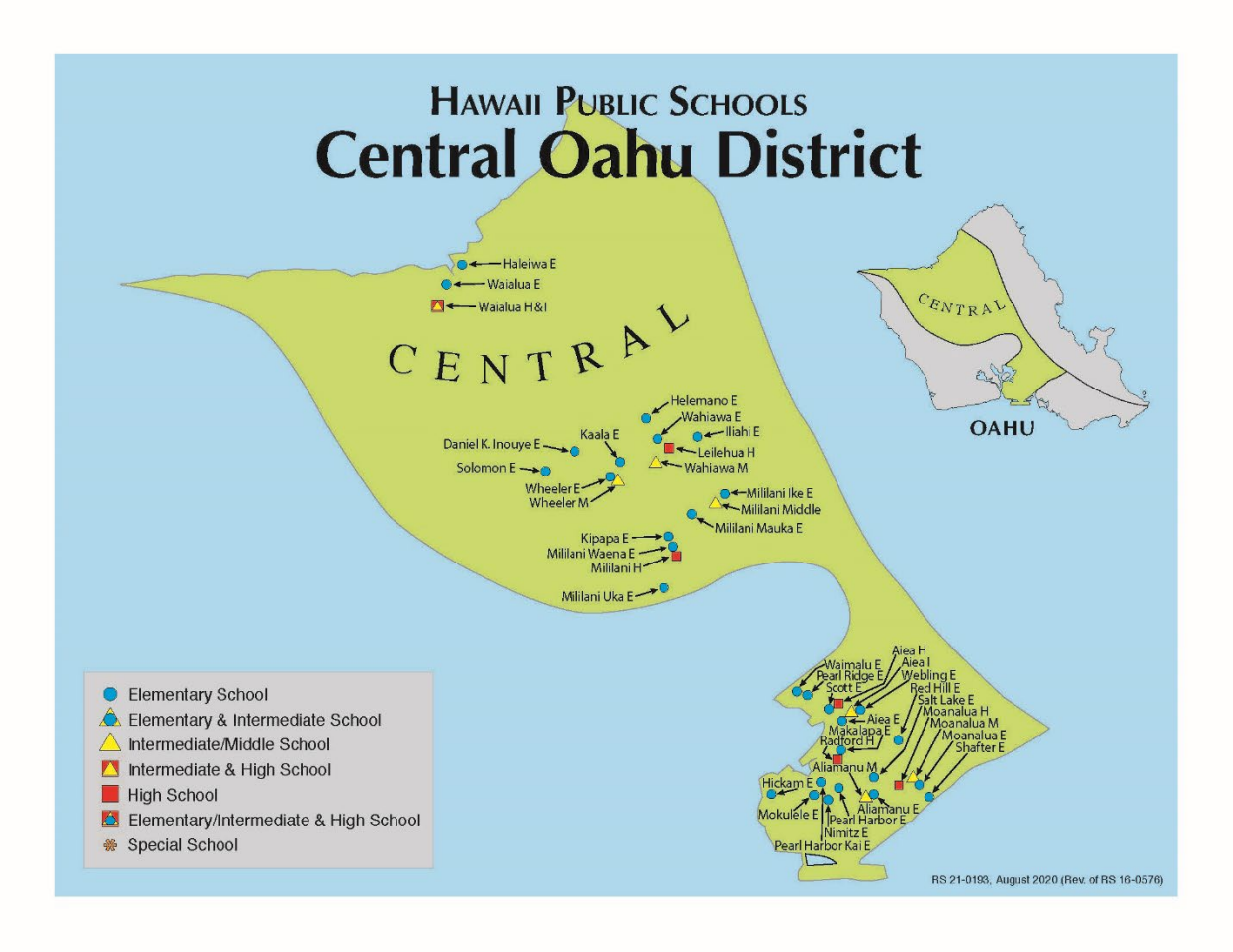


Figure 11. Central O‘ahu District.

In the northern region is the Leilehua-Mililani-Waialua Complex Area and located to the south is the Aiea-Moanalua-Radford Complex Area. The high schools in the Central District included in the Study of Educational Equity in Hawai‘i (SEE-HI) are noted by the red squares. All the high schools in Central Oahu District are “Town” schools except for Waialua High & Intermediate School. The population density of Waialua’s complex is 11,772, well below 30,000,

which identifies it in the study as a “Country” school (HIDOE, 2019c). Waialua High School is also a non-traditional school because the intermediate and high school students share the campus.

A map of the Leeward District shows the regional section of O‘ahu that comprises three complex areas and six complexes (see Figure 12).

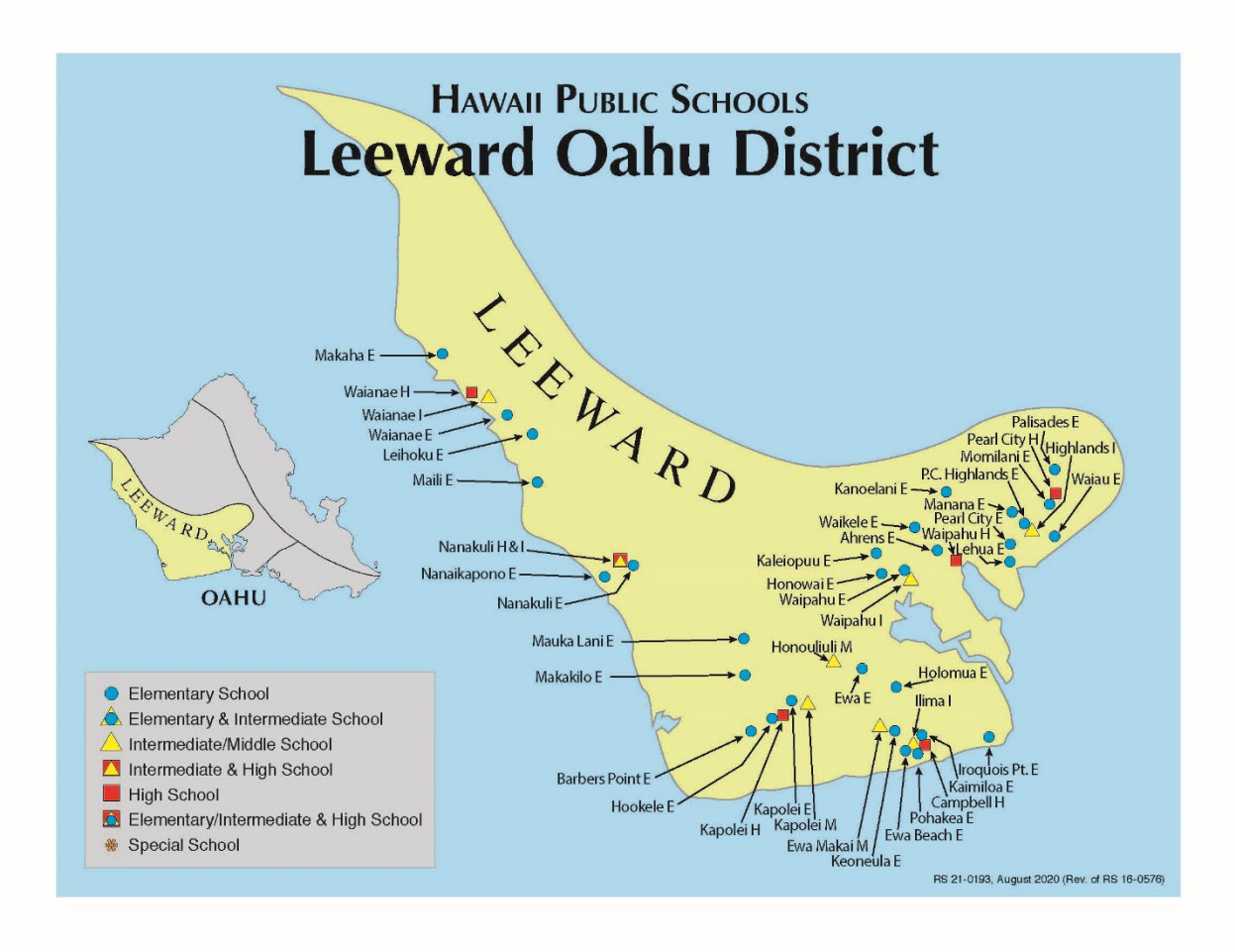


Figure 12. Leeward O‘ahu District.

This map identifies the complex areas; Campbell-Kapolei Complex Area is in the southwest region, Nanakuli-Waianae Complex Area takes in the far west region, and the Pearl City-Waipahu Complex Area covers more central O‘ahu. The six high schools marked on the

map and included in this study are Campbell, Kapolei, Nanakuli, Waianae, Pearl City, and Waipahu. Waianae and Nanakuli High Schools are considered “Country” schools in the Leeward District, and the other four are “Town” schools with population densities over 30,000. Campbell’s total population within the complex community is 62,735 (HIDOE, 2019c).

The fourth school district on O‘ahu is the Windward District which is divided into two complex areas, Castle-Kahuku and Kailua-Kalaheo, with two complexes in each area. This region extends from the island's north side to the southeast shores (see Figure 13). The cross-section of the island is shown on the map and includes four high schools in the SEE-HI study; Castle, Kahuku, Kailua, and Kalaheo. Castle and Kalaheo are “Town” schools and Kahuku and Kailua are “Country” schools. Olomana Intermediate and High School is also in the Kailua Complex Windward District, as noted on the map. This school serves at-risk students from Windward O‘ahu’s secondary schools, incarcerated youth attending the Hawaii Youth Correctional Facility, and students in transit. Due to the small student population at Olomana, complete data is unavailable, and this school will not be included in the study.

Figure 13. Windward Oʻahu District.

On Hawaiʻi Island, there are three complex areas and nine complexes that make up the Hawaiʻi District (see Figure 14). The Hilo-Waiakea Complex Area includes Hilo and Waiakea High School and is located on the east side. Both schools serve a population density of less than 30,000 and are designated "Country" schools. To the south of these schools is the Kau-Keaau-Pahoa Complex Area, and all three schools within this complex area are also "Country" schools. The third complex area includes Honokaa High and Intermediate School and Kohala High School along the north shore of the island. Kealakehe and Konawaena High School serve the west side of the island. All these schools are "Country" schools except Kealakehe High School,

with a population density within the Kealakehe Complex of 42,511. There is another high school in the district, Ke Kula ʻo ʻEhunuikaimalino, a public Hawaiian Immersion school, and because of the small student population, to maintain student confidentiality, data was unavailable; thus, the school is not included in the study.

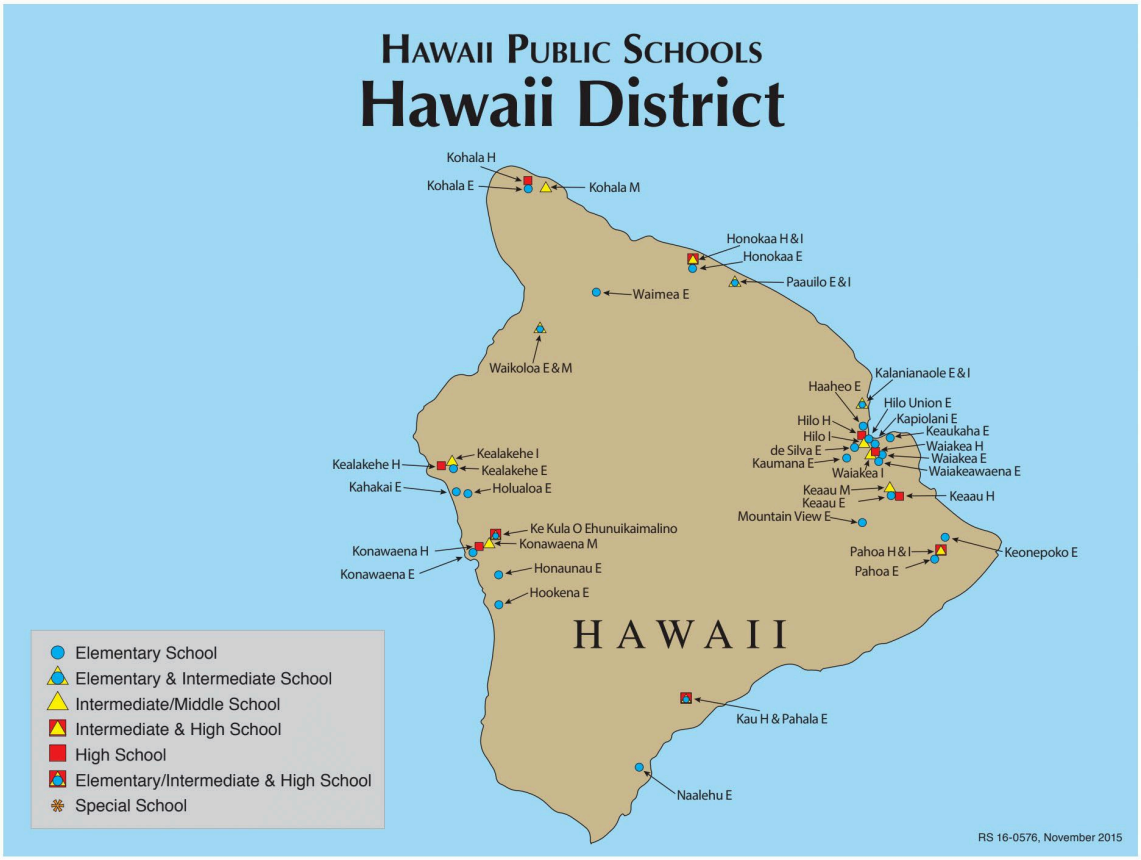


Figure 14. Hawaiʻi District.

The Maui District encompasses high schools located on three separate islands. On the island of Maui, there are five high schools in the study and two complex areas. Baldwin, King Kekaulike, and Maui High School are in the complex area located in central Maui. All three of these high schools are "Town" schools based on the populations they serve. A new high school

in this complex area just opened for the 2022-23 school year to serve the Kihei Complex. The other Maui Complex Area includes Hana and Lahainaluna, both "Country" schools on opposite sides of the island. The high schools on Molokai and Lanai are also part of Maui's second complex area, the Hana-Lahainaluna-Lanai-Molokai Complex Area. Lanai and Molokai High Schools are "Country" schools in the study (see Figure 15).

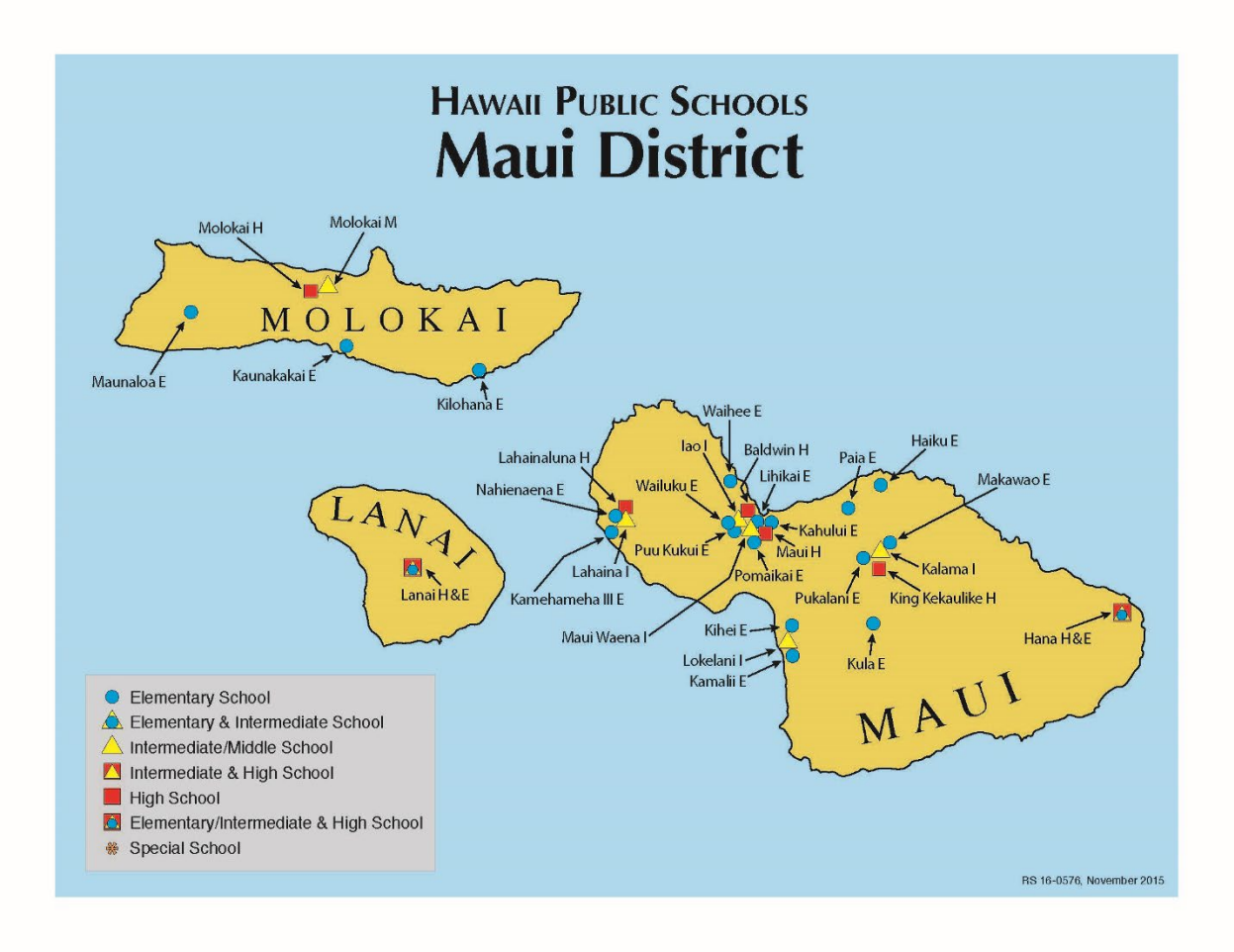


Figure 15. Maui District.

Kauai District comprises three complexes, Kauai, Kapaa, and Waimea. These three complexes form a complex area. All three high schools are "Country" schools in SEE-HI. Niʻihau High & Elementary is part of the Waimea Complex, but due to the small student

enrollment, data from this school is unavailable and will not be included in the analysis (see Figure 16). There are 41 public high schools, 21 town schools, 20 country schools, 3,273 teachers, and 49,863 students from six Hawaiian Islands in the Study of Educational Equity in Hawai‘i.

