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Daley, Ben

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Improvement Science for College, Career, and Civic Readiness:
Achieving Better Outcomes for Traditionally Underserved Students
through Systematic, Disciplined Inquiry

A dissertation submitted in partial satisfaction of the
requirements for the degree Doctor of Education

in

Educational Leadership

by

Ben Daley

Committee in charge:

University of California, San Diego

Professor Alan Daly, Chair
Professor Amanda Datnow

California State University, San Marcos

Professor Patricia Prado-Olmos

2017

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University of California, San Diego

California State University San Marcos

2017

Dedication

I would like to thank and acknowledge my colleagues, the faculty and staff at High Tech High, too many to list by name, who have contributed to the work in this document. Thank you for embracing working systematically to improve outcomes for students.

Thank you to my committee, who were always supportive in helping me try to do a different kind of project. This project did not always fit neatly into expectations, and Patricia Prado-Olmos and Amanda Datnow were just the right people to help push this work forward. In addition, Alan Daly helped me in more ways than I can count, including talking me back from the brink on occasion, as well as pushing my thinking at critical moments and helping me translate my ideas so they could be better heard.

I want to thank all my new colleagues and friends at the Carnegie Foundation who started me on this path of improvement science. In particular, I want to thank Tony Bryk, Louis Gomez, Alicia Grunow, Paul LeMahieu, Sandra Park, and Sola Takahashi. They each have spent more time helping me on this journey than could reasonably have been expected.

I thank Becky Kanis Margiotta and Joe McCannon of the Billions Institute who have taught me about the science of how practices spread. I also thank Kim Smith at the Pahara Institute, who encouraged me to think about how this work might have a broader national impact.

Thank you to Barbara Chow and Marc Chun from the William and Flora Hewlett Foundation. They not only supported our work financially, but have been great thought partners as well. They have also been willing to take a chance on my ideas, for which I am truly grateful.

Finally, I want to thank my family. Thank you to my parents, Barbara and Phil Daley, for teaching me the importance of education. Thank you to my grandfather, Carlton Daley, who shared with me a passion for reading. Thank you to Joyce Bloss, who has helped so much in the past three years; I could not have done this without you. Thank you to my children, who do not quite understand why I have been away so many evenings. Most of all, thank you to my wife and life partner Cinnamon Bloss, who acted like it was reasonable for me to start graduate school in this phase of our life and who took on so much to make this possible.

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Vita

EDUCATION

- 1995 Bachelor of Science, Haverford College
- 2000 Master of Arts, University of California, Santa Barbara
- 2017 Doctor of Education, University of California, San Diego and California State University

PROFESSIONAL EXPERIENCE

- 2016 - Academic Dean, High Tech High Graduate School of Education
- 2003 - Chief Academic Officer, High Tech High
- 2000 - Founding teacher, High Tech High
- 1998 – 1999 Lecturer in physics, Pomona College
- 1998 – 1999 Assistant basketball coach, Pomona and Pitzer Colleges
- 1996 – 1998 Physics teacher, Madeira School
- 1995 – 1996 Math and science teacher, Brent International School

Abstract of the Dissertation

Improvement Science for College, Career, and Civic Readiness:
Achieving Better Outcomes for Traditionally Underserved Students
through Systematic, Disciplined Inquiry

by

Ben Daley

Doctor of Education in Educational Leadership

University of California, San Diego, 2017
California State University, San Marcos, 2017

Professor Alan Daly, Chair

Preparing more students for success in college, career, and civic life is of critical importance, particularly for traditionally underserved students. Improvement science represents promising ideas and practices for how to achieve greater outcomes for students, particularly at scale. In this dissertation, two projects were undertaken related to college, career, and civic readiness, one to reduce chronic absenteeism and the other to increase Cal Grant award rates. Using improvement science methodology, chronic absenteeism was reduced by up to 85% across three schools and Cal Grant award rates increased from 35% to 46% across five high schools. These projects were written up according to guidelines for reporting on improvement projects taken from healthcare.

Prologue

A ninth-grade student is wrapping up her presentation to her classmates. The teacher scans the room, “Does anyone have a question for Monica?” Three seconds of uncomfortable silence elapse. “Well, I have a question!” the teacher cheerfully announces. The teacher asks a question. Monica responds. The teacher asks, “Any other questions?” in a tone of voice that suggests that no questions are expected. This time two seconds go by. The teacher starts clapping. The class half-heartedly joins in. Monica sits down. The next student stands up. The process repeats.