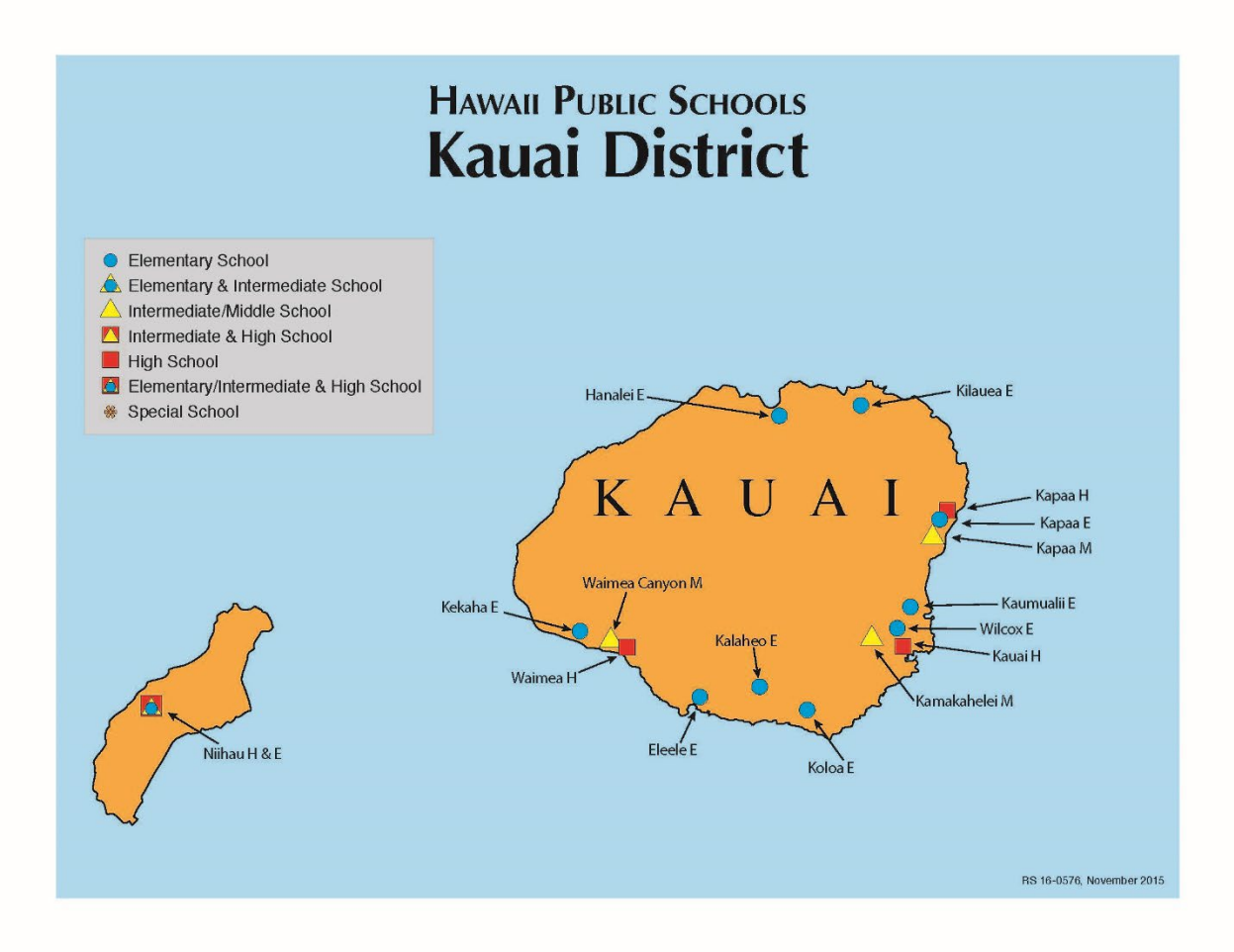


Figure 16. Kauai District.

Data Analysis

The data for this Study of Educational Equity in Hawai‘i will be stored and analyzed in Excel and SPSS. The variables used in the analyses are in Table 4, and the descriptive statistics are presented in Table 5. The mean percentage of students meeting math proficiency standards in Hawai‘i’s public high schools is 27%. The highest percentage of student math proficiency is 50% at Kalani High School. The lowest percentage is 3% at Waianae High School and Lanai High & Elementary School (see Table 4). The mean percentage of students enrolled in college the fall after graduation is 53%. The percentages range from 80% at Kalani High School to 32% at Pahoa High & Intermediate School. Kalani High School has the highest percentage of students meeting math proficiency standards and the highest percentage of college enrollment of the forty-one high schools in the state (see Tables 4 and 5).

Table 4. SEE-HI Research Variables

School	Math Proficiency	College Enrollment	Qualified Teaching	SES	Ethnicity	Location	Climate	Learning Environment
Aiea	21%	57%	55%	49%	61%	1	80%	4
Baldwin	20%	49%	50%	45%	68%	1	72%	5
Campbell	21%	51%	28%	36%	68%	1	71%	6
Castle	34%	55%	42%	45%	58%	1	68%	4
Farrington	20%	47%	52%	67%	94%	1	74%	3
Hana	5%	43%	28%	61%	77%	0	63%	6
Hilo	31%	57%	79%	68%	72%	0	72%	2
Honokaa	16%	44%	47%	65%	75%	0	62%	3
Kahuku	25%	34%	45%	49%	67%	0	70%	3
Kailua	26%	43%	50%	50%	65%	0	77%	6
Kaimuki	18%	48%	62%	58%	63%	1	71%	4
Kaiser	48%	79%	91%	14%	22%	1	80%	5
Kalaheo	41%	66%	70%	24%	23%	1	67%	5
Kalani	50%	80%	80%	19%	16%	1	76%	5
Kapaa	34%	50%	73%	43%	54%	0	68%	3
Kapolei	32%	46%	45%	40%	67%	1	74%	7
Kau	7%	38%	56%	100%	80%	0	60%	3
Kauai	37%	59%	81%	42%	65%	0	77%	4
Keaau	27%	43%	67%	91%	67%	0	61%	5
Kealakehe	26%	48%	48%	57%	59%	1	67%	4
Kekaulike	28%	55%	67%	49%	45%	1	75%	7
Kohala	33%	46%	78%	61%	71%	0	59%	3
Konawaena	29%	34%	43%	64%	59%	0	76%	3
Lahainaluna	17%	43%	74%	44%	64%	0	63%	7
Lanai	3%	50%	33%	34%	78%	0	66%	4
Leilehua	30%	48%	84%	53%	57%	1	74%	5
Maui	28%	51%	65%	44%	71%	1	75%	7
McKinley	33%	71%	75%	66%	53%	1	78%	6
Mililani	39%	71%	71%	20%	42%	1	79%	6
Moanalua	38%	66%	83%	29%	42%	1	85%	5
Molokai	16%	54%	69%	74%	92%	0	53%	4
Nanakuli	6%	37%	33%	85%	91%	0	74%	6
Pahoa	31%	32%	31%	100%	69%	0	64%	3
Pearl City	47%	61%	83%	34%	56%	1	74%	5
Radford	31%	51%	66%	29%	35%	1	76%	5
Roosevelt	45%	75%	77%	38%	34%	1	76%	5
Waiakea	40%	69%	82%	51%	54%	0	83%	3
Waialua	16%	55%	28%	46%	55%	0	76%	3
Waianae	3%	40%	33%	83%	87%	0	71%	5
Waimea	23%	59%	23%	49%	76%	0	74%	4
Waipahu	34%	52%	67%	54%	91%	1	81%	6

Table 5. SEE-HI Descriptive Statistics

Descriptive Statistics	Math Proficiency	College Enrollment	Qualified Teaching	SES	Ethnicity	Location	Climate	Learning Environment
Mean	27.05%	52.61%	58.88%	51.95%	62.02%	0.512	71.76%	4.610
Median	28.00%	51.00%	65.00%	49.00%	65.00%	1	74.00%	5
Mode	31.00%	43.00%	28.00%	49.00%	67.00%	1	74.00%	5
Std. Dev.	12.19%	12.10%	19.43%	20.62%	18.76%	0.506	7.07%	1.358
Minimum	3.00%	32.00%	23.00%	14.00%	16.00%	0	53.00%	2
Maximum	50.00%	80.00%	91.00%	100.00%	94.00%	1	85.00%	7
Count	41	41	41	41	41	41	41	41

Student access to qualified or state-certified math teaching ranges from 91% at Kaiser High School to 23% at Waimea High School. School's proportions of low SES students range from 100% at Kau High and Pahoa High Schools to 14% at Kaiser High School. The distributions indicate that Kaiser High School has the lowest percentage of economically disadvantaged students and the highest percentage of access to qualified math teachers. The Kaiser community is primarily upper-middle class, according to the school's profile and history, "Per capita income and home ownership are the second highest in the state". These distributions suggest that schools serving high SES students also have greater access to qualified teaching and educational resources.

The ethnicity variable is a composite variable denoting the share of the high school population composed of three underrepresented groups, Hawaiian, Filipino, and Pacific Islander. The highest proportion of these three subgroups is 94% at Farrington High School and the lowest proportion is 16% at Kalani High School. Kalani High School also has the highest percentage of math proficiency and college enrollment, suggesting a relationship between access to higher education, math proficiency, and underrepresented ethnic subgroups. The distributions of schools in terms of student outcomes also indicate that town schools have higher percentages of students

meeting math proficiency and higher percentages of college enrollment. Of the top ten schools for both outcome variables, eight out of ten were town schools.

Positive School Climate, measuring levels of student support, ranged from 85% at Moanalua High School to 53% at Molokai High School. Seven of the top ten schools reporting positive school climate were town schools, which serve the lowest proportions of economically disadvantaged students, another indication that students with the least amount of support at home also feel the least supported at school. The learning environment was assessed on a scale of 1 to 10 for cleanliness, safety, and functionality. According to the HIDOE Facilities Inspection Tool, a rating of 1-4 is critical, 4-6 poor, 6-8 fair, and 8-10 is in good condition. The level of safety and cleanliness in learning spaces is another measure of student and teacher support. The average overall condition of Hawai‘i’s public school facilities was 4.61, a critical to poor rating; the high was 7 and the low 2. All ten of the lowest ratings of 2-3, indicating learning environments are in critical condition, were in country schools serving the highest proportions of economically disadvantaged and underrepresented minority groups. The notes section of one school report receiving a critical condition rating reads, “Theft on campus is a constant issue as well as the presence of drug paraphernalia and human feces. Trespassing on campus is frequent and the restrooms need maintenance” (HIDOE, 2023a).

Conclusion

Hawai‘i spends less than any other state per student per year and ranks last in the country for educational capital improvement funding and facilities, last for cost-adjusted teacher pay, and last for government expenditures on public education. This poor ranking places Hawai‘i at the bottom of the United States, which is at the bottom of developed countries internationally, for

investing in educationally at-risk and underrepresented students. The last placement means as the educational opportunity gap between students of privilege and high-poverty students continues to widen in Hawai'i schools, compared with the rest of the world, Hawai'i is doing the least about it. Even within the public school system, there is a vast range of differences in educational opportunities available to students depending on the school district in which they live. Private and charter schools are not an option for most children living in rural communities. Darling-Hammond argues that there are "real differences in the services provided in schools: higher-spending districts have smaller classes, higher-paid and more experienced teachers, and greater instructional resources, as well as better facilities, more up-to-date equipment, and a wider range of course offerings. Districts serving a large proportion of poor children have fewer resources. Thus, those students least likely to encounter an array of educational resources at home are also the least likely to encounter them at school" (2004, p. 610).

This study contributes valuable quantitative analysis of school data and visual images documenting student equity or inequity and the distribution of resources in public high schools. SEE-HI aims to inform future efforts to improve access to quality educational opportunities for underserved students, families, and communities in Hawai'i.

CHAPTER 4. RESULTS AND FINDINGS

Correlation Results

Preliminary analyses and correlations between the seven school-level variables are summarized in Table 6. Asterisks identify the statistically significant relationships. Several correlations between explanatory variables were statistically significant. Notably, all the predictor variables are strongly associated with Math Proficiency, except Learning Environment. Math Proficiency is negatively correlated with Socioeconomic Status and Ethnicity, meaning as the percentage of low SES and underrepresented students increases, Math Proficiency decreases. Conversely, significant positive correlations exist between Math Proficiency, Location, Qualified Teaching, and school Climate, suggesting town schools have higher qualified math teaching, higher percentages of positive school climate, and higher math proficiency. High School SES is also strongly correlated with Ethnicity and Location, suggesting that country schools serve higher proportions of economically disadvantaged students and higher proportions of underrepresented ethnic groups—Hawaiian, Filipino, and Pacific Islander.

Table 6. Math Proficiency Correlations

	1	2	3	4	5	6	7
1 Math Proficiency	1.000						
2 Socioeconomic Status	-0.550 ***	1.000					
3 Ethnicity	-0.721 ***	0.684 ***	1.000				
4 Location	0.470 ***	-0.529 ***	-0.467 **	1.000			
5 Qualified Teaching	0.687 ***	-0.344 *	-0.500 ***	0.317 *	1.000		
6 Climate	0.458 **	-0.492 ***	-0.393 **	0.462 **	0.241	1.000	
7 Learning Environment	0.051	-0.310 *	-0.148	0.444 **	0.072	0.232	1.000

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

Qualified Teaching is significantly and positively correlated with Math Proficiency (r = .687). In other words, access to licensed math teaching helps to explain the variability in school-level math proficiency, and higher percentages of qualified math teachers are associated with higher percentages of math proficiency. The relationships are shown in the plot, r = .687, n = 41, p < .001, and R^2 = .4719 (see Figure 17). R-squared indicates that 47% of the variability in math proficiency is explained by the percentage of qualified math teachers in the high school. The strong, positive correlation between these two variables means that as the number of qualified math teachers increases, the number of students meeting math proficiency increases.

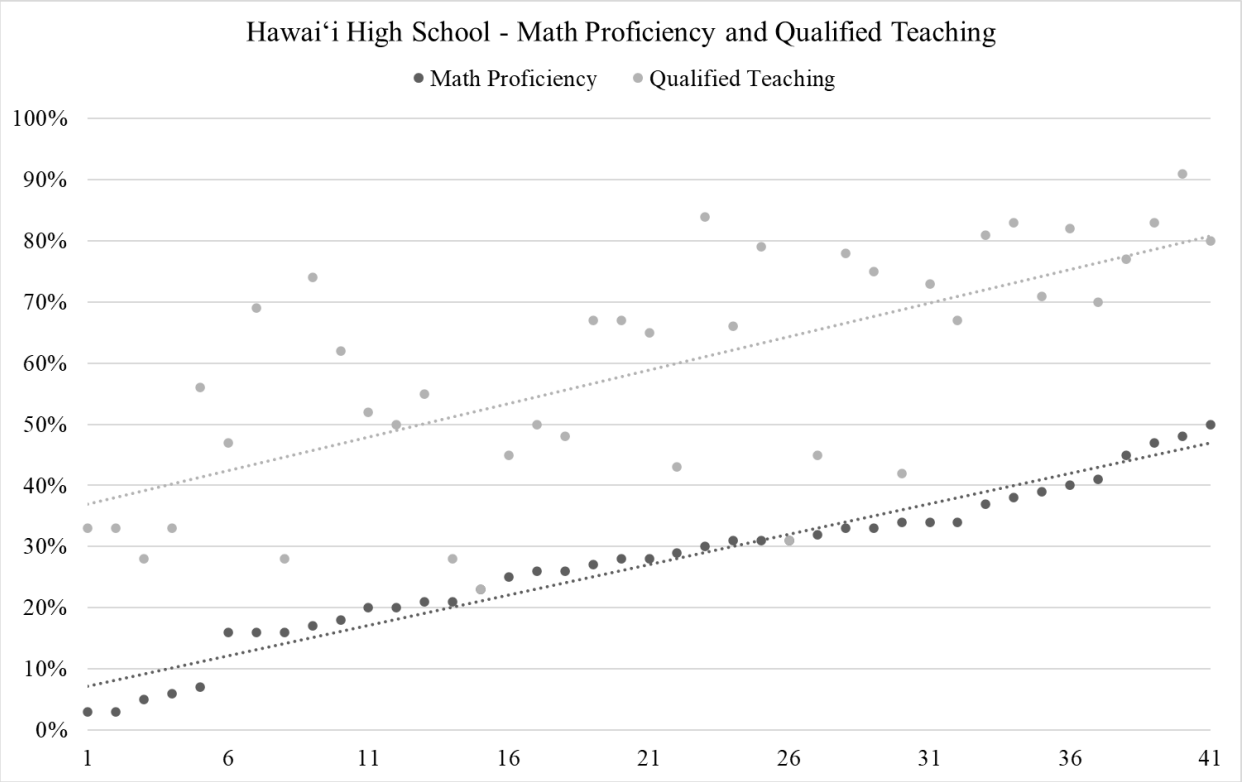


Figure 17. Correlation Analysis of Qualified Math Teaching and Math Proficiency

Ethnicity is negatively correlated with Qualified Teaching meaning schools that serve higher proportions of underrepresented ethnicities in higher education also have the lowest

proportions of qualified math teachers. The strong, negative correlation between Qualified Teaching and Ethnicity is shown in Figure 18, $r = -.500$, $n = 41$, $p < .001$, $R^2 = .250$, suggesting schools serving higher percentages of students of Hawaiian, Filipino, and Pacific Islander ethnicity have significantly lower percentages of qualified or certified math teachers. A negative correlation means that as one variable increases, in this case, the percentage of Hawaiian, Filipino, and Pacific Islander students, the other variable decreases which is the percentage of qualified math teachers. Therefore, access to licensed math teaching decreases in public schools serving higher proportions of Hawaiians, Filipinos, and Pacific Islanders.

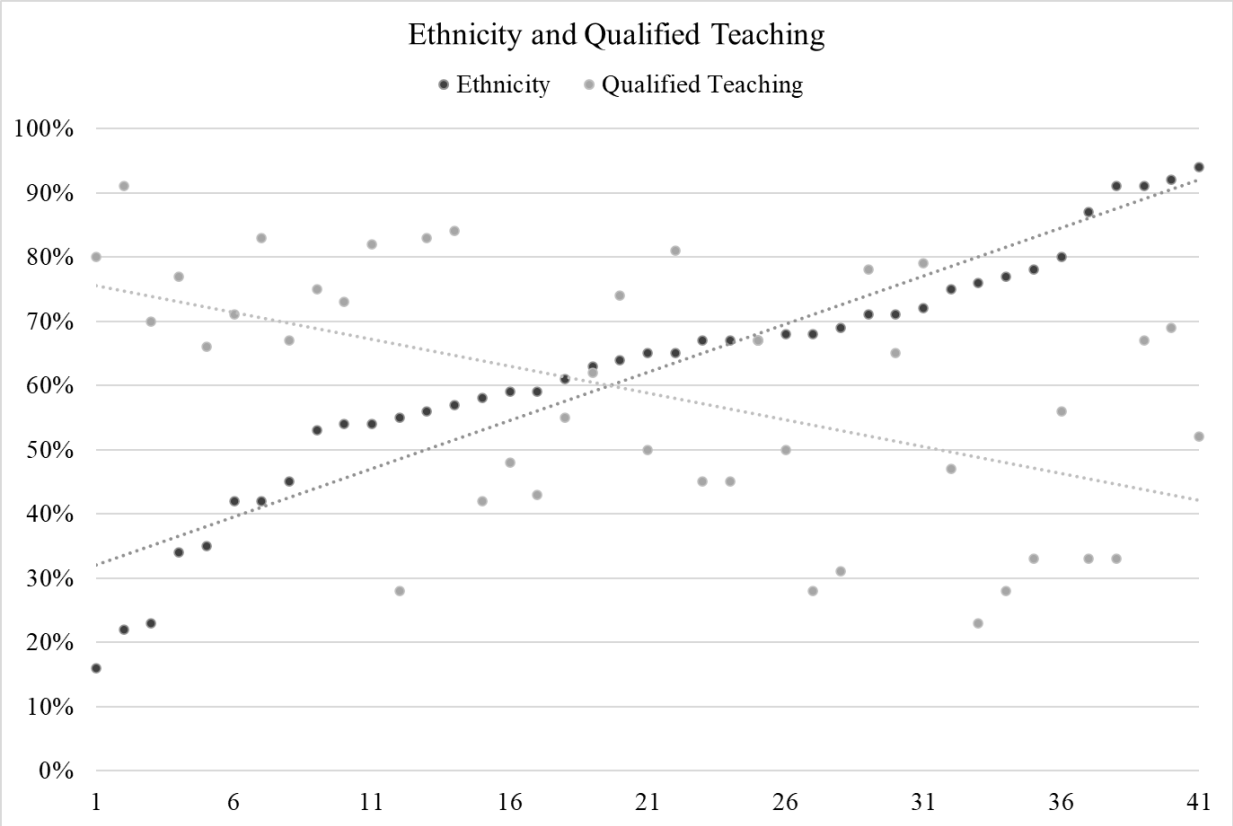


Figure 18. Correlation Analysis of Qualified Math Teaching and Ethnicity

Results of the correlations between college enrollment and the six explanatory variables are presented in Table 7. There is a statistically significant correlation between the percentage of students enrolled in college following graduation and almost all the explanatory variables. Socioeconomic Status and Ethnicity are negatively correlated with College Enrollment, meaning as the percentage of low SES and underrepresented students increases, the college-going rate decreases at the school level. Location, Qualified Teaching, and Climate are all positively correlated with College Enrollment, indicating town schools and schools with higher percentages of licensed math teachers and positive school climates have higher percentages of college enrollment.

Table 7. College Enrollment Correlations

	1	2	3	4	5	6	7
1 College Enrollment	1.000						
2 Socioeconomic Status	-0.664 ***	1.000					
3 Ethnicity	-0.680 ***	0.684 ***	1.000				
4 Location	0.499 ***	-0.529 ***	-0.467 **	1.000			
5 Qualified Teaching	0.583 ***	-0.344 *	-0.500 ***	0.317 *	1.000		
6 Climate	0.499 ***	-0.492 ***	-0.393 **	0.462 **	0.241	1.000	
7 Learning Environment	0.153	-0.310 *	-0.148	0.444 **	0.072	0.232	1.000

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

Learning Environment was the only variable not found to be significantly associated with college enrollment. Possibly because the average condition of all public school facilities was found to be in critical or poor condition; therefore, the variance in the quality of learning environments were not significant enough to determine a relationship with the student outcomes. However, there was a significant negative association between Learning Environment and the percentage of low SES students, suggesting that schools with high proportions of economically

disadvantaged students have lower-quality learning environments. Learning Environment was also positively associated with school Location, suggesting that Hawai‘i’s town schools have higher-quality learning environments than country schools. The significant strong positive correlation between Qualified Teaching and both student outcomes, Math Proficiency and College Enrollment, supports the view that teacher “preparation and certification are legitimate criteria for entry into the profession” (Heck, 2007, p. 406). Correlation is a preliminary analysis of multiple regression. Multiple regression determines how well the set of variables predicts student outcomes, which variable is the best predictor, and how much variance in student achievement can be explained by demographic, geographic, and policy-associated variables (Pallant, 2013).

Multiple Regression Results

Math Proficiency

After we account for high school socioeconomic status, ethnicity, geographic location, school climate, and learning environment, what is the relationship between licensed mathematics teaching and math proficiency in Hawai‘i’s public high schools?

Data analyses and correlation results were used to inform an empirical investigation of the association of multiple independent variables and Math Proficiency using regression analysis. Multiple regression is based on correlation “but allows a more sophisticated exploration of the interrelationship among a set of variables” (Pallant, 2013, p. 154). In this study, multiple regression statistically controls the variance explained by demographic, geographic, and governance variables and determines the relationship of access to licensed mathematics teaching

and Math Proficiency. The distribution of schools in terms of their proportion of students meeting math proficiency standards is shown in Figure 19.

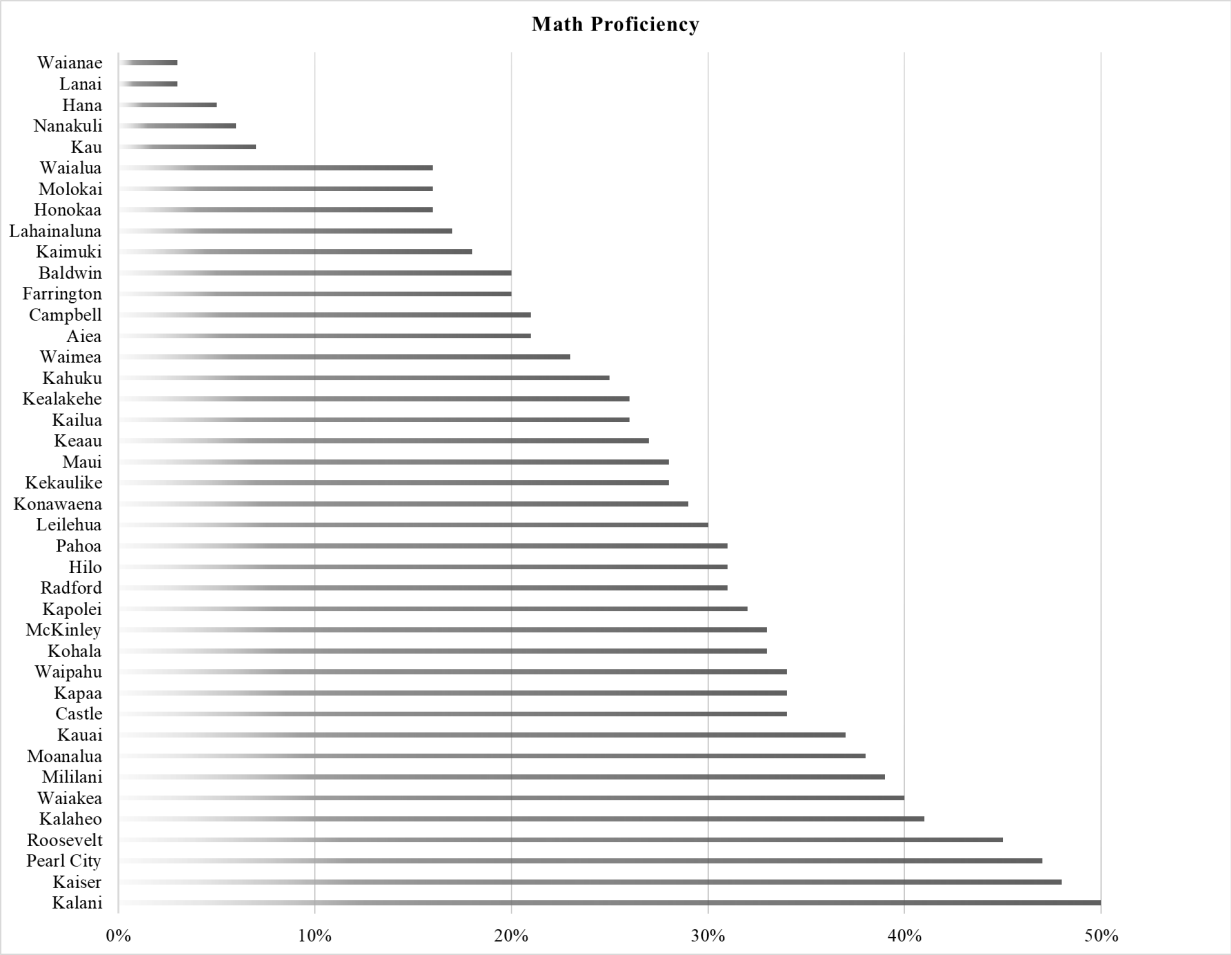


Figure 19. SEE-HI Math Proficiency.

Graph of Hawai‘i high schools and the percentage of 11th-grade students meeting Math Proficiency Standard on the Smarter Balanced Mathematics Assessment.

This study examines the magnitude and significance of variable relationships and develops an equation for making predictions about Math Proficiency based on the observed values of the variables. There are three main types of multiple regression analyses: standard,

hierarchical or sequential, and stepwise (Pallant, 2013). Using sequential or hierarchical regression, the demographic and geographic variables are entered as Model 1 data. Model 2 includes the same three variables, controlling for their influence, and adds the three policy or governance variables. The unique relationship of each policy-controlled variable is examined contolling for demographic and geographic variables. The overall model is measured in terms of its ability to predict Math Proficiency, and the contribution of each block of variables is also assessed (see Table 8).

Table 8. SEE-HI Math Proficiency Regression Model Summary.

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.737[a]	.544	.507	8.56120%	.544	14.699	3	37	<.001
2	.842[b]	.709	.658	7.12935%	.166	6.451	3	34	.001

a. Predictors: (Constant), Location, Ethnicity, Socioeconomic Status

b. Predictors: (Constant), Location, Ethnicity, Socioeconomic Status, Learning Environment, Qualified Teaching, Climate

c. Dependent Variable: Math Proficiency

Model 1, which included demographic and geographic variables, explains 54.4% of the variance in Math Proficiency. After adding the policy-controlled or governance variables (Learning Environment, Climate, and Qualified Teaching), Model 2 explains 70.9% of the variance in Math Proficiency. The column labeled R Square Change indicates how much of the variability is explained by policy-associated variables, after controlling for Location, Ethnicity, and SES. The R Square Change value is 16.6%, which means that Learning Environment, School Climate, and access to licensed math teaching explain an additional 16.6% of the variance in Math Proficiency after controlling for demographic and geographic differences. This is a statistically significant change and contribution, as indicated by the column labeled Sig. F Change, and the value (.001).

The ANOVA table indicates the results of the model are statistically significant. Based on hypothesis tests, both Model 1, which included Location, Ethnicity, and SES, and Model 2, which included all six explanatory variables, are statistically significant as shown in the column labeled Sig, $p < .001$ (see Table 9).

Table 9. SEE-HI Math Proficiency Regression ANOVA

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3232.018	3	1077.339	14.699	<.001[b]
	Residual	2711.884	37	73.294		
	Total	5943.902	40			
2	Regression	4215.761	6	702.627	13.824	<.001[c]
	Residual	1728.142	34	50.828		
	Total	5943.902	40			

a. Dependent Variable: Math Proficiency

b. Predictors: (Constant), Location, Ethnicity, Socioeconomic Status

c. Predictors: (Constant), Location, Ethnicity, Socioeconomic Status, Learning Environment, Qualified Teaching, Climate

The first part of the analysis assessed the ability of Model 2 to predict Math Proficiency and the unique contribution of each block of variables. ANOVA results indicate that both models were statistically significant, with $p < .001$. Model 2 explained 71% of the variance in Math Proficiency, with 17% of the variance explained by policy-contolled variables.

The next part of the analysis evaluates the unique relationship of each independent variable and Math Proficiency, controlling for the other variables in the model. The regression coefficients, or Beta values, represent the partial correlations. The unique relationships of the independent variables and math proficiency can be compared by looking at the column labeled Standardized Coefficients Beta (Pallant, 2013). The variable with the largest beta value makes

the strongest unique contribution to the final equation (Pallant, 2013). The significance of the contribution is shown in the "Sig." column. The variable with the largest Beta coefficient is access to Qualified Math Teaching. The Beta coefficient for Qualified Math Teaching is .411, which represents the unique relationship of the variable after controlling for the other covariates in the model. The "Sig." column indicates that Qualified Teaching and Ethnicity are statistically significant predictors of math proficiency (see Table 10).

Table 10. SEE-HI Math Proficiency Regression Coefficients

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Correlations			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	51.339	6.371		8.058	<.001					
	Socioeconomic Status	-.027	.095	-.045	-.280	.781	-.550	-.046	-.031	.476	2.101
	Ethnicity	-.401	.100	-.617	-3.992	<.001	-.721	-.549	-.443	.517	1.935
	Location	3.803	3.200	.158	1.189	.242	.470	.192	.132	.699	1.431
2	(Constant)	13.122	16.845		.779	.441					
	Socioeconomic Status	-.026	.083	-.045	-.318	.752	-.550	-.054	-.029	.433	2.307
	Ethnicity	-.250	.091	-.384	-2.750	.009	-.721	-.427	-.254	.438	2.284
	Location	3.015	2.974	.125	1.014	.318	.470	.171	.094	.561	1.783
	Qualified Teaching	.258	.068	.411	3.815	<.001	.687	.547	.353	.738	1.356
	Climate	.278	.191	.161	1.459	.154	.458	.243	.135	.699	1.430
	Learning Environment	-1.276	.945	-.142	-1.351	.186	.051	-.226	-.125	.772	1.295

a. Dependent Variable: Math Proficiency

Access to licensed mathematics teaching and the composite variable of underrepresented ethnic groups are the only variables that can still predict a significant amount of the variance in math proficiency when the other variables are controlled. Variables not making significant unique contributions may have overlapping influences with other variables in the model (Pallant, 2013). The "Part" correlation coefficient can be squared to determine the total variance uniquely explained by access to licensed math teaching. Access to Qualified Math Teaching is 12.46% (.353*.353) of R Square; the total explained variance in Math Proficiency. The unstandardized coefficients listed as B values are used to construct the Regression Equation. The B value for Qualified Teaching suggests that as the percentage of qualified math teachers increases by 1%,

math proficiency will increase by 0.258%. Based on the B values, the constructed Math Proficiency Regression Equation takes the following form:

$$\% \text{ Math Proficiency} = ß_o + ß_1(SES) + ß_2(ETH) + ß_3(LOC) + ß_4(QMT) + ß_5(CLI) + ß_6(LE) + \varepsilon$$

$$\hat{Y} = 13.122 - .026(SES) - .25(ETH) + 3.015(LOC) + .258(QMT) + .278(CLI) - 1.276(LE)$$

The percentage of Math Proficiency in Hawai‘i high schools is the outcome variable. The predictor variables are Socioeconomic Status (SES), Ethnicity (ETH), Location (LOC), Qualified Math Teaching (QMT), School Climate (CLI), and Learning Environment (LE), and a residual value added to account for error.

The results of the model are summarized in Table 11. Hierarchical multiple regression was used to assess the ability of three policy/governance measures (Qualified Teaching, Climate, and Learning Environment) to predict Math Proficiency after controlling for the influence of Socioeconomic Status, Ethnicity, and Location. Preliminary analyses were conducted to ensure no violation of normality, linearity, multicollinearity, and homoscedasticity assumptions. Socioeconomic Status, Ethnicity, and Location were entered in Model 1, explaining 54% of the variance in Math Proficiency. After the entry of Qualified Teaching, Climate, and Learning Environment in Model 2, the total variance the model explained was 71%, F (6, 34) = 13.82, $p <$ .001. The three policy-controlled measures explained an additional 17% of the variance in Math Proficiency after controlling for Socioeconomic Status, Ethnicity, and Location, R squared change = .17, F change (3, 34) = 6.45, $p < .001$. In the final model, only Qualified Teaching and Ethnicity were statistically significant, with Qualified Teaching recording a higher beta value (*Beta* = .41, $p < .001$) than Ethnicity (*Beta* = -.38, $p < .009$).

Table 11. Multiple Regression Predicting Math Proficiency.

Independent Variable	Model 1		Model 2	
	B	S.E	B	S.E
Constant	51.339 ***	6.371	13.122	16.845
Socioeconomic Status	-0.027	0.095	-0.026	0.083
Ethnicity	-0.401 ***	0.1	-0.25 **	0.091
Location	3.803	3.2	3.015	2.974
Qualified Teaching			0.258 ***	0.068
Climate			0.278	0.191
Learning Environment			-1.276	0.945
R^2	0.544 ***		0.709 ***	

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

College Enrollment

After we account for high school socioeconomic status, ethnicity, geographic location, school climate, and learning environment, what is the relationship between licensed mathematics teaching and college enrollment in Hawai‘i’s public high schools?

The second research question examines the relationship between College Enrollment and the same six explanatory variables, socioeconomic status, ethnicity, geographic location, school climate, learning environment, and access to licensed mathematics teaching. An empirical investigation of educational equity and school quality variables impacting College Enrollment is also explored using hierarchical or sequential regression. Multiple regression statistically determines the unique relationship of each independent variable while controlling for the other variables. Regression analysis determines which variables are significantly associated with

College Enrollment. The distribution of schools in terms of their proportion of College Enrollment is shown in Figure 20 as reported in the Strive-HI School Performance Reports.