The year was 2000 and the teacher was me. High Tech High, a new public charter high school in San Diego had opened in the fall. With an emphasis on social class integration and project based learning, student presentations (known in the school as “presentations of learnings” or “POLs”) were already a core feature of the program. Fortunately for me, Rob Riordan, the school’s cheekily self-titled Emperor of Rigor, was sitting in the back of the room during the presentations. At the break, Rob observed, “What strikes me is audience engagement. For your next round, try preparing the audience by asking them to think about what strikes them during the presentation and write that down. Then have them share that with a neighbor. Then ask for questions and comments.” I made the adjustment five minutes later. When I asked for questions and comments at the end of the next presentation, almost every hand in the room shot into the air.

Fast forward seventeen years. I am now the chief academic officer for High Tech High, which has grown to thirteen K12 schools across San Diego County serving over 5000 students and employing over 700 staff. I frequently observe presentations of

learning, which continues to be a widespread practice across our organization. I think it is good news that this practice happens so regularly across our organization, as I believe it leads to students developing oral communication skills as well as confidence, leadership, and other beneficial attributes. We have successfully spread a practice across an organization that spans a county almost the geographic size of the state of Connecticut. The bad news, however, is how frequently the presentations play out just the way they did back in 2000 when I was a teacher. We know a better way to give students feedback at the end of their presentations, but we do not consistently do it. We have spread a practice, but we have not spread it with consistently high quality. In that moment, when I observe an earnest, hard-working, well-meaning teacher execute a practice in a less than ideal manner, I think to myself, “But we already fixed this. We know how to do this.” Of course, “we” have not fixed this; “we” do not know how to do this.

Feedback at the end of a student presentation is just one of thousands of practices that happen on a regular basis across our organization and where the quality of implementation is uneven. I started to learn about the idea of improvement science, an effort to learn how to make practice consistently and systematically better. The idea is to collect data on an area of interest, make small, iterative changes, and then see if those changes lead to an improvement. I read about how industry (Rother, 2010; M. Smith, Saunders, Stuckhardt, & McGinnis, 2013) and then health care (Catchpole et al., 2007; Haynes et al., 2009; Pronovost et al., 2006) have made significant improvements in outcomes by implementing these practices. Following the lead of the Carnegie Foundation for the Advancement of Teaching (Bryk, 2009; Bryk, Gomez, Grunow, & LeMahieu, 2015), I started to wonder how schools might benefit from the implementation

of improvement science principles. In this dissertation, I tried to implement improvement science at High Tech High to more consistently prepare more students for success in college, career, and civic life, with a focus on traditionally underserved students.

Chapter I: Introduction

If the ladder of educational opportunity rises high at the doors of some youth and scarcely rises at the doors of others, while at the same time formal education is made a prerequisite to occupational and social advance, then education may become the means, not of eliminating race and class distinctions, but of deepening and solidifying them (Zook, 1947, p. 36).

In 1947, President Truman's Commission on Higher Education warned that access to higher education could either serve as a tool for social mobility or to exacerbate existing social class stratification. In 1970, 40% of 24 year olds in the top quartile by family income had earned a Bachelor's degree, compared to 6% from the bottom quartile, while in 2013, the top quartile number had leaped to 77% even as the bottom quartile had barely budged to 9% (Cahalan & Perna, 2015). There is a growing recognition among practitioners, scholars, and policy makers that preparing all students for success in college, career, and civic life should be a top priority for the K-12 educational system (Heller, Wolfe, & Steinberg, 2015). From an economic perspective, getting a college degree leads to lower unemployment and higher lifetime earnings, among other positive outcomes (Bureau of Labor Statistics, 2015). From an international competitiveness perspective, the United States has dropped from first in the world in 2000 in percentage of young adults earning a college degree to 19th of 34 OECD countries in 2014 (OECD, 2015),¹ due to improvements in the college graduation rate in other countries while the U.S. rate has remained stagnant. Others observe that the United States has large gaps in life outcomes based on race, class, first generation college going status, language ability, special needs, and other factors (Noguera, Darling-Hammond, & Friedlaender, 2015). As

¹ International comparison rank calculated by author. Data available [here](#).

such, preparing students to graduate from high school ready for success in college, career, and civic life may be viewed as the defining social justice issue of our era.

In this chapter, I aim to provide a high level overview of college, career, and civic readiness. I then focus on four particularly interesting aspects of college, career, and civic readiness: (a) family engagement, (b) sense of belonging, (c) raising awareness of college and career pathways, and (d) academic preparation and eligibility. These four aspects were chosen based on a review of the literature combined with interviews with a broad range of experts, including scholars, practitioners, recent first generation alums, and current first generation high school students. I will then describe a brief history of education reform efforts over the past several decades and identify an opportunity for a new way to think about educational reforms that builds upon the best of earlier efforts. In particular, I will describe improvement science, a promising set of practices from other disciplines, which may prove useful for improving educational outcomes, including college, career, and civic readiness.

College, Career, and Civic Readiness

College, career, and civic readiness are important goals for an effective K-12 educational system. There has been much focus on college readiness in recent years, while career and civic readiness have a tendency to be named in headlines but largely ignored in practice (Hoffman, 2015; Levine & Kawashima-Ginsberg, 2015). Of course, preparation for college shares overlap with preparation for career and life (Conley & McGaughy, 2012), but there are some differences which I aim to elucidate below.

College Readiness. College readiness has been defined as “the degree to which previous educational and personal experiences have equipped [students] for the

expectations and demands they will encounter in college” (Conley, 2008a, p. 3).

Strayhorn (2014) notes that this definition has been criticized for not being specific and operational enough and instead proposes another definition based on Conley’s work: “the level of preparation a student needs in order to enroll and succeed, without remediation, in a credit-bearing general education course at a postsecondary institution that offers a baccalaureate degree or transfer to a baccalaureate program” (as cited in Strayhorn, 2014, p. 974). Yet another framing of college readiness is a four part conceptual model for college readiness: cognitive strategies (e.g. students can interpret results, support arguments with evidence, etc.), content knowledge (foundational content knowledge in reading, math, etc.), learning skills and techniques (self-management skills, etc.), and transition knowledge and skills (the privileged information necessary to navigate the admissions and financial aid processes, etc.) (Conley, McGaughy, Kirtner, van der Valk, & Martinez-Wenzl, 2010). Another similar framework lists three dimensions of college readiness: academic preparedness, college knowledge, and academic tenacity (Borsato, Nagaoka, & Foley, 2013). Academic preparedness refers to key content knowledge and cognitive strategies. College knowledge is similar to Conley’s transition knowledge and skills. Academic tenacity is about the student beliefs and attitudes that lead to student academic success.

Career readiness. Although there is currently significant rhetoric supporting college, career, and civic readiness, career and civic readiness both often take a back seat to college readiness (Hoffman, 2015; Levine & Kawashima-Ginsberg, 2015). This raises the question as to whether college readiness is synonymous with career and civic readiness and if not, what are the same and different about these ideas. Historically,

preparation for college and preparation for a job were seen as entirely different enterprises; in fact, some students were prepared for college and others for work (Conley & McGaughy, 2012). The second vocational high school in the United States, Rindge School of Technical Arts, opened in 1888 with the funding of Frederick Rindge, a local businessman who despite democratic impulses helped to create a pathway for sorting students to their “evident and probable destinies” (Rosenstock & Steinberg, 1995, p. 41) or as he put it more starkly, that the school should serve “boys of strong physique and average talents” (Steinberg, 1997). Unfortunately, nationally, which students were placed onto the college track and which were placed on the vocational track was strongly predicted by socio-economic class (Schwartz, 2014). Today, there is growing recognition that all students should be prepared for both college and career (Conley & McGaughy, 2012). Conley and McGaughy (2012) argue that the overlap between college and career readiness is in skills such as time management, persistence, and ownership of learning as well as reasoning and problem solving, while some practices unique to preparing students for careers include career exploration and other career awareness activities. Additionally, Conley (2014) argues that rather than moving back to a model in which students deemed non-college material are tracked into a vocational track, all students would benefit from options for personalization within their high school experience tailored to the transition they plan to make after graduation.

Civic readiness. Beyond preparation for college and career, it is almost a truism that schools should prepare students for life. However, while most educational organizations claim to prepare students for life, the past several decades of school reform have pushed schools away from this direction (Levine & Kawashima-Ginsberg, 2015).

Further, what precisely we mean by preparing students for life is not entirely clear.