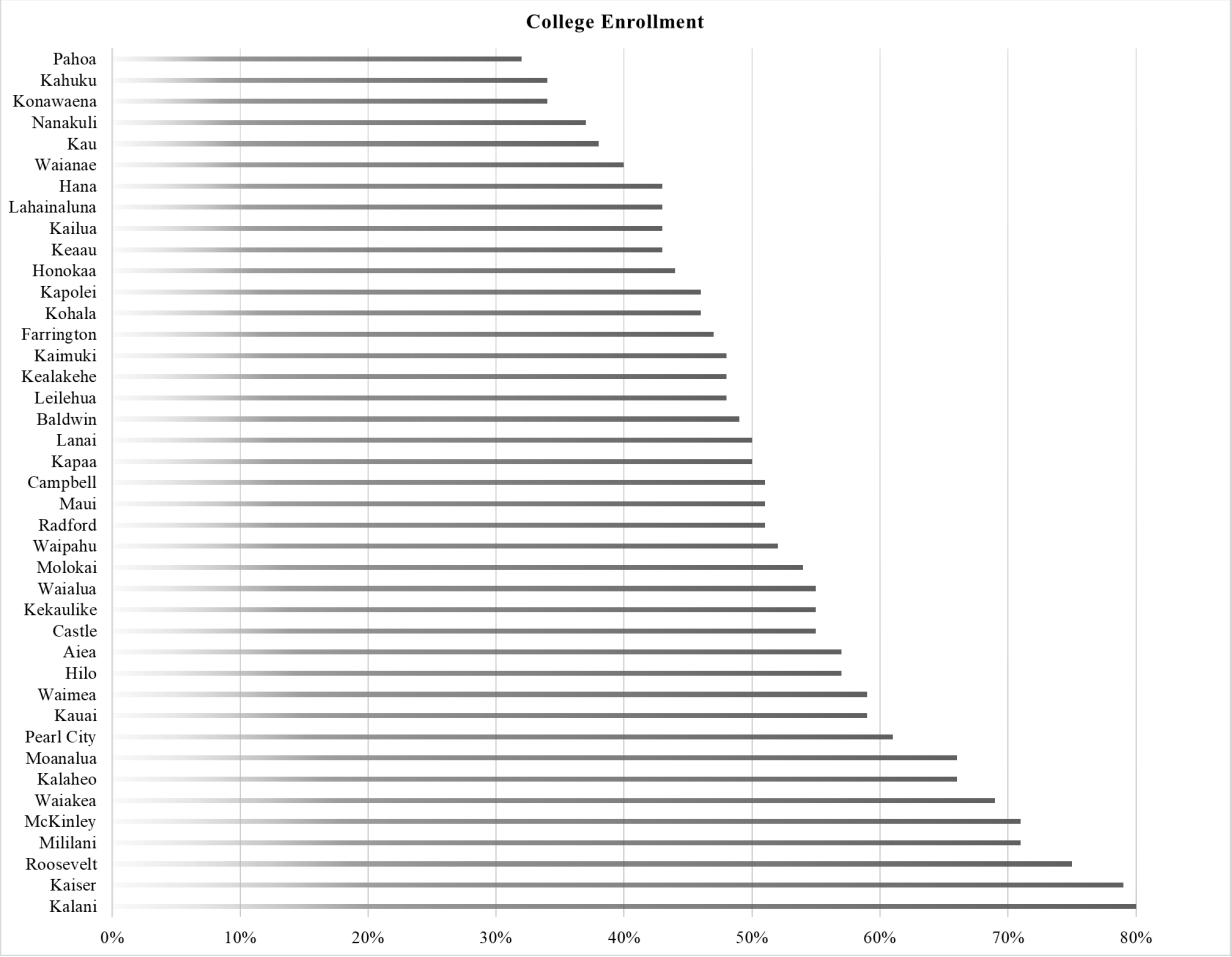


Figure 20. SEE-HI College Enrollment.

In hierarchical regression, sets of variables are entered in blocks, and each independent variable is then assessed in terms of what it uniquely contributes to predicting College Enrollment. Demographic and geographic variables are entered as Model 1 data. Model 2 includes the same three variables in Model 1 (Location, Ethnicity, and SES), controlling for their influences, and adds three policy or governance variables (Learning Environment, Climate, and Qualified Teaching), to the model (see Table 12).

Table 12. SEE-HI College Enrollment Regression Model Summary.

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.743[a]	.551	.515	8.42549%	.551	15.163	3	37	<.001
2	.804[b]	.646	.583	7.81196%	.094	3.013	3	34	.043

a. Predictors: (Constant), Location, Ethnicity, Socioeconomic Status

b. Predictors: (Constant), Location, Ethnicity, Socioeconomic Status, Learning Environment, Qualified Teaching, Climate

c. Dependent Variable: College Enrollment

Model 1, which included demographic and geographic variables, explains 55.1% of the variance in College Enrollment. After adding policy-controlled or governance variables (Learning Environment, Climate, and Qualified Teaching), Model 2, or the overall model, explains 64.6% of the variance in College Enrollment. The R Square Change value is 9.4%, which means that Learning Environment, School Climate, and access to licensed math teaching explain an additional 9.4% of the variance after controlling for demographic and geographic differences. The change is statistically significant, as indicated by the column labeled Sig. F Change, and the value (.043).

The ANOVA table indicates the statistical significance of the College Enrollment regression model. Both Model 1 and Model 2 are statistically significant as shown in the column Sig, $p < .001$ (see Table 13).

Table 13. SEE-HI College Enrollment Regression ANOVA.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3229.165	3	1076.388	15.163	<.001[b]
	Residual	2626.592	37	70.989		
	Total	5855.756	40			
2	Regression	3780.849	6	630.141	10.326	<.001[c]
	Residual	2074.907	34	61.027		
	Total	5855.756	40			

a. Dependent Variable: College Enrollment

b. Predictors: (Constant), Location, Ethnicity, Socioeconomic Status

c. Predictors: (Constant), Location, Ethnicity, Socioeconomic Status, Learning Environment, Qualified Teaching, Climate

The unique relationships of the independent variables can be identified in the Coefficients table under Standardized Coefficients Beta. The Beta coefficient for Qualified Math Teaching is .302. The .302 coefficient is the largest Beta coefficient, suggesting that access to licensed mathematics teaching makes the strongest unique contribution to College Enrollment. The second largest is the -.295 Beta value for Socioeconomic Status. The negative relationship means as the percentage of economically disadvantaged students increases, the percentage of College Enrollment decreases at the school level. With all six variables included in the model, the only statistically significant variable was Qualified Teaching. Socioeconomic Status was marginally significant, suggesting that economic disadvantage impacts access to higher education. Ethnicity was not significantly associated with College Enrollment, suggesting there may be other programs in place supporting underrepresented students in higher education (see Table 14).

Table 14. SEE-HI College Enrollment Regression Coefficients.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Correlations			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	76.233	6.270		12.158	<.001					
	Socioeconomic Status	-.186	.094	-.316	-1.981	.055	-.664	-.310	-.218	.476	2.101
	Ethnicity	-.254	.099	-.395	-2.576	.014	-.680	-.390	-.284	.517	1.935
	Location	3.516	3.149	.147	1.117	.271	.499	.181	.123	.699	1.431
2	(Constant)	41.479	18.458		2.247	.031					
	Socioeconomic Status	-.173	.091	-.295	-1.905	.065	-.664	-.311	-.195	.433	2.307
	Ethnicity	-.147	.100	-.227	-1.473	.150	-.680	-.245	-.150	.438	2.284
	Location	2.356	3.259	.099	.723	.475	.499	.123	.074	.561	1.783
	Qualified Teaching	.188	.074	.302	2.544	.016	.583	.400	.260	.738	1.356
	Climate	.279	.209	.163	1.335	.191	.499	.223	.136	.699	1.430
	Learning Environment	-.669	1.035	-.075	-.646	.523	.153	-.110	-.066	.772	1.295

a. Dependent Variable: College Enrollment

Access to licensed mathematics teaching is the only variable that can still predict a significant amount of the variance in college enrollment when the influences of all other variables are controlled. Qualified Math Teaching is 6.76% (.260*.260) of R Square; the total explained variance in College Enrollment. The Coefficients suggest that as the percentage of qualified math teachers increases by 1%, College Enrollment will increase by 0.19%. Based on the unstandardized coefficient values listed as B, the constructed College Enrollment Regression Equation takes the following form:

$$\% \text{ College Enrollment} = ß_o + ß_1(SES) + ß_2(ETH) + ß_3(LOC) + ß_4(QMT) + ß_5(CLI) + ß_6(LE) + \varepsilon$$

$$\hat{Y} = 41.479 - .173(SES) - .147(ETH) + 2.356(LOC) + .188(QMT) + .279(CLI) - .669(LE)$$

The percentage of College Enrollment in Hawai‘i high schools is the outcome variable. The predictor variables are Socioeconomic Status (SES), Ethnicity (ETH), Location (LOC), Qualified Math Teaching (QMT), School Climate (CLI), and Learning Environment (LE), and a residual value to account for error.

The results of the model are summarized in Table 15. Hierarchical multiple regression was used to assess the ability of three policy/governance measures (Qualified Teaching, Climate, and Learning Environment) to predict College Enrollment after controlling for the influence of Socioeconomic Status, Ethnicity, and Location. Preliminary analyses were conducted to ensure no violation of normality, linearity, multicollinearity, and homoscedasticity assumptions. Socioeconomic Status, Ethnicity, and Location were entered in Model 1, explaining 55% of the variance in College Enrollment. After the entry of Qualified Teaching, Climate, and Learning Environment in Model 2, the total variance the model explained was 65%, F (6, 34) = 10.33, $p <$ .001. The three policy-controlled measures explained an additional 9% of the variance in College Enrollment after controlling for Socioeconomic Status, Ethnicity, and Location, R squared change = .09, F change (3, 34) = 3.01, $p < .05$. In the final model, only Qualified Teaching was statistically significant, and Socioeconomic Status was marginally significant, with Qualified Teaching recording a higher beta value (*Beta* = .302, $p < .05$) than Socioeconomic Status (*Beta* = -.295, $p < .10$).

Table 15. Multiple Regression Predicting College Enrollment

Independent Variable	Model 1		Model 2	
	B	S.E	B	S.E
Constant	76.233 ***	6.27	41.479 *	18.458
Socioeconomic Status	-0.186	0.094	-0.173	0.091
Ethnicity	-0.254 *	0.099	-0.147	0.1
Location	3.516	3.149	2.356	3.259
Qualified Teaching			0.188 *	0.074
Climate			0.279	0.209
Learning Environment			-0.669	1.035
R^2	0.551 ***		0.646 ***	

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

Findings

The Study of Educational Equity in Hawai‘i (SEE-HI) finds that of the six variables tested including Socioeconomic Status, Ethnicity, Location, Qualified Teaching, Climate, and Learning Environment, only Qualified Teaching was statistically significant in explaining the variances in Math Proficiency and College Enrollment. The linear relationship of access to Qualified Teaching to math proficiency and College Enrollment is shown in the scatter plots. The positive correlation between the variables suggests that increasing Qualified Math Teaching will increase Math Proficiency and College Enrollment (see Figures 21 and 22).

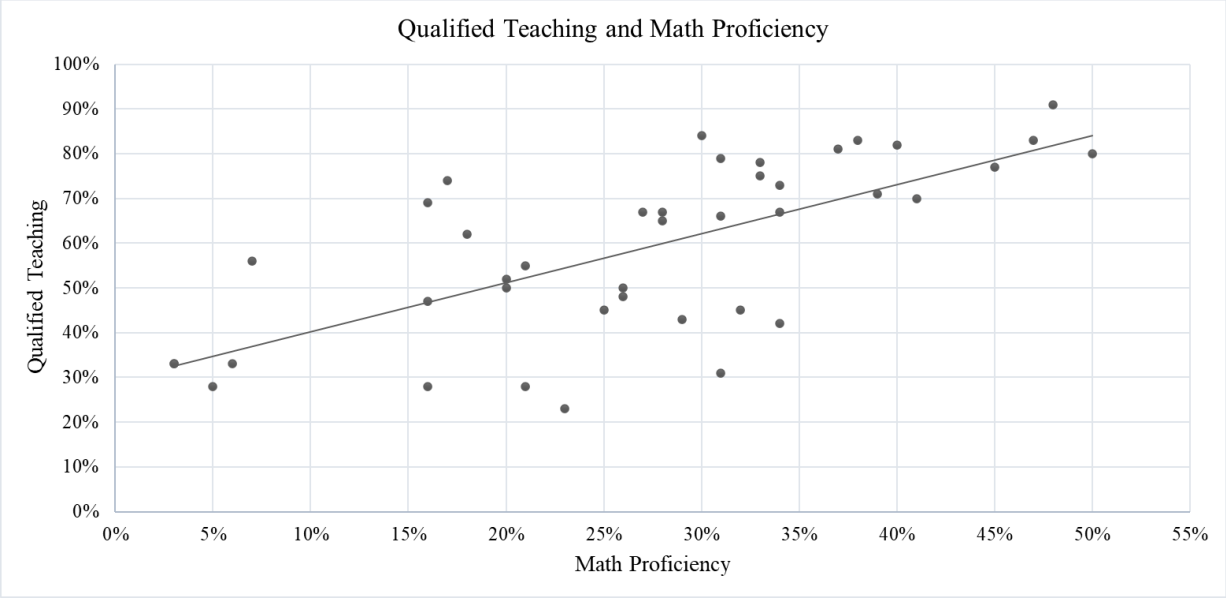


Figure 21. The Linear Relationship Between Qualified Teaching and Math Proficiency.

As the percentage of licensed math teachers increases, the percentage of students meeting math proficiency standards and college enrollment increases at the school level.

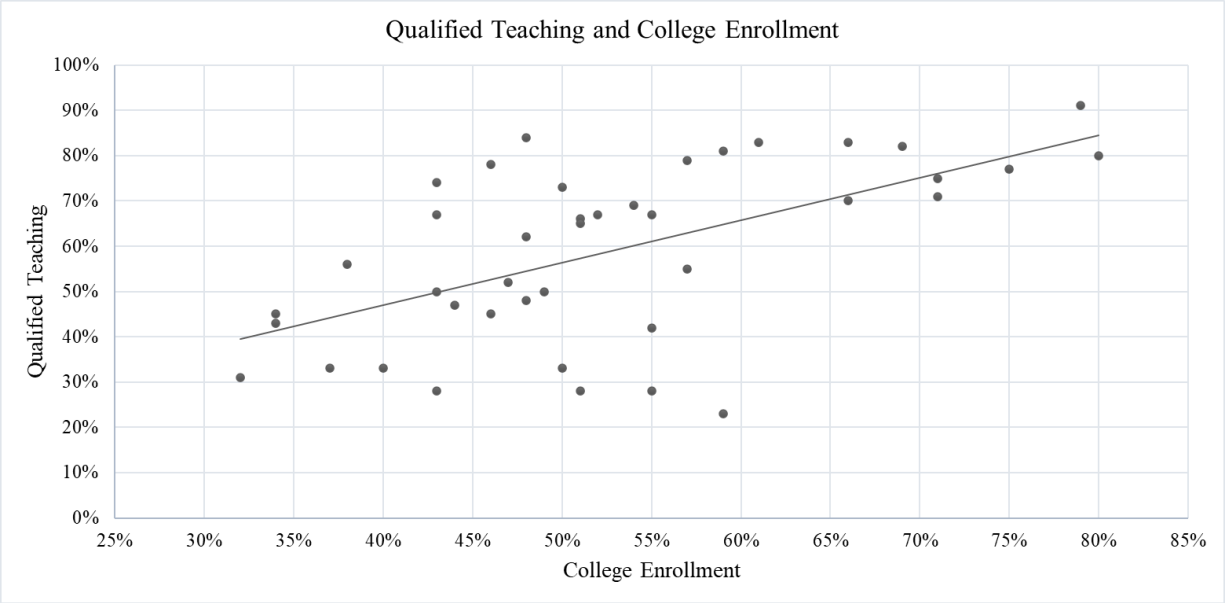


Figure 22. The Linear Relationship Between Qualified Teaching and College Enrollment.

Qualified Math Teaching was statistically significant in both models when testing both dependent variables. It also made the strongest unique contribution in explaining variances in Math Proficiency and College Enrollment. In Table 16, the columns show a rank order of the high schools from top to bottom in Qualified Teaching, Math Proficiency, and College Enrollment. The top ten schools in each variable are marked with a plus sign. The bottom ten are marked with a minus, another visual representation of the impact of quality teaching on the two dependent variables. Also included is a graph that shows the linear relationship between qualified teaching, the dark gray bars, math proficiency, the medium gray bars, and college enrollment, the light gray bars of the 41 public high schools (see Figure 23). As qualified teaching increases, math proficiency and college enrollment increase, suggesting an effective way to increase math proficiency and college enrollment is to have more qualified teachers in the classroom.

Table 16. SEE-HI: Distribution of Qualified Teachers and Student Outcomes

School	Qualified Teaching	Rank		School	Math Proficiency	Rank		School	College Enrollment	Rank	
Kaiser	91%	1	+	Kalani	50%	1	+	Kalani	80%	1	+
Leilehua	84%	2	+	Kaiser	48%	2	+	Kaiser	79%	2	+
Moanalua	83%	4	+	Pearl City	47%	3	+	Roosevelt	75%	3	+
Pearl City	83%	3	+	Roosevelt	45%	4	+	Mililani	71%	4	
Waiakea	82%	5	+	Kalaheo	41%	5		McKinley	71%	5	
Kauai	81%	6	+	Waiakea	40%	6	+	Waiakea	69%	6	+
Kalani	80%	7	+	Mililani	39%	7		Kalaheo	66%	7	
Hilo	79%	8	+	Moanalua	38%	8	+	Moanalua	66%	8	+
Kohala	78%	9	+	Kauai	37%	9	+	Pearl City	61%	9	+
Roosevelt	77%	10	+	Castle	34%	10	-	Kauai	59%	10	+
McKinley	75%	11		Kapaa	34%	11		Waimea	59%	11	-
Lahainaluna	74%	12		Waipahu	34%	12		Aiea	57%	12	
Kapaa	73%	13		Kohala	33%	13	+	Hilo	57%	13	+
Mililani	71%	14		McKinley	33%	14		Castle	55%	14	-
Kalaheo	70%	15		Kapolei	32%	15		Kekaulike	55%	15	
Molokai	69%	16		Radford	31%	16		Waialua	55%	16	-
Keaau	67%	19		Hilo	31%	17	+	Molokai	54%	17	
Kekaulike	67%	18		Pahoa	31%	18	-	Waipahu	52%	18	
Waipahu	67%	17		Leilehua	30%	19	+	Radford	51%	19	
Radford	66%	20		Konawaena	29%	20	-	Campbell	51%	20	-
Maui	65%	21		Kekaulike	28%	21		Maui	51%	21	
Kaimuki	62%	22		Maui	28%	22		Kapaa	50%	22	
Kau	56%	23		Keaau	27%	23		Lanai	50%	23	-
Aiea	55%	24		Kailua	26%	24		Baldwin	49%	24	
Farrington	52%	25		Kealakehe	26%	25		Kaimuki	48%	25	
Baldwin	50%	27		Kahuku	25%	26		Kealakehe	48%	26	
Kailua	50%	26		Waimea	23%	27	-	Leilehua	48%	27	+
Kealakehe	48%	28		Aiea	21%	28		Farrington	47%	28	
Honokaa	47%	29		Campbell	21%	29	-	Kapolei	46%	29	
Kahuku	45%	31		Farrington	20%	30		Kohala	46%	30	+
Kapolei	45%	30		Baldwin	20%	31		Honokaa	44%	31	
Konawaena	43%	32	-	Kaimuki	18%	32		Hana	43%	32	-
Castle	42%	33	-	Lahainaluna	17%	33		Kailua	43%	33	
Lanai	33%	36	-	Honokaa	16%	34		Keaau	43%	34	
Nanakuli	33%	35	-	Molokai	16%	35		Lahainaluna	43%	35	
Waianae	33%	34	-	Waialua	16%	36	-	Waianae	40%	36	-
Pahoa	31%	37	-	Kau	7%	37		Kau	38%	37	
Hana	28%	40	-	Nanakuli	6%	38	-	Nanakuli	37%	38	-
Campbell	28%	39	-	Hana	5%	39	-	Kahuku	34%	39	
Waialua	28%	38	-	Lanai	3%	40	-	Konawaena	34%	40	-
Waimea	23%	41	-	Waianae	3%	41	-	Pahoa	32%	41	-