Gibson & Levine (2003) argue that “for more than 250 years, Americans have shared a vision of democracy in which all citizens understand, appreciate, and engage actively in civic and political life” (p. 4) and yet increasing numbers of Americans are disengaging from traditional civic and political institutions, particularly young people.

Levine and Kawashima-Ginsberg (2015) note that the original purpose of public education was to prepare young people for two important roles in the community: jury service and informed voting. In another paper, Levine (2013) described four aspects of the civic mission of schools: (a) civic skills (e.g. working with others to address problems), (b) civic values (e.g. “concern for the common good and the rights of others”), (c) civic engagement (e.g. voting and volunteering), (d) civic knowledge (of law, history, politics, etc). The Spencer Foundation developed an operational definition of civic engagement: engagement across difference and use of evidence in arguments (“Measuring the Quality of Civic and Political Engagement,” n.d.). Engagement across difference refers to understanding the perspectives of people with whom you might disagree and using evidence in arguments is self-explanatory. Six promising practices for increasing the civic readiness of young people include (a) instruction in government and democracy, (b) discussion of current issues, (c) service learning linked to the curriculum, (d) after school activities connected to communities, (e) student participation in school governance, (f) simulations of democratic processes (Levine & Kawashima-Ginsberg, 2015).

Four focus areas. Our team reviewed literature and talked with experts (including high school students and recent graduates) to develop a theory of action about

how to organize our improvement efforts. We became interested in four aspects of college, career, and civic readiness: (a) family engagement, (b) sense of belonging, (c) raising awareness of college and career pathways, and (d) academic preparation and eligibility. Family engagement refers to the ways that parents, siblings, and others can support students in having a college going predisposition, doing well in school, and navigating the college process (Tierney, 2002). Particularly for students traditionally underrepresented on college campuses, having a sense of belonging uncertainty “do I belong here?” can undermine a student’s chances for success (Walton & Cohen, 2011). Raising awareness of college and career pathways refers to several ways that students can better understand life opportunities, including internships, access to mentorship, college visits, career days, and other practices. Academic preparation and eligibility refers to content knowledge and skills as well as mechanical aspects of the college application process such as taking the right courses, preparation for college entrance exams, and filling out financial aid forms (Conley, 2014). These focus areas will be described in greater detail in the next chapter.

Three Waves of Educational Reform²

We want more students to graduate from high school ready for success in college, career, and civic life. There have been many efforts to improve the U.S. K-12 educational system with limited results (Bryk et al., 2015). In this section, I describe a brief history of educational reform efforts from 1983 to the present, using the lens of two waves of

² Thanks to Kim Smith, founder and CEO of the Pahara Institute, for introducing me to the idea of the three waves. The broad concept is Kim’s idea. The details in this paper and the connection to improvement science are my own.

educational reform. I argue that it is time for a third wave of educational reform and that improvement science represents a promising set of practices that can aid a third wave of reformers.

In 1983, the National Commission on Excellence in Education (1983) issued the well-known report *A Nation at Risk*. A blistering assessment of the United States K-12 educational system, the authors argued that “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 et al., 1983, p. 1). Since that time there have been several efforts to reform the U.S. K-12 educational system. Kim Smith, founder of New Schools Venture Fund and founder and CEO of the Pahari Institute, describes these efforts as coming in three waves of reform: thesis, antithesis, and synthesis (K. Smith, personal communication, April 6, 2014).

The first wave of educational reform began in the mid-1980s and included the work by TheodoreSizer and others to establish “essential schools,” meaning both that schools should focus on what is essential and that changing our nation’s elementary and secondary schools was essential to our future (Sizer, 1984). In another well-known book from this era, Powell, Farrar, and Cohen (1985) documented the failings of large, comprehensive, “shopping mall high schools” where in an effort to be all things for all students, schools set low expectations. Under the guise of “student choice,” many lower income and lower performing students ended up with the weakest teachers (A. Powell et al., 1985). Sizer (1984) described the life of a typical high school English teacher in a typical American suburb, where the school was seen as a “good school” within the community. However, the teacher, overwhelmed by trying to teach and give feedback to

five classes of 25 students each followed Horace's compromise: "I won't expect too much of you if you don't expect too much of me." Sizer (1984) did not fault individual teachers for this compromise, but rather felt that the structure of typical schools did not allow for students to be known and known well.