‘+ ten highest ranked schools, - ten lowest ranked schools

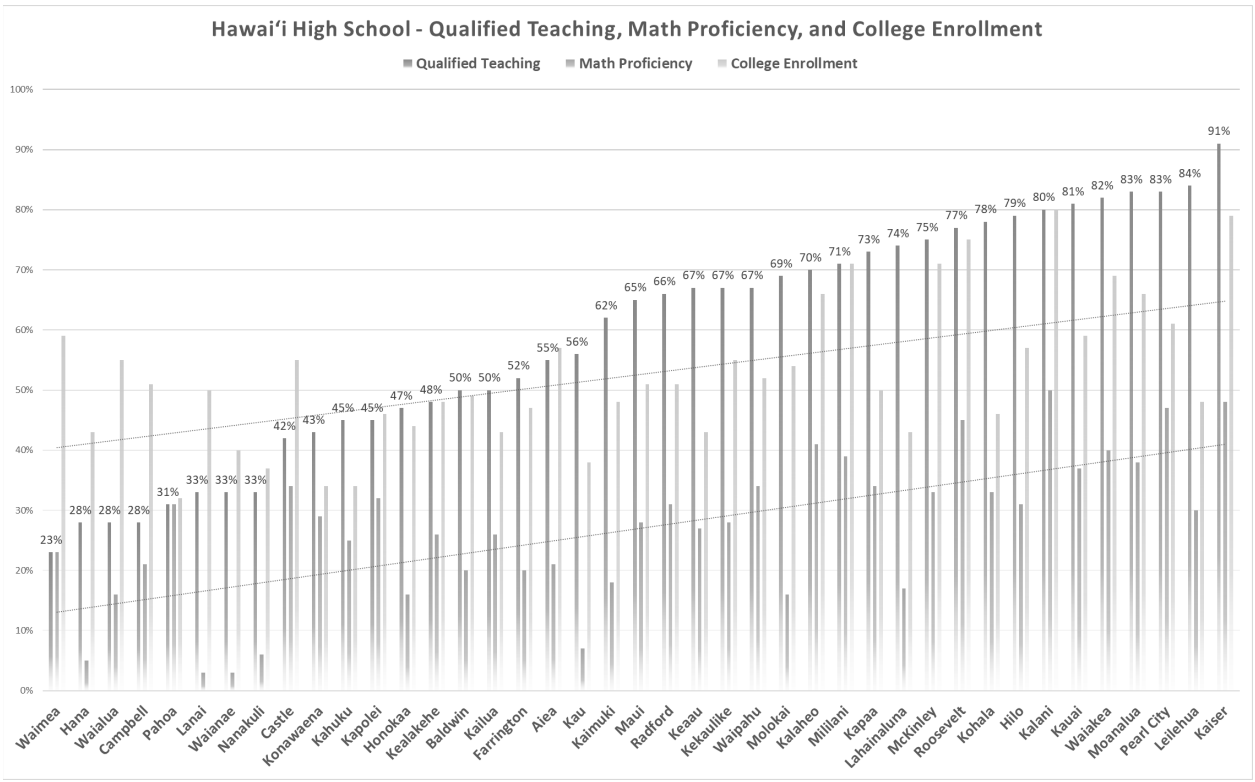


Figure 23. Qualified Teaching, Math Proficiency, and College Enrollment.

The new federal education law, Every Student Succeeds Act, requires the Hawai‘i Department of Education to publish annual reports measuring the progress of educational equity, particularly in disadvantaged groups, low SES, minorities, and underachieving. Academic standards and statewide assessments were mandated to “ensure all students are provided with an opportunity to receive a fair, equitable, and high-quality education” (HIDOE, 2019a). The Hawai‘i Department of Education publishes student access to licensed teachers in each high school. Student access to licensed Math teachers in the schools is not publicly available, even when requested; however, it is reported in the Civil Rights Data Collection (see Figure 24). The darker bars represent the information published by the state regarding licensed teaching. The lighter bars represent licensed math teaching, information extracted from the Civil Rights Data

Collection through significant effort and analysis. The public may not be aware of the state's low percentages of Licensed Math Teaching. Following the trend lines, the data suggests that almost all schools have licensed teachers, but not all have licensed math teachers.

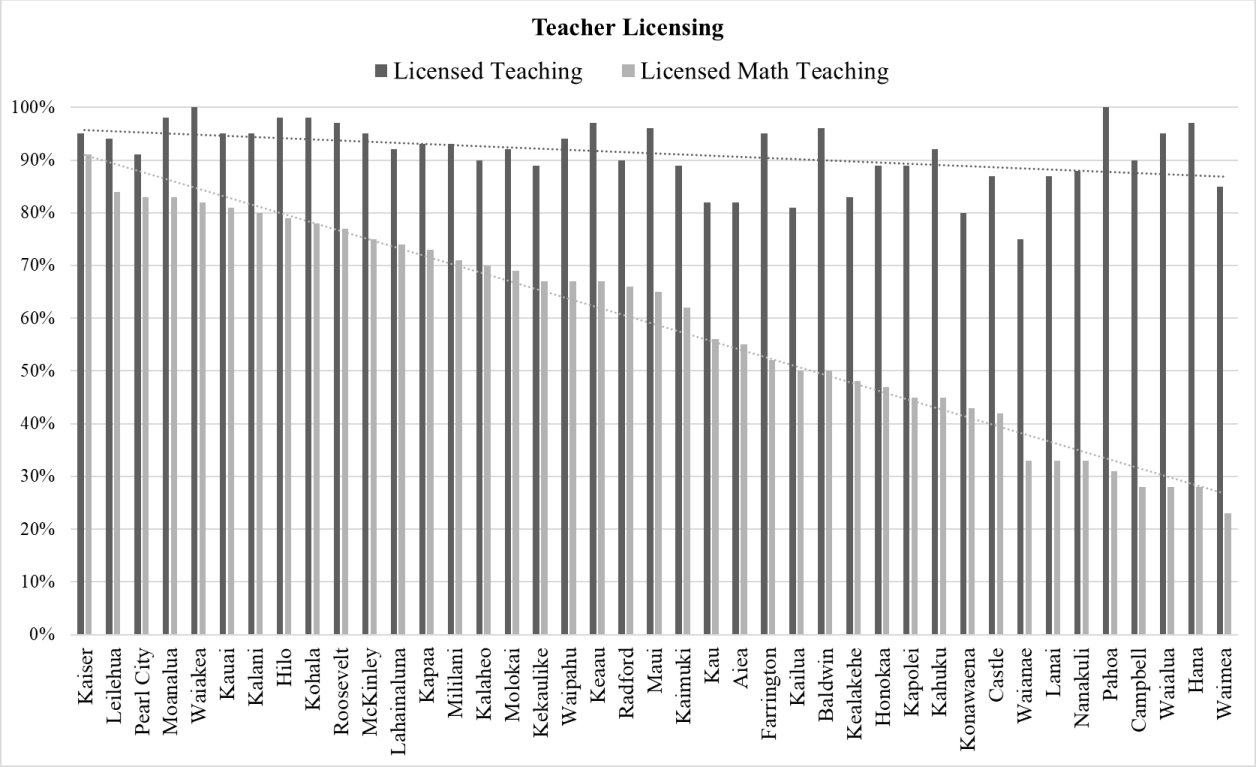


Figure 24. Licensed Teachers and Licensed Math Teachers.
Comparison of the percentage of total Licensed Teachers to the percentage of Licensed Math Teachers in Hawai'i's public high schools.

Students' access to qualified or licensed math teaching varies depending on the school and district in which they live. Country schools serving the highest proportions of low SES and Hawaiian, Filipino, and Pacific Islander ethnicity students have higher percentages of unqualified teachers. The distribution and access to educational resources and opportunities is unequal for low SES and underrepresented ethnicities in Hawai'i's high schools. In addition, 20% of Licensed Teaching in the state is out-of-field teaching (HIDOE, 2022a). One in every

five teachers, or over 2,220 public school teachers, have been assigned a subject or grade level they are not licensed or state-certified to teach. Licensing standards have received considerable attention as a "policy lever to enhance learning outcomes and mediate inequities in students' opportunities to learn-that is the quality of academic expectations, content, instruction, and support students receive in their schools (Heck, 2007, p. 400).

The number of inexperienced educators and emergency hires is also a concern in public schooling. Over 2,200, or 19% of Hawai‘i's teachers, principals, and other school-level educational officers are "inexperienced" or have one year or less of experience, and 8%, or 869 teachers are emergency hires, meaning they have a bachelor's degree but have not completed the full requirements of licensure (HIDOE, 2022a). The "most consistent highly significant predictor of student achievement in reading and mathematics in each year tested is the proportion of well-qualified teachers in a state: those with full certification and a major in the field they teach" (Darling-Hammond, 2000, p. 23). Teacher education and credentialing is "as important to teaching as a driver's license is to driving a car" (Darling-Hammond, 2004, p. 5).

Educational equity is not about equal outcomes of high achievement, equity in education is about the fair and just distribution of learning opportunities and resources (Jordan, 2010). SEE-HI examined the distribution of qualified teachers and access to educational resources in Hawai‘i's public high schools. School resources, according to HIDOE, include the opportunity to learn from a licensed or certified teacher in a safe and supportive environment. Although most Hawai‘i students have access to certified teaching, this study's in-depth analysis of the Civil Rights Data Collection discovered some alarming facts; here are a few; 1) there are 28 sections of Algebra 1 at Campbell High School with zero certified math teachers, 2) about 2,000 students at Campbell are enrolled in math courses without a certified math teacher, 3) there are 14

sections of Algebra 1, and about 1,000 students at Waianae High School, without a certified math teacher, 4) Waimea High School has 13 sections of Algebra 1 and Algebra 2, and 250 students without a certified math teacher. In total, there are 19,630 students in Hawai‘i’s public high schools without certified math teachers (see Table 17).

Table 17. Access to Certified Math Teachers.

School	Algebra	Geometry	Algebra II	Advanced Mathematics	Calculus	Total
Aiea	91%	100%	56%	100%	100%	89%
Baldwin	64%	100%	100%	50% *	100%	78%
Campbell	0% ***	36% *	7% **	46% *	100%	30% *
Castle	80%	44% *	100%	0% ***	100%	57%
Farrington	17% **	100%	100%	80%	0% ***	71%
Hana	100%	0% ***	100%	N/A	N/A	54%
Hilo	100%	100%	91%	67%	100%	92%
Honokaa	60%	91%	86%	0% ***	100%	61%
Kahuku	100%	100%	89%	29% *	100%	76%
Kailua	20% **	60%	100%	25% **	100%	57%
Kaimuki	100%	100%	100%	0% ***	N/A	88%
Kaiser	89%	100%	100%	100%	100%	98%
Kalaheo	71%	100%	100%	50% *	100%	80%
Kalani	73%	100%	100%	29% *	100%	76%
Kapaa	100%	100%	100%	100%	N/A	100%
Kapolei	55%	84%	38% *	13% **	100%	49% *
Kau	80%	100%	100%	100%	N/A	92%
Kauai	100%	80%	100%	100%	100%	96%
Keaau	67%	100%	100%	25% **	100%	84%
Kealakehe	14% **	100%	100%	50% *	100%	66%
Kekaulike	100%	100%	100%	14% **	100%	78%
Kohala	100%	100%	100%	33% *	100%	81%
Konawaena	50% *	100%	40% *	33% *	100%	61%
Lahainaluna	93%	100%	100%	100%	100%	98%
Lanai	60%	0% ***	67%	0% ***	N/A	37% *
Leilehua	100%	100%	100%	88%	100%	97%
Maui	78%	92%	100%	63%	100%	83%
McKinley	100%	100%	50% *	100%	0% ***	89%
Mililani	86%	76%	81%	47% *	100%	72%
Moanalua	100%	100%	100%	54%	100%	88%
Molokai	70%	100%	78%	50% *	100%	77%
Nanakuli	30% *	100%	100%	0% ***	100%	61%
Pahoa	36% *	83%	50% *	100%	100%	62%
Pearl City	100%	100%	100%	100%	100%	100%
Radford	83%	100%	100%	13% **	100%	71%
Roosevelt	38% *	47% *	92%	100%	100%	75%
Waiakea	94%	100%	100%	100%	100%	98%
Waialua	60%	50% *	20%	50% *	100%	46% *
Waianae	0% ***	67%	33% *	28% *	100%	36% *
Waimea	0% ***	69%	0%	100%	N/A	34% *
Waipahu	77%	100%	79%	29% *	100%	73%

*** < 1%; ** 1%-25%; * 26%-50%

Applying an educational equity lens, SEE-HI examined access to educational resources in Hawai‘i, especially in underserved schools and communities. The study found that Qualified Teaching made the strongest unique contribution to both outcome variables and the model with all six variables was statistically significant, explaining 71% of the total variance in math proficiency and 65% in college enrollment. However, it also found that school climate, a measure of student perceptions of safety and support, was positively associated with student outcomes. As a result, images of the teaching and learning environments are also included in this study to document school resource distribution visually. Photos of the schools at the top and bottom of the distributions are presented in the following pages (see Figures 25-36).

Documentary Photographs

Figure 25. Roosevelt High School Administration Building.

Figure 26. Kahuku High School Administration Building.

Figure 27. Kalani High School Classrooms.

Figure 28. Kahuku High School Classrooms.

Figure 29. Moanalua High School Performing Arts Building.

Figure 30. Waialua High School Performing Arts Building.

Figure 31. Moanalua High School Restroom.

Figure 32. Kahuku High School Restroom.

Figure 33. Kihei High School Library.

Figure 34. Waialua High School Library.

Figure 35. Kapolei High School Classrooms.

Figure 36. Waialua High School Classrooms.

CHAPTER 5. CONCLUSIONS AND IMPLICATIONS

> The world changes according to the way people see it, and if you can alter, even by a millimeter, the way people look at reality, then you can change it.
>
> —James Baldwin

Discussion

Limitations

One of the initial limitations of the study was defining qualified teaching and accessing data on teacher qualifications. State licensing standards vary, and "highly qualified" teaching definitions have been unclear since NCLB. In the HIDOE database, six teaching quality measures are reported, the percentage of fully licensed teachers, the percentage of emergency hires, teachers not teaching in their field of licensure, teachers' average years of experience, teachers with advanced degrees, and teachers with five or more years at the same school. Although each measure contributes to general school-level teaching quality, the data is not available for subject-specific teacher qualifications. For example, the percentage of licensed or certified math teachers in each school is not published and was unavailable when requested through HIDOE.

Several previous studies identified two significant problems in K-12 mathematics education in the United States, a lack of qualified teachers and inequitable access to those teachers by students of varying socioeconomic status and ethnicity (Akiba et al., 2007; Darling Hammond, 2000, 2004, 2007, 2013; Dolton & Marcenaro-Gutierrez, 2011; Flores, 2007; Kang & Hong, 2008; Ingersoll 2007; Ingvarson & Rowley, 2017; NCES, 2015; OECD, 2005). Because

of the shortage of qualified math teachers and unequal educational opportunities nationwide, the original intent of this study was to examine equity and access to qualified teachers in Hawai‘i based on full certification and a major in the field they teach. One of the study's interests was to determine the relationship between math achievement and access to certified teachers that earned a degree in math or math education. Examining the relationship was not possible because educational background, or majors of teachers are separate qualifications from state licensing or certification. Entry-level teachers in Hawai‘i could be licensed with a bachelor's degree, but the major of the degree may be out of their teaching field. Therefore, a Hawai‘i certified teacher translates to a bachelor's degree, but does not guarantee the teacher's major is in their assigned subject.

Data for subject-specific qualified teaching varies between schools and districts depending on the number of emergency hires and the percentage of out-of-field teachers. 20% of licensed teachers in Hawai‘i are not licensed in their teaching field, and 869, or 8%, are emergency hires. Schools with high proportions of low SES and underrepresented ethnicities have higher percentages of inexperienced and unqualified teachers. ESSA data reports 23% of teachers at Waianae High School are emergency hires, and 44% are out of their field of licensure. Data for subject-specific teaching quality is unavailable because of Hawai‘i's longstanding teacher shortage problem, high teacher turnover rate, and because administrators can assign teachers to teach multiple subjects, even if they are not certified in the subject or grade level.

Although subject-specific teacher qualifications are not available in HIDOE reports, the data is reported by HIDOE, in accordance with ESSA law, and published in the Civil Rights

Data Collection (CRDC). The CRDC has collected data for use by the Department of Education's Office for Civil Rights in its "enforcement and monitoring efforts regarding schools' and districts' obligation to provide equal educational opportunity" (CRDC, 2014). The Civil Rights Data Collection is a tool for agencies, policymakers, researchers, administrators, educators, and the public to "analyze student equity and opportunity trends locally and nationwide" (CRDC, 2014). The data regarding the number of classes taught by certified math teachers and racial disparities in accessing certified teachers were found in the collection. To be a certified/licensed math teacher in Hawai‘i, a bachelor's degree in math or math education is not required. Therefore, a math teacher in Hawai‘i could be certified to teach mathematics and hold a degree in a different subject if the teacher passed the Praxis test for minimum content knowledge in math. This study examined the relationship between math proficiency and access to certified math teachers. Further research could explore the relationship between student achievement and the educational qualifications of teachers in Hawai‘i's schools to determine access to certified teachers with a degree in the field they are teaching.

Another limitation came during the conceptual design of the study and the regression model. Several variables were considered to possibly influence math proficiency and college enrollment but were difficult to quantify. The influences of multiple variables are controlled by including them in the equation. The quality of teaching, learning, and outcomes are impacted by variables that cannot be fully measured, and some effective teaching variables that may contribute to student achievement but were not included in the study are positive student-teacher relationships, verbal abilities, or effective communication between teachers and students, student composition, attitudes, and behavior, expectations, curriculum choice, coverage, and consistency, instructional approaches and student engagement activities, level of classroom management

required, opportunities for teacher collaboration, and parent support and involvement. Instructional differentiation is also influenced by school leadership, school expectations and processes, diversity in school composition and support systems, and the extent that student behavior is managed by the school (Heck, 2007). Further study could investigate these variables on a micro or macro level within various classroom and school contexts and their relationships with student outcomes.