Sizer and other progressive reformers of that time period focused on a bottom up approach through sharing a set of ten common principles and by trying to engage students, families, teachers, and communities in local conversations about school improvement. The first wave reformers had notable successes, including exemplary schools such as Central Park East (Meier, 2002), Urban Academy, and the Francis W. Parker Charter Essential School. However, the first wave reformers failed to realize their ambitions and most U.S. K-12 schools, in structure and pedagogy, remained largely unchanged.

Somewhat in opposition to first wave reform efforts, the second wave of school reform in some ways can also be connected back to *A Nation at Risk* in 1983, but grew more prominent in the early 1990s. The second wave of educational reform is distinctive for its focus on top down policy, school choice, common academic standards, and state and federal accountability. Because of a push for charter and voucher schools, an openness to for-profit organizations, and a frustration with teacher unions, second wave education reforms have been derisively referred to as "corporate ed reform."³ Policies from the past fifteen years consistent with second wave reform ideas include No Child Left Behind, Race to the Top, and focusing teacher evaluation on standardized multiple

³ e.g. see https://www.washingtonpost.com/blogs/answer-sheet/post/a-primer-on-corporate-school-reform/2011/10/26/gIQAyWrUKM_blog.html?utm_term=.cc9474571777

choice test scores. Second wave reformers have arguably been more effective than the first wave reformers, in the sense that their ideas have dominated the U.S. K-12 educational landscape over the past two decades. Second wave reformers have had many successes in the creation of schools, such as well-regarded KIPP, Achievement First, and Uncommon Schools, as well as other organizations such as Teach for America and the New Teacher Project. Further, second wave reforms have focused attention on outcome gaps, particularly for disadvantaged students, that were previously obscured by presentations of average student level data. However, a backlash against second wave style reforms has grown in the last few years. Common Core standards are under attack by a surprising alliance of anti-testing progressives and anti-government conservatives. The opt-out movement from standardized testing, while still small, has garnered considerable attention. The ability of schools of choice to raise standardized test scores has been mixed (Cremata et al., 2013). The massive increase in the role of the federal government in U.S. K-12 education is increasingly questioned.

In this context, it is time for a third wave of educational reform, which is a synthesis of the best ideas from the first and second waves of reform. Third wave reform efforts will focus on data as second wave reformers have insisted, but a broader range of data through a system of assessments (Conley & Darling-Hammond, 2013), acknowledging first wave reformers' argument that an overreliance on multiple choice test scores has narrowed the curriculum and undermined the true purpose of education (e.g. see Kohn, 2000). Similarly, third wave reform efforts will attempt to side step back and forth debates about charter schools and unions and focus on areas of agreement about improving teaching practice through organized partnerships of schools regardless of

governance model. Finally, third wave efforts will seek to balance the importance of spreading good ideas at scale while acknowledging the need for local adaptation of these good ideas.

When I heard the story of the three waves of educational reform, it instantly resonated for several reasons. Although I did not have the language of the first and second waves of reform, as the chief academic officer of a network of progressive minded public charter schools, for the past 17 years I have found myself with one foot in the first wave of Coalition of Essential Schools and Deeper Learning style reforms but the other foot in the “ed reform” camp of school choice. I agreed with my first wave colleagues’ dismay at the overuse and misuse of multiple choice standardized tests but also shared my second wave colleagues’ impatience with an exclusive focus on bottom up solutions as well as what I perceived from some first wave reformers as a “failure to compromise.” When I learned about improvement science, I saw an opportunity to bring my two worlds together. Practitioners of improvement science argue that we cannot improve at scale that which we cannot measure, a second wave idea (Bryk et al., 2015). But improvement scientists also argue that in order to change the outcomes, you have to change the process that led to those outcomes (Bryk et al., 2015; Grayson, 2013). In this way, improvement science rejects the second wave argument that all that should be measured is outcome data, because measuring process level data is equally important. Similarly, improvement science argues for seeing the system, including the policy milieu in which educators and students work, consistent with second wave aspirations. But improvement science also insists upon a user-centered perspective, such as listening carefully to the voices of students and teachers, a first wave principle. Finally,

improvement science pays careful attention to how to scale and spread practices, also a preoccupation of the second wave reformers. However, improvement science also recognizes that local adaptations of practices and ownership of ideas are critical, and that “best practices” cannot be imposed from above across a school, district, or country, a strongly held first wave argument.