Accessing comparable data was another limitation of the study. Initially, one of the study‘s interests included comparing quality, equity, and outcome variables among all high schools in Hawai‘i, private and public. In exchange for federal grant money through the Race to The Top program, Hawai‘i adopted the Common Core Standards of Achievement in reading and math. One of the accountability measures was a new mandatory assessment in ELA and math called the Smarter Balanced Assessment (SBA). The 2015 Strive HI Report explained SBA “sets a new baseline to measure student progress and isn’t comparable with previous years’ assessment results.” SBA achievement results are also not comparable with data from private schools, which are exempt from taking the comprehensive assessments in ELA and Math. SBA is part of Hawai‘i’s statewide assessment program for public schools and measures ELA and math proficiency on national standards aligned with Common Core. However, the standards were not adopted in every state, meaning achievement results cannot be compared between all states. Further study could explore differences in educational experiences and achievement between private and public school students using different proficiency measures. Given the historical context of Hawai‘i’s private and public education system, it would also be relevant to explore the proportion of public school policymakers, education leadership, and administration

that have been students in the public school system or have children attending the schools they oversee.

Conclusions

Since the publication, A Nation at Risk, "few educational issues have received more attention…than the problem of ensuring that the nation's elementary and secondary classrooms are all staffed with quality teachers" (Ingersoll et al., 2007, p. 95). Studies worldwide claim that "the quality of teachers and teaching is a vital resource…with much concern surrounding how equitably this resource is distributed within educational systems" (Ingersoll et al., 2007, p. 1). The results of SEE-HI are consistent with previous studies measuring student equity and access to educational opportunities. There are two significant problems with mathematics education in Hawai‘i public schools, a shortage of qualified teachers and inequitable access to certified teachers by students of varying socioeconomic status and ethnicity. Multiple factors influence student learning; however, "of those variables which are potentially open to policy influence, factors to do with teachers and teaching are the most important influences on student learning" (OECD, 2005, p. 2).

Access to quality teaching has become a growing problem for many countries, especially in computer science and math, the two areas with the highest staffing difficulty (OECD, 2005). School systems respond to shortages in these areas by lowering teacher qualification requirements, assigning teachers to teach subjects they are not qualified to teach, increasing the number of courses teachers are assigned, and increasing class sizes. Comparative studies found sizable differences between systems and the extent to which teachers were teaching out of the field they were educated and trained. The problem of teachers assigned by administrators to teach in areas that do not match their educational background was most severe in the United

States (Ingersoll et al., 2007). Of the four academic fields, math has the highest percentage of out-of-field teaching. The shortage of qualified math teachers in Hawai‘i, and the unequal distribution of this vital resource is shown in the following graph (see Figure 37).

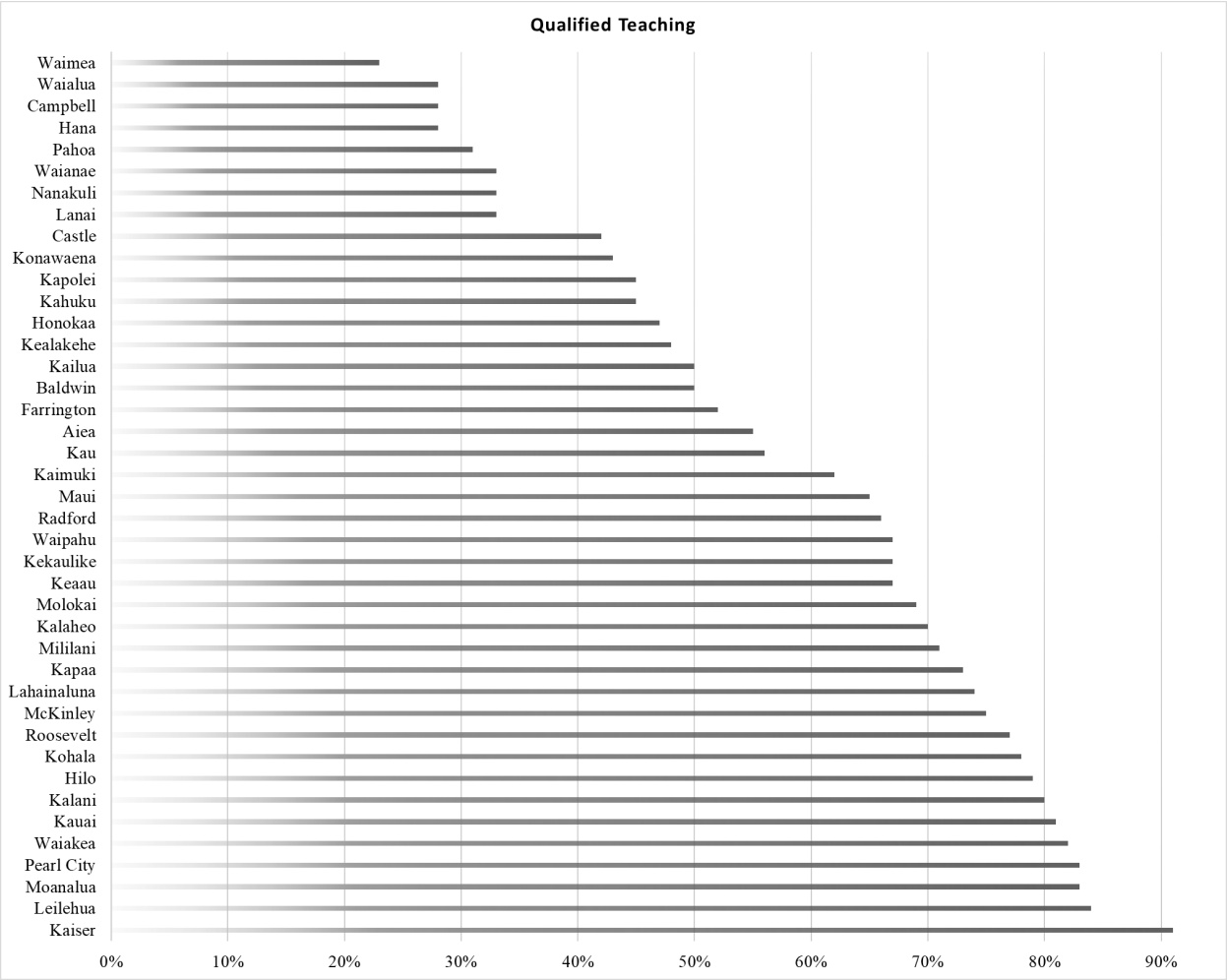


Figure 37. SEE-HI Percentage of Qualified Math Teaching.

In addition to teacher shortages in hard-to-staff subjects, there are concerns about the inequitable distribution of qualified teachers among schools, particularly in disadvantaged areas (OECD, 2005). There are 19,630 students in Hawai‘i’s public high schools without certified

math teachers. The distributions indicate that Kaiser High School has the highest percentage of qualified math teaching and the lowest percentage of economically disadvantaged students (see Figure 38).

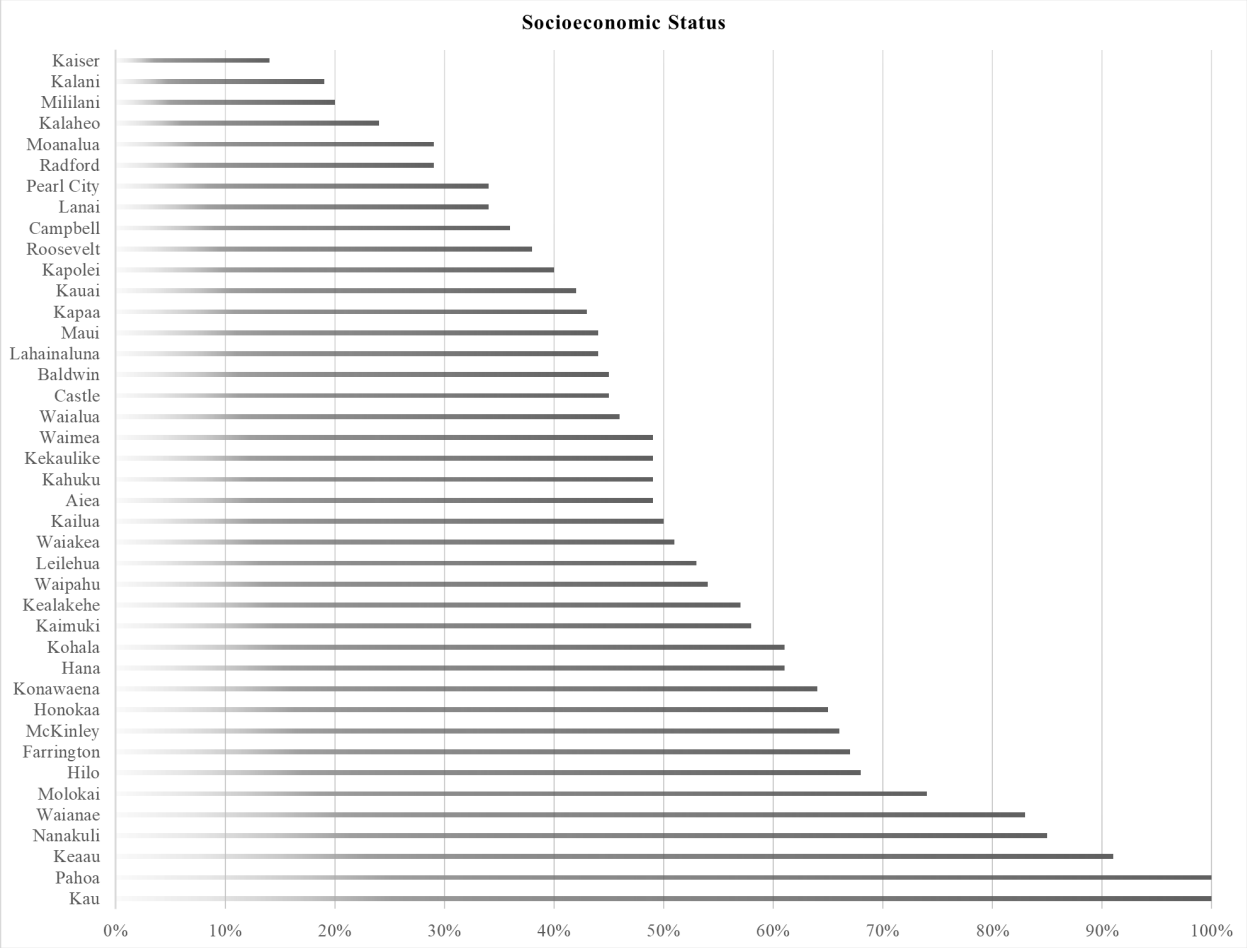


Figure 38. SEE-HI Percentage of Low Socieoeconomic Status.

Kaiser High School also has the second lowest percentage of Hawaiian, Filipino, and Pacific Islander students (see Figure 39). Schools and districts that serve higher proportions of economically disadvantaged, educationally at-risk, and students of Hawaiian, Filipino, and Pacific Islander ethnicity, have lower proportions of qualified teachers. Town schools have higher SES students and lower percentages of underrepresented ethnicities. Students attending

country schools, which have the highest percentages of economically disadvantaged and underrepresented, also have the highest percentages of uncertified teachers and the lowest quality learning environments. Thus, student equity and access to qualified teaching and resources is contingent upon socioeconomic status, ethnicity, and where students live.

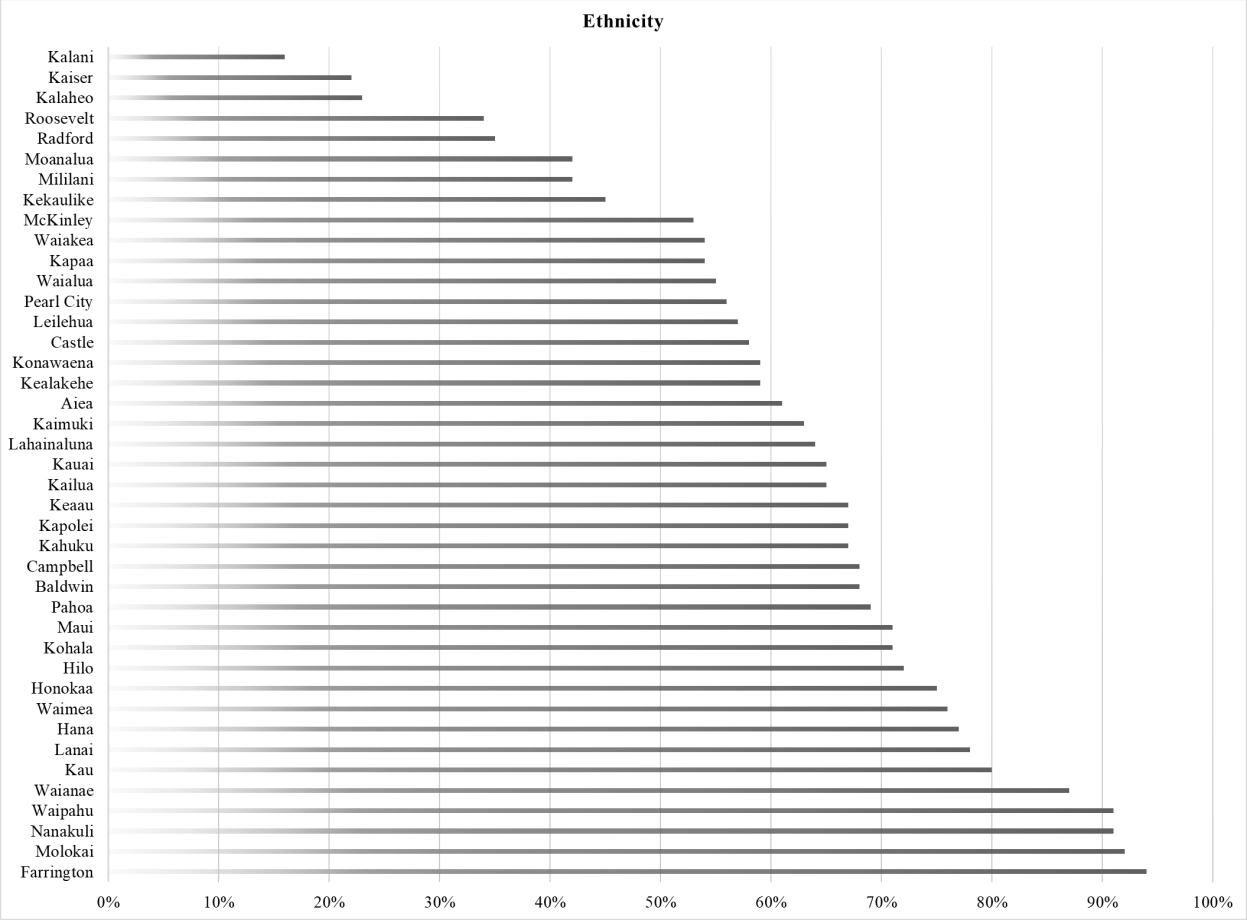


Figure 39. SEE-HI Percentage of Hawaiian, Filipino, and Pacific Islander Students.

As part of the new federal education law, states must detail their efforts to improve equitable access to qualified teaching and outcomes in disadvantaged, underrepresented, and underachieving groups. Since ESSA was enacted in 2015, Waianae High School's percentage of qualified teachers has dropped every year, impacting math proficiency at the school level, which

also dropped from 13% to 2% in the last four years. At 2%, Waianae High School has the lowest percentage of math proficiency in the state, they also have over 1,000 students enrolled in math classes without certified math teachers. The opportunity gap in students' access to qualified teaching in the United States is among the largest in the world (Akiba et al., 2007). Empirical research measuring educational equality is relevant in evaluating how Hawai‘i meets federal expectations and implements specific policy goals.

Using multiple regression analysis, SEE-HI found that access to licensed mathematics teaching is statistically significant in explaining math proficiency and college enrollment. The results support previous research suggesting higher professional teaching standards are positively associated with student outcomes (Heck, 2008; Darling-Hammond, 2000). Schools with higher percentages of qualified math teachers had higher percentages of math proficiency and college enrollment. Pearl City High School had among the highest percentages of math classes taught by licensed or certified teachers, and are third highest in the state for math proficiency. Half of their math teachers are alumni, which helps with retention, and success is attributed to administrative support and time for collaboration and professional development. Kaiser High School had the highest percentage of students with access to qualified math teachers and the second highest percentage in both outcomes—math proficiency and college enrollment. Kalani high school had the highest percentage of math proficiency and the highest percentage of college enrollment, suggesting a positive relationship between mathematical understanding and accessing higher education (see Figure 40).

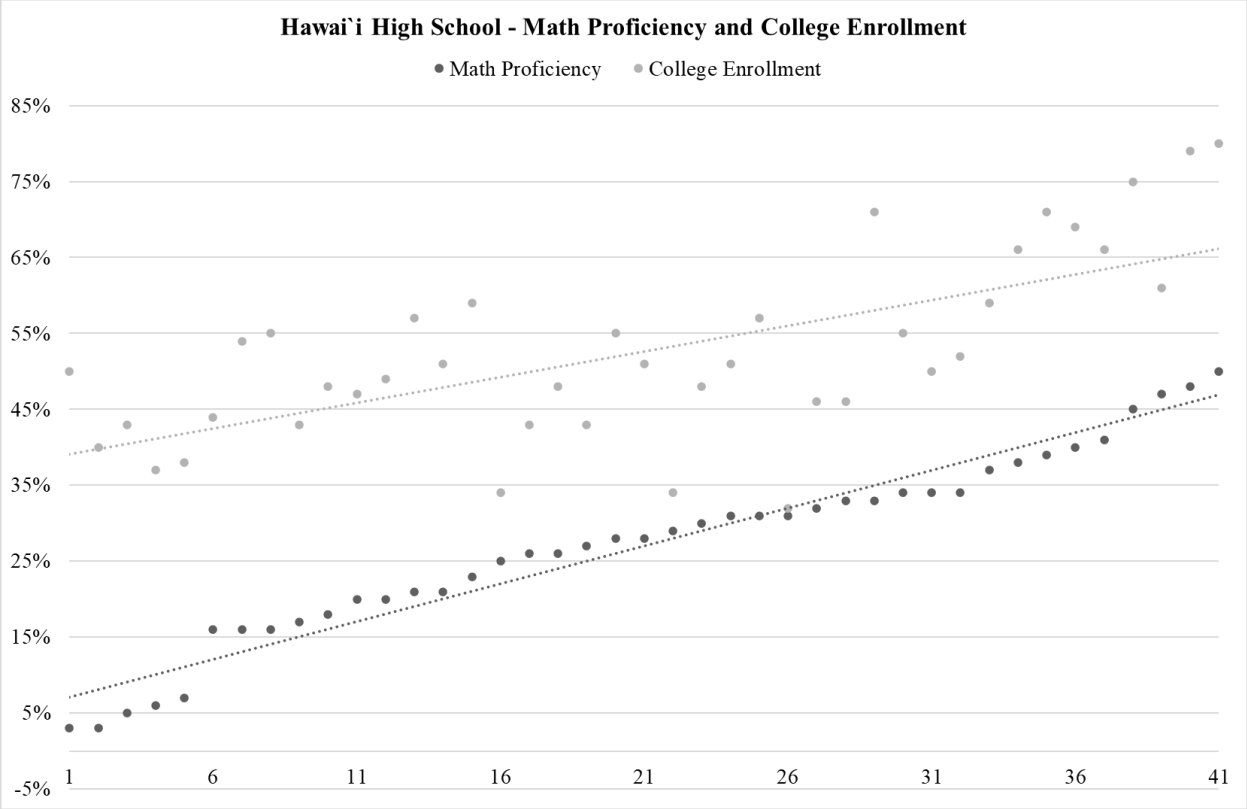


Figure 40. Math Proficiency and College Enrollment Correlation.

Access to qualified math teachers made the most substantial contribution to both math proficiency and college enrollment. As math proficiency increases, college enrollment increases, suggesting an effective way to increase college enrollment is to have more qualified teachers in the classroom. Another explanation for Kalani High School's highest college enrollment of public schools statewide is Kalani has the highest percentage of students enrolled in math courses during all four years of high school. To graduate from high school, students in Hawai'i are required to complete a basic math elective, Algebra 1, and Geometry. Kalani High School has the highest enrollment of students in multiple math courses, beginning with Algebra 1, Geometry, Algebra 2, Trigonometry, Calculus, and Statistics. Kalani's high achievement in both math proficiency and college enrollment suggests that college enrollment increases as students

take more math courses taught by licensed or certified teachers. Four years of English Language Arts and Social Studies are required for graduation in Hawai‘i, but only two years of high school level math are required. The lower math standards for graduation may be impacting college enrollment.

Implications

Mathematics is a dying language in the United States and, consequently, Hawai‘i. Nearly 40% or 20,000 of Hawai‘i’s 50,000 high school students must take a national proficiency assessment in a mathematical language their teachers are not licensed to teach. If the standards of proficiency are the same for all schools, but the levels of proficiency are different for all teachers, with some teachers being 0% proficient, the outcomes are expected to be different. Teachers cannot prepare students for a proficiency assessment in a language they cannot speak. The state must invest in the preparation and certification of math teachers, recruiting, developing, and retaining qualified teachers proficient in mathematical language, so that they can prepare their students for the mandated proficiency assessment in math. The United States has overinvested in testing and underinvested in attracting qualified teachers to prepare students for testing. Top-performing countries in mathematics achievement are well known for effective recruitment policies. In contrast to U.S. policymakers, their governments offer a profession with high status, salaries above average GDP per capita, and attractive working conditions, ensuring a high demand for teacher education placement from their ablest graduates (Ingvarson & Rowley, 2017).

Attracting, developing, and retaining qualified teachers is impossible with limited resources. The OECD claims, “if teaching is not perceived as an attractive profession, and teaching does not change in fundamental ways...the quality of schools will decline and a

downward spiral will be difficult to reverse" (2005, p. 3). Teaching quality and unequal access to educational resources can only be improved through policy and governance evaluation and accountability. Policymakers and administrators should increase investments in expanding access to qualified teachers and resources to all students. While the global trend has been to increase investments in equitable access to high-quality education, Hawai‘i has experienced a decreasing trend. The percentage of the state's budget for public education has been consistently the lowest in the country and has decreased yearly for the last 20 years. Hawai‘i ranks 50th in public school expenditures, cost-adjusted teacher pay, per-pupil spending, and educational capital improvement funding. Hawai‘i has the lowest teaching salaries and the highest teacher turnover in the country, suggesting a relationship between teacher salaries, and teacher attrition, and explaining the constant teacher shortage problem in Hawai‘i's public schools. Hawai‘i needs to do better than 50th in investing in public education if student equity and access to qualified teaching is to improve. Countries that have prioritized policies to make teaching an attractive career choice by improving teachers' image and social standing have more well-qualified applicants than vacant positions (OECD, 2005).

As societies have become wealthier, teaching salaries relative to GDP are declining, and teaching's appeal has diminished (OECD, 2005). During the 2018-2019 school year, the entry-level salary for newly hired teachers who "hold a Bachelor's degree from an accredited institution recognized by the HIDOE" was $35,962 (HIDOE, 2018d). New Teachers to the Hawai‘i State Department of Education with a Master's degree started at $38,838, and newly hired Teachers with a PhD or EdD, who completed a state-approved teacher education program with up to three years of experience started at $61,094 (see Table 18).

Table 18. Teachers' Gross Annual Salary Schedule, School Year 2018-2019.

Years of Teaching Experience Prior to HIDOE	Class II Bachelor's		Class III Bachelor's + 30 or Master's		Class VII PhD or EdD	
Steps	1st Quarter	2nd Quarter	1st Quarter	2nd Quarter	1st Quarter	2nd Quarter
* No SATEP 1	$35,962	$37,218	$38,838	$40,195		
** SATEP 5 (0-3 yrs)	$47,443	$49,100	$51,238	$53,028	$61,094	$63,228

According to the National Institute of Corrections, in that same year, the state prison budget covered a "Cost Per Inmate" of $72,270. Hawai'i spent double the budget on each inmate than it spent on each newly hired teacher holding a bachelor's degree. Hawai'i had the highest reported cost per inmate budget in the country at $72,270, and the lowest per-pupil expenditures at $15,242, lowest teacher salaries, starting at $35,962 and lowest percentage of public education expenditures. The state's allocation of resources regarding public education investments need to be re-evaluated.

OECD findings show that "teaching is a profession in long-term decline"; expectations and demands on teachers and schools increase while "resources have not kept pace" (2005, p. 5). However, resource allocations outside of public education are increasing at a faster pace. For example, the Honolulu Salary Commission recently approved a 63% salary increase for city council members to $113,000 for positions once considered part-time work. In comparison, full-time teachers received a 4% salary increase (see Figure 41). Hawai'i has among the highest-paid government and education leadership officials and the lowest-paid teachers. Policy initiatives must improve employment conditions, increase teaching salaries, and recruit and retain effective teachers, primarily in hard-to-staff schools (OECD, 2005). Countries with competitive teaching salaries, and improved working conditions for teachers, have higher academic achievement, lower unemployment rates, and lower percentages in criminal justice and welfare systems (Darling-Hammond, 2004; Ingersoll et al., 2007; Williams, 2010). By increasing teacher salaries,

Hawai‘i could attract and retain more qualified teachers and improve student equity. Research suggests every dollar spent on improving teaching quality netted more significant gains in student achievement than other uses of school resources (Darling-Hammond, 2000).

The Salary Commission adopted these schedule of salaries listed for the upcoming fiscal year:

- Honolulu mayor: $209,856
- Council chair: $123,292
- Council members: $113,292
- Prosecuting attorney: $198,888
- First deputy prosecuting attorney: $189,096
- Managing director: $200,712
- Deputy managing director: $190,296
- Corporation council: $192,864
- First deputy corporation council: $183,220
- Deputy heads: $187,488
- Deputy department heads: $177,888
- Police chief: $231,648
- Deputy police chiefs: $220,944
- Fire chief: $224,304
- Deputy fire chief: $213,912
- Medical examiner: $363,151
- Deputy medical examiner: $354,161
- Band director: $177,888

Figure 41. Honolulu Salary Commission Schedule of Salaries for City Officials.

There are three main categories that education policy and investment can be placed to assure teaching quality: first, recruitment, or making teaching an attractive career option; second, accreditation or evaluating and assessing teaching; and third, certification or governing entry into the profession (Ingvarson & Rowley, 2017). Where education policies place emphasis can determine accountability for the quality of teaching. Governments may attempt to defer the accountability spotlight to teacher education providers by focusing on accreditation or excessive

evaluations and assessments of teachers and programs (Ingvarson & Rowley, 2017). Based on teacher policy criteria, the United States received low ratings in the category of recruitment, the status of teaching as a profession and a career, and teaching salaries. The U.S. also received the highest rating in the category of accreditation, or external evaluation of teachers and teacher education programs by a government, statutory, or professional agency (Ingvarson & Rowley, 2017). Numerous studies report that "high-performing countries are more likely to focus educational policy directly on recruiting academically successful students and treating teachers as professionals" (Ingvarson & Rowley, 2017, p. 179). The U.S. and Hawai'i need an educational policy shift that prioritizes recruiting and retaining qualified teachers over costly assessments and evaluations of students, teachers, and programs.

The U.S. education system has been "moving toward authoritarianism, letting the government dictate what and how students should learn and what schools should teach," while top-performing countries are decentralizing curriculum, diversifying assessment, and encouraging local autonomy and innovation" (Sahlberg, 2011). Finland has been consistently among the top-performing countries in international testing. Like other high-performing countries, they have a highly educated teacher workforce; all K-12 teachers obtain a government-financed Master's degree, teaching salaries are competitive, and teaching is a highly respected profession (Sahlberg, 2011). In contrast to the US, students in Finland do not take standardized tests, and the school inspection system that provided external feedback on how teachers taught was abolished in the 1990s (Sahlberg, 2011). In Singapore, the top-performing country in reading and math, recruitment policies ensure that teaching is more attractive than other professions. In the highest-performing nations, subsidized education, respect for teachers, and high salaries attract the highest-performing students to teaching. In contrast, teaching in the

United States has been considered a less attractive line of work (Ingersoll et al., 2007). The preference to work in areas other than teaching is especially true for males since females represent the majority of teachers in the US. Historically, “female-dominated occupations have tended to have less prestige, lower pay and less authority” (Ingersoll et al., 2007, p. 10). Successful education reform in Hawai‘i and the U.S. will require boosting salaries, incentivizing teaching in hard-to-staff schools and subjects, rewarding additional teacher education, recruiting top academic high school students by subsidizing education, increasing licensing standards for teachers and administrators, improving working conditions, and reducing the administrative practice of out of field teaching assignments.

The Study of Educational Equity in Hawai‘i (SEE-HI) examined public schooling using an educational equity lens, or the extent to which equal opportunities and access to qualified teaching and resources are achieved. Based on the results of the study and the significant relationship between access to qualified teaching and student outcomes, evaluation of resource allocation is necessary to ensure equal educational opportunities for all students. Collaboration among policymakers, administrators, educators, and families is the way forward. Possible discussion topics SEE-HI could inform include state allocation of resources to public education, Department of Education policies on resource allocation, teaching recruitment and retention policies, educational capital improvement spending, teaching salaries and working conditions, evaluating student and teacher assessment programs, and investment in teacher scholarship and training.

Hawai‘i needs educational accountability from all stakeholders. SEE-HI aims to move government and education policymakers and administrators towards policy reform, empower vulnerable communities, increase awareness and knowledge, promote critical dialogue, and

inform future efforts to improve teaching and learning conditions for underserved students, teachers, schools, and communities. SEE-HI contributes a quantitative analysis of school data to help policymakers and educational officials see the lack of qualified teachers and the unequal opportunities to access those teachers. Substantial evidence supports, "The quality of an education system cannot exceed the quality of its teachers. The only way to improve outcomes is to improve instruction" (Dolton & Marcenaro-Gutierrez, 2011). The Study of Educational Equity in Hawai‘i (SEE-HI) aims to help government and education policymakers and administrators **SEE** the needs of all public schools, teachers, and students in Hawai‘i. Regardless of socioeconomic status, ethnic background, or where they live, all children deserve access to quality teaching and equity in education in Hawai‘i's public schools.

APPENDIX

Table 19. Descriptive Statistics of 20 Country Schools.

Country Schools	Socioeconomic Status	School	Ethnicity	School	Qualified Teaching	School	Learning Environment
Lanai	34%	Kapaa	54%	Waiakea	82%	Lahainaluna	7
Kauai	42%	Waiakea	54%	Kauai	81%	Hana	6
Kapaa	43%	Waialua	55%	Hilo	79%	Kailua	6
Lahainaluna	44%	Konawaena	59%	Kohala	78%	Nanakuli	6
Waialua	46%	Lahainaluna	64%	Lahainaluna	74%	Keaau	5
Kahuku	49%	Kailua	65%	Kapaa	73%	Waianae	5
Waimea	49%	Kauai	65%	Molokai	69%	Kauai	4
Kailua	50%	Kahuku	67%	Keaau	67%	Lanai	4
Waiakea	51%	Keaau	67%	Kau	56%	Molokai	4
Hana	61%	Pahoa	69%	Kailua	50%	Waimea	4
Kohala	61%	Kohala	71%	Honokaa	47%	Honokaa	3
Konawaena	64%	Hilo	72%	Kahuku	45%	Kahuku	3
Honokaa	65%	Honokaa	75%	Konawaena	43%	Kapaa	3
Hilo	68%	Waimea	76%	Lanai	33%	Kau	3
Molokai	74%	Hana	77%	Nanakuli	33%	Kohala	3
Waianae	83%	Lanai	78%	Waianae	33%	Konawaena	3
Nanakuli	85%	Kau	80%	Pahoa	31%	Pahoa	3
Keaau	91%	Waianae	87%	Hana	28%	Waiakea	3
Kau	100%	Nanakuli	91%	Waialua	28%	Waialua	3
Pahoa	100%	Molokai	92%	Waimea	23%	Hilo	2

Country Schools	Socioeconomic Status	Ethnicity	Qualified Teaching	Learning Environment
Mean	63%	71%	53%	4
Std. Dev.	20%	11%	21%	1
Range	66%	38%	59%	5
Minimum	34%	54%	23%	2
Maximum	100%	92%	82%	7
Count	20	20	20	20

Table 20. Descriptive Statistics of 21 Town Schools.

Town Schools	Socioeconomic Status	School	Ethnicity	School	Qualified Teaching	School	Learning Environment
Kaiser	14%	Kalani	16%	Kaiser	91%	Kapolei	7
Kalani	19%	Kaiser	22%	Leilehua	84%	Kekaulike	7
Mililani	20%	Kalaheo	23%	Moanalua	83%	Maui	7
Kalaheo	24%	Roosevelt	34%	Pearl City	83%	Campbell	6
Radford	29%	Radford	35%	Kalani	80%	Mililani	6
Moanalua	29%	Mililani	42%	Roosevelt	77%	McKinley	6
Pearl City	34%	Moanalua	42%	McKinley	75%	Waipahu	6
Campbell	36%	Kekaulike	45%	Mililani	71%	Radford	5
Roosevelt	38%	McKinley	53%	Kalaheo	70%	Kaiser	5
Kapolei	40%	Pearl City	56%	Kekaulike	67%	Baldwin	5
Maui	44%	Leilehua	57%	Waipahu	67%	Kalaheo	5
Castle	45%	Castle	58%	Radford	66%	Kalani	5
Baldwin	45%	Kealakehe	59%	Maui	65%	Leilehua	5
Aiea	49%	Aiea	61%	Kaimuki	62%	Moanalua	5
Kekaulike	49%	Kaimuki	63%	Aiea	55%	Pearl City	5
Leilehua	53%	Kapolei	67%	Farrington	52%	Roosevelt	5
Waipahu	54%	Baldwin	68%	Baldwin	50%	Aiea	4
Kealakehe	57%	Campbell	68%	Kealakehe	48%	Castle	4
Kaimuki	58%	Maui	71%	Kapolei	45%	Kaimuki	4
McKinley	66%	Waipahu	91%	Castle	42%	Kealakehe	4
Farrington	67%	Farrington	94%	Campbell	28%	Farrington	3

Town Schools	Socioeconomic Status	School	Ethnicity	School	Qualified Teaching	School	Learning Environment
Mean	41%		54%		65%		5
Std. Dev.	15%		21%		16%		1
Range	53%		78%		63%		4
Minimum	14%		16%		28%		3
Maximum	67%		94%		91%		7
Count	21		21		21		21

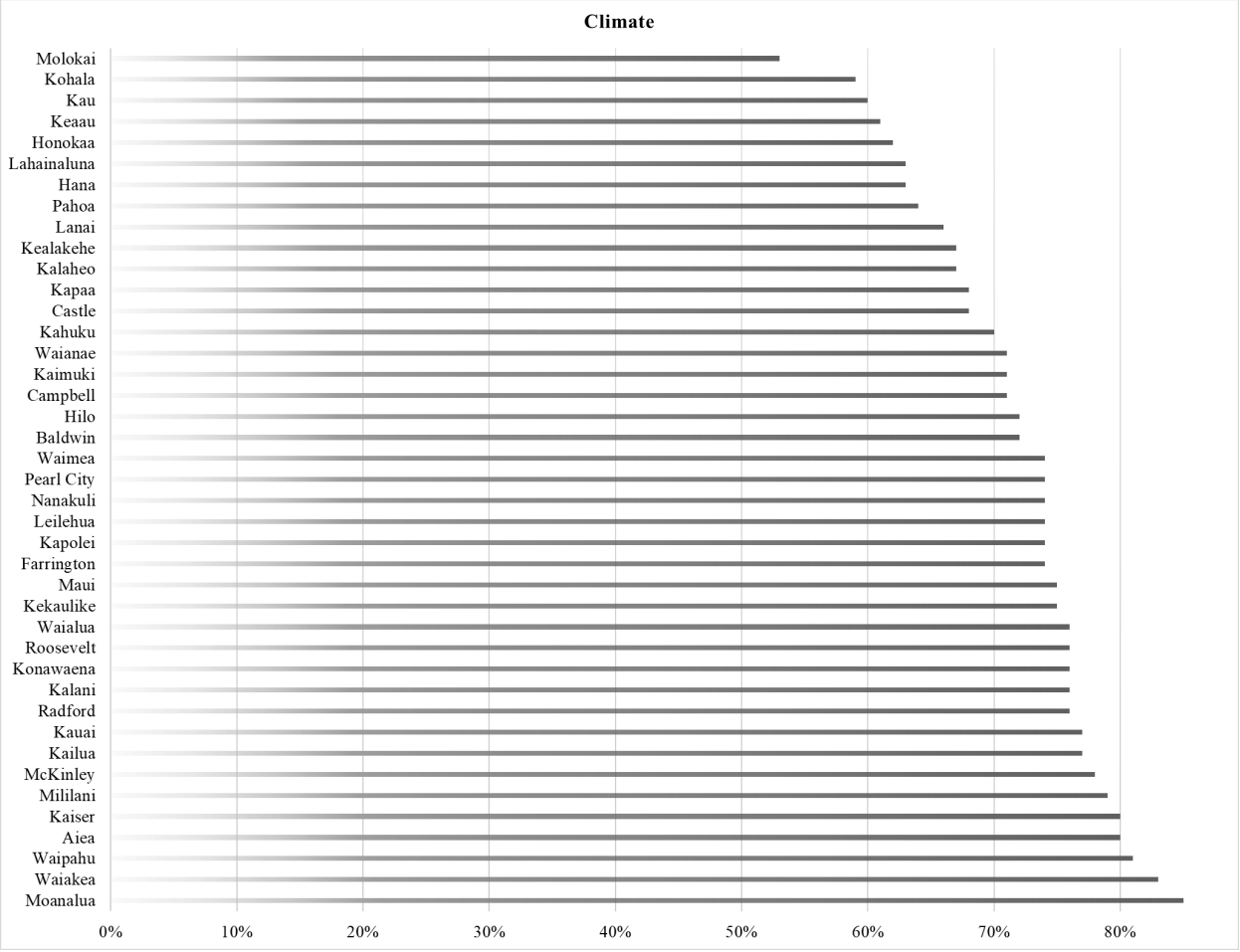


Figure 42. Percentage of Students Reporting Positive School Climate.