Improvement science represents a promising opportunity to instantiate the theory of the third wave of educational reform. Educators from across the ideological spectrum might work together on common problems of practice if the correct grain size of problem is chosen. For example, educators from almost any school would agree that helping students to work well together is an important goal and a challenging task. One could imagine educators from “no excuses” style schools and “progressive” schools working together on a common goal of more students learning to work well in groups (and attending to social justice concerns in this context), using a common theory of action and some common measures of success. Regardless of school governance model or pedagogical leaning, these educators might make more progress on the issue of improving student collaboration skills through working together than apart.

The larger goal of this project broadly speaking was to improve college, career, and civic readiness outcomes at a K-12 organization. For the purposes of this dissertation, I focused deeply on two specific improvement projects at High Tech High, reducing chronic absenteeism and increasing Cal Grant award rates, especially for low income students. While there are other improvement projects underway at High Tech High addressing career and civic readiness, these two projects were primarily related to college readiness. Other goals of this project were to learn how and whether improvement

science might be a useful set of ideas and practices in an educational context, to experiment with using improvement science practices as the methodology for a dissertation in an Ed.D. in educational leadership, and to report on this work using a model of standards for reporting on improvement projects in healthcare. As far as I am aware, these two reports are the first in an educational context to report on improvement projects using these healthcare standards. It is hoped that these example reports can help advance a conversation about how to report on educational improvement projects. Taken together, the goals of this project were to improve outcomes for students and to contribute to an ongoing conversation about improvement science and education reform.

Chapter II: Review of Relevant Literature

The goal in this project was to graduate more students from a K-12 organization that are ready for success in college, career, and civic life using improvement science methodology. This chapter will describe improvement science, its theoretical underpinnings, the tools of improvement science, results of improvement science outside of education and then results inside education. The chapter will then focus on four areas within college, career, and civic readiness (family engagement, sense of belonging, raising awareness of college and career pathways, and academic preparation and eligibility). I am not aware of any improvement science projects focusing on improving college, career, and civic readiness, and so I describe why this was a worthwhile area of study.

Improvement Science

Improvement science (aka improvement research or quality improvement or improvement)⁴ is a solution to a problem: the current educational research infrastructure is not doing enough to improve our nation's schools (Bryk, 2009; Bryk & Gomez, 2008; Bryk, Gomez, & Grunow, 2011; Donovan, 2013). Critics of current educational research argue that it is frequently disconnected from practice (Anderson & Shattuck, 2012; Bryk et al., 2011; Penuel, Fishman, Cheng, & Sabelli, 2011; The Design-Based Research Collective, 2003) and does not scale across contexts (Bryk, 2009; Bryk et al., 2011, 2015). To enable educational research to be more relevant, some scholars argue that educational research should be conducted by teams of scholars and practitioners together

⁴ The terms are often used interchangeably in the literature.

and should focus on improving problems of practice (Bryk et al., 2011; Donovan, 2013; Gutiérrez & Penuel, 2014; Russell et al., 2015). In this section, I aim to describe the history and philosophy of improvement science, acknowledge criticisms of bringing improvement science and related ideas into education, describe some of the tools of improvement science, and discuss successes of improvement science both inside and outside of education.

Translating Research into Practice. Improvement science challenges existing epistemologies of “What counts as research?” While the randomized control trial (RCT) has been enormously successful in many areas of scientific inquiry, including drug development, it is not the only method for developing new knowledge (Berwick, 2008). Indeed, when conducting research on complex systems of human behavior, “the RCT is an impoverished way to learn. Critics who use it as a truth standard in this context are incorrect” (Berwick, 2008, p. 1183). Two areas of research that have aimed to make educational research more relevant to practice include translational research and action research (Dolle, Wardrip, Russell, Gomez, & Bryk, 2012). In translational research, information flows down from scholars to practitioners, as theories are well developed by scholars and then are attempted to be implemented by practitioners. However, translational research has been critiqued for becoming too removed from local contexts in its efforts to create generalizable knowledge (Dolle et al., 2012). In action research, in contrast, information flows up. Individual teachers or groups of teachers study local problems of practice in systematic ways. This knowledge may become aggregated to form more general theories, but action research, because it is so grounded in a particular context, has been criticized for failing to work across contexts and thus build scalable

knowledge (Dolle et al., 2012). Dolle et al. (2012) argue that improvement science is well situated as a new form of educational research to address the shortcomings of randomized control trials, translational research, and action research because it focuses on improving problems of practice at scale.

Another form of research that attempts to connect research to practice is design-based research (Anderson & Shattuck, 2012; Penuel et al., 2011; The Design-Based Research Collective, 2003). In design-based research, teams of researchers and practitioners work together to study how to improve problems of practice (Penuel et al., 2011). At first glance, it is not obvious how design-based research differs from improvement science and why there would be two different names for such similar activities. However, improvement science has a set of tools and goals that are notably different from empirical studies that use a design-based research approach. For example, using a design-based research approach, scholars at a graduate school of education partnered with a rural school district to try to better prepare school leaders (Sanzo, Myran, & Clayton, 2011). While these scholars wanted to improve the quality of their leadership preparation program, their research questions were about answering academic questions, e.g. “How does embedding leadership preparation in the context of practice help build stronger bridges between theory and practice?” (Sanzo et al., 2011, p. 298). An improvement science perspective would focus squarely on improving the quality of leadership preparation and then scaling and spreading high quality leadership preparation.

Theoretical Basis of Improvement Science. While improvement science is relatively new to education, it has a rich theoretical foundation. Key ideas and thinkers in improvement science include the learning organization (Senge, 2006), double-loop

learning (Argyris, 1991), C-level learning (Englebart, 2003), Edwards Deming (1986), industrial quality and variation (Shewhart, 1925, 1926), quality management (Juran, 1956), and total quality management (T. Powell, 1995; Schmoker & Wilson, 1993b).

Morgan (2006) identified multiple metaphors that may be used to better understand organizations. The dominant view of organizations throughout the 20th century was as machines to be optimized. This view was articulated and developed by Frederick the Great of Prussia in the mid-1700s and Frederick Taylor in the early 1900s. This perspective came to be known as scientific management and includes ideas such as: (a) managers are responsible for thinking while workers are responsible for doing; (b) find the most efficient and precise way to complete a task; (c) select and train workers on the task; and then (d) monitor workers to ensure compliance (Morgan, 2006). Scientific management has been critiqued as creating organizations that are rigid bureaucracies that develop employee apathy and encourage passivity, and as a result, other competing theories of organizations developed (Morgan, 2006).

In opposition to viewing organizations as optimizable machines, a competing metaphor is to view organizations as brains, which is to say flexible, resilient, and inventive learning organizations (Morgan, 2006; Senge, 2006). If viewed in this way, organizations may be understood to be able to learn how to learn (Morgan, 2006).

Argyris (1991) described learning as detecting and correcting errors. Frequently, when an error is discovered, people will attempt to make a change that does not question the “goals, values, plans and rules” of the normal operations of the organization (Mark Smith, n.d.). This type of response is called single-loop learning (Argyris, 1991). In contrast, double-loop learning requires questioning the fundamental ways that an

organization operates; double-loop learning requires the organization to learn how it learns (Mirvis, 2006). Relatedly, Engelbart (2003) argued that for any organization, there are three domains of activity related to improvement. A-level activity is the core activity of the organization. In K-12 schools, one example of A-level activity would be teaching and learning. B-level activity is the part of the organization concerned with how to get better at A-level activity. In K-12 schools, B-level activity could be professional development for teachers, including the people, systems, and resources focused on helping teachers get better at the core A-level activity of teaching and learning. Engelbart believed there is an additional level of activity possible in organizations: C-level activity. C-level activity is the next step beyond B-level activity and is focused on systematically getting better at how we improve (Engelbart, 2003). In K-12 schools, C-level activity could be systematically studying and improving the effectiveness of professional development for teachers. Improvement science is fundamentally about C-level activity, getting better at getting better (Bryk et al., 2015).

One contributor to the theory of learning organizations was the statistician and management consultant Edwards Deming, known for helping to transform Japanese industry in the 1950s through a series of ideas opposed to scientific management (Holt, 1993). In contrast to scientific management principles, where the manager's job is to monitor for compliance, Deming (1986) dismissed the feasibility and wisdom of such inspection. Instead, he argued that employees should be managed such that they can monitor and inspect their own work (Schmoker & Wilson, 1993b). Rather than attempting to improve the final product through inspection at the end, Deming argued for building quality control into the process itself (Holt, 1993) and argued for a process of

continuous improvement: “improve constantly and forever” (Deming, 1986, p. 23).

Deming believed his theories had implications for leadership. According to Deming, leadership is not about supervision; it is about finding ways to help workers do their jobs better. “The aim of leadership is not merely to find and record failures of men, but to remove the causes of failure: to help people to do a better job with less effort” (Deming, 1986, p. 90). In Deming’s view, quality comes from top management, not from exhortations that workers try harder (Holt, 1993).

Another key idea in improvement science is to understand variation (Shewhart, 1925, 1926). In any system, there will naturally be variation both in processes and outcomes. Some variation is due to random chance, which Shewhart referred to as common cause variation. Other variation is so significant as to be due to something other than random chance, which Shewhart referred to as special cause variation (Perla, Provost, & Parry, 2013). Understanding whether variation is due to common or special cause is important because improvement teams could leap to make changes due to variation that is merely due to random chance. A concrete life example would be for a dieter to step on the scale, observe a gain of one pound, and abandon a current weight loss plan rather than recognizing that small fluctuations of weight are to be expected. Shewhart’s control charts help practitioners of improvement science understand the variation in data that they are observing (Shewhart, 1926).

Although Deming reportedly disliked the term and did not agree with all aspects of the concept, total quality management (TQM) is a set of ideas and practices built upon Deming’s work that came into prominence in business management in the second half of the 20th century (Peck & Reitzug, 2012; T. Powell, 1995). Key ideas from TQM include

focusing on the customer, continuous improvement, and systems thinking (Peck & Reitzug, 2012), as well as teamwork and the idea that employees should gather data which is used to guide decision making (Schmoker & Wilson, 1993c). While TQM advocates for the rigorous use of data, it is noteworthy that data are used to improve the overall system, not to blame individuals (Schmoker & Wilson, 1993c).

Improvement science is based on systems thinking: understanding how a particular intervention fits within a larger system of actors, pressures, and structures (Perla et al., 2013). Bryk et al. (2015) argue that making improvements in complex systems is not about changing individual behavior, whether through incentives (e.g. merit pay) or better training for individuals, but is rather best accomplished through first seeing the complexities of the system and then analyzing and implementing the most efficacious change ideas. Systems thinking grows out of double loop learning (Argyris, 1991) and TQM (Peck & Reitzug, 2012, p. 372). Additionally, in contrast to scientific management that presumes that workers will not be motivated to do good work without inspection by their manager, Deming and improvement science enthusiasts believe that individuals will naturally try to do high quality work; the challenge is changing the system they work within (Bryk et al., 2015).

TQM advocates for a focus on the customer (Peck & Reitzug, 2012, p. 372). Similarly, improvement science advocates for user centered design, which includes scholars focusing on the problems that practitioners actually have and building partnerships between scholars and practitioners to solve common problems of practice (Bryk, 2014). Bryk et al. (2015) argue that by more closely connecting scholarship and practice, it will be possible to create solutions more likely to be successfully

implemented. Similarly, Juran (1956) is credited with bringing a human dimension to the quality management process. In contrast with scientific management, Juran (1956) argued for more human centered management, such as the importance of including people closest to the work in the decision-making process and understanding other people's perspectives when trying to introduce change into an organization. This principle is seen today in improvement science with the mantra to be user centered, which includes including educators in the design of potential solutions and listening well to the actual problems of educators before rushing in with solutions (Bryk et al., 2015).

One aspect of improvement science is identifying high leverage processes that currently have high variability in execution and outcome that are likely to benefit from creating standard work processes (Bryk, 2014). Standard work processes are a way to create routines that people can rely upon that reduce complexity and improve quality (Bryk, 2014). In healthcare, hospital systems have used standard work processes, such as checklists, to dramatically improve patient outcomes while maintaining the creative aspects of being a doctor (Gawande, 2010).

Improvement science scholars argue that improving at scale requires measurement, because when a change has been introduced into the system, it is important to get objective confirmation as to whether the change has had the intended effect (Bryk, 2014). Improvement scholars argue for a range of data, including both outcome and process data. Outcome data includes outcomes such as college graduation rates, while process data is data that tells improvement science practitioners how a process is being implemented. For example, the number of families who attend a school financial aid night is a measure of the school's process in supporting more students to attend college.

Balancing measures (Bryk