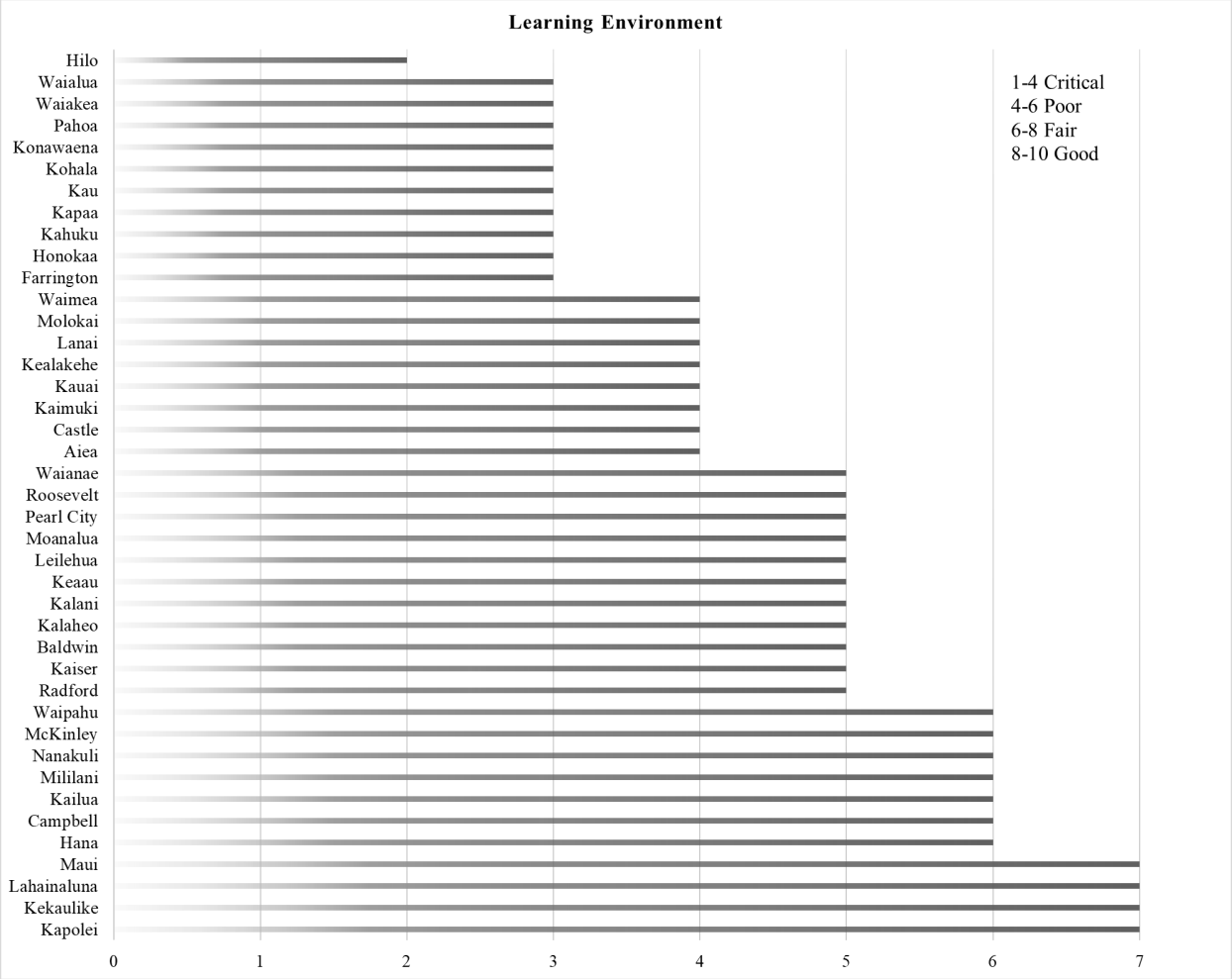


Figure 43. Rating of Quality, Safety, and Functionality of Learning Environment.

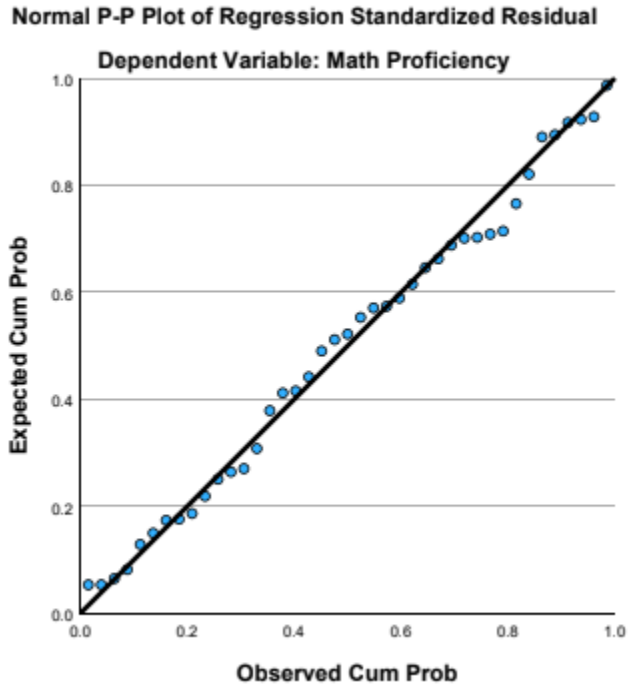


Figure 44. Math Proficiency Normal P-P Plot.

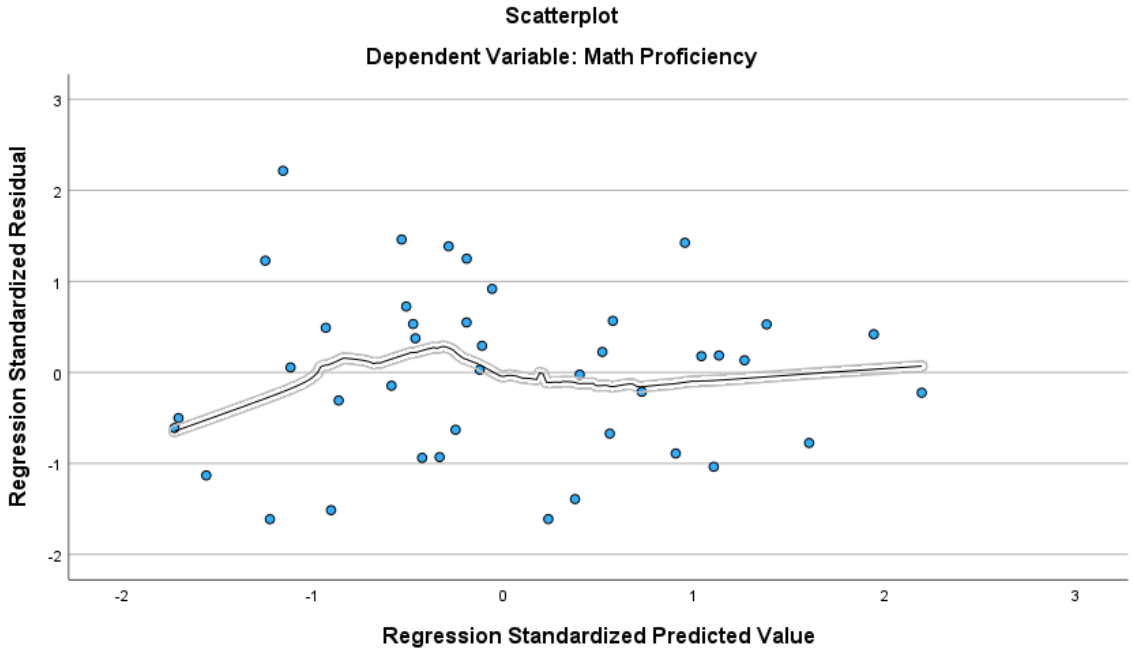


Figure 45. Math Proficiency Scatterplot with Loess Line.

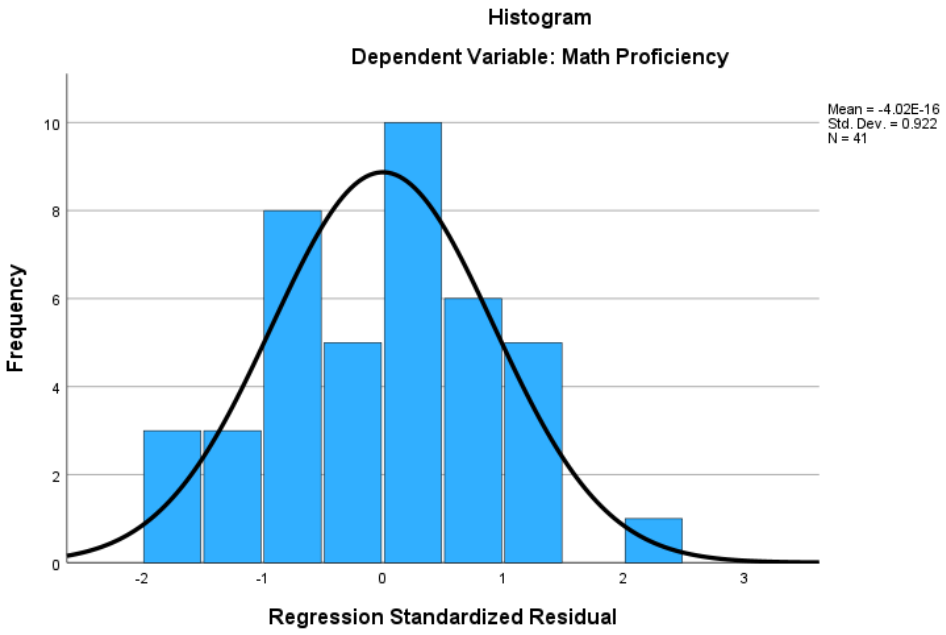


Figure 46. Math Proficiency Histogram.

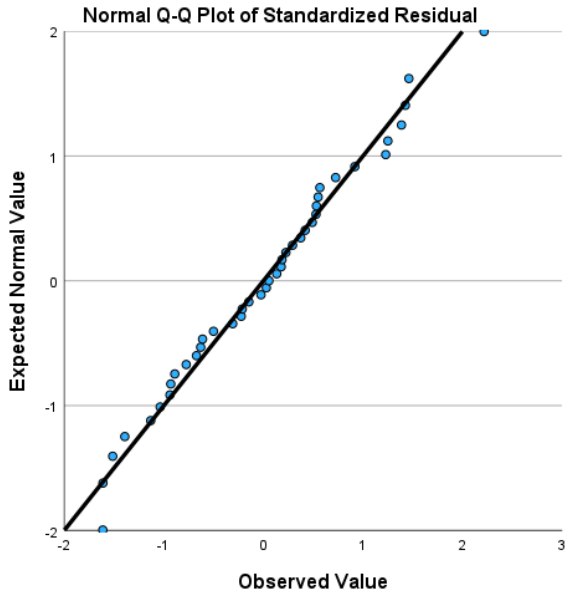


Figure 47. Math Proficiency Normal Q-Q Plot.

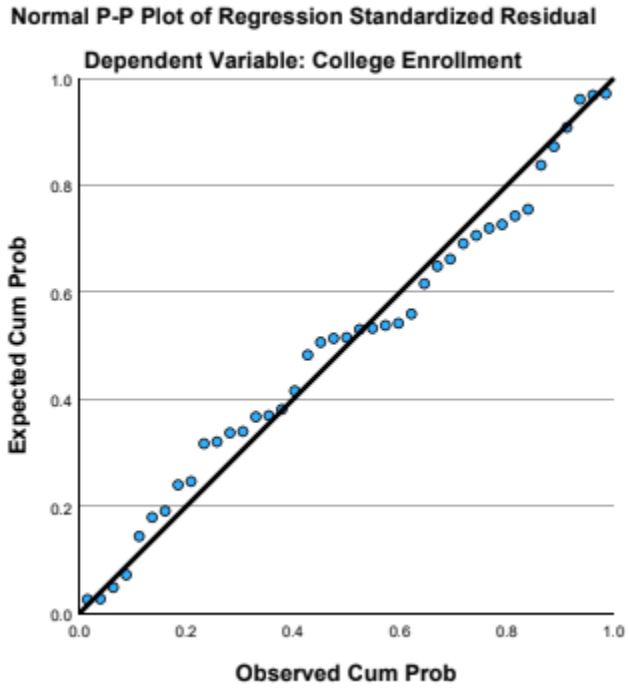


Figure 48. College Enrollment Normal P-P Plot.

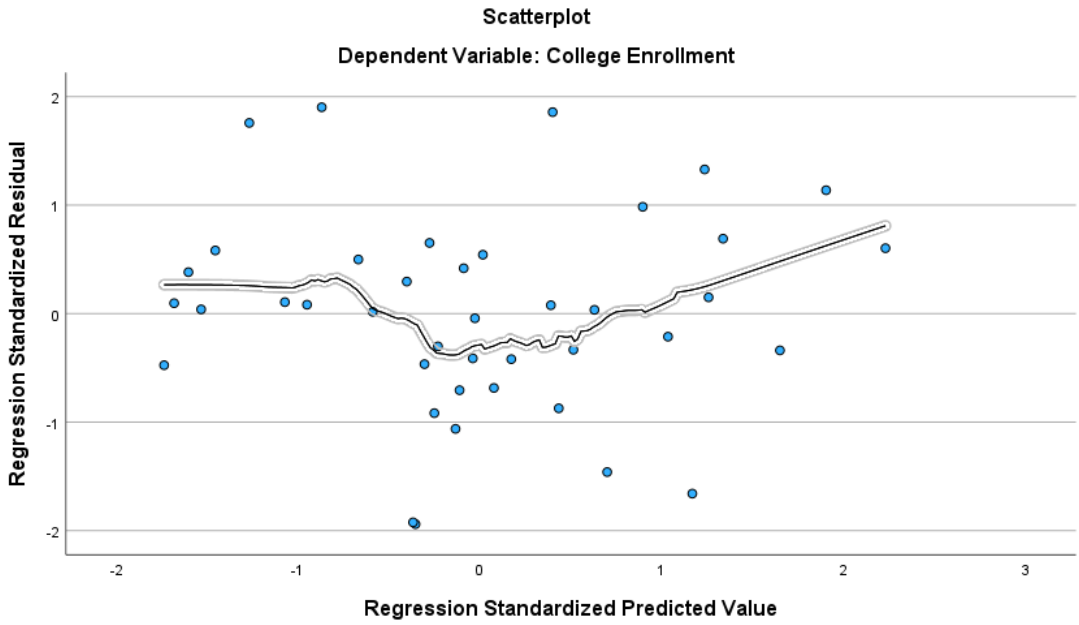


Figure 49. College Enrollment Scatterplot with Loess Line.

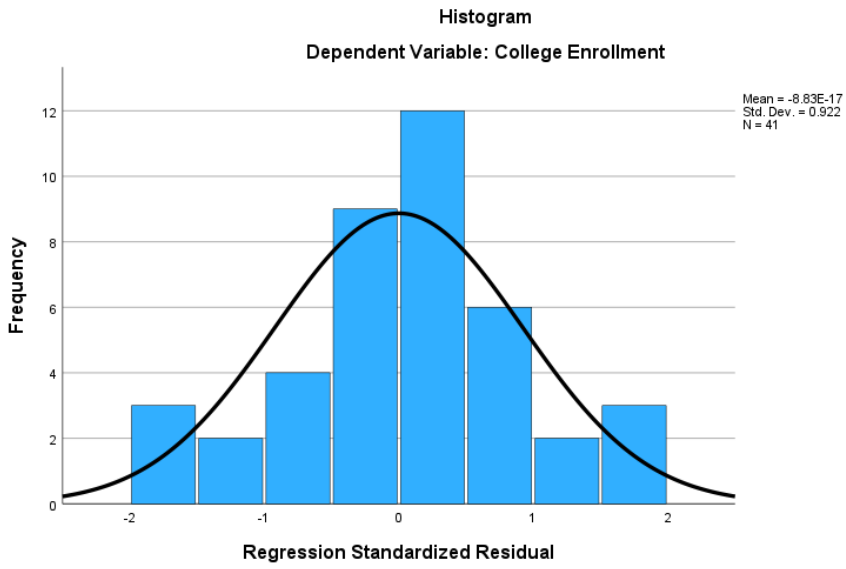


Figure 50. College Enrollment Histogram.

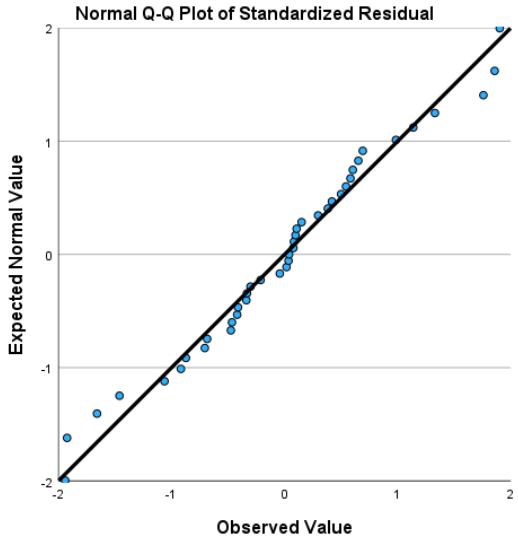


Figure 51. College Enrollment Normal Q-Q Plot.

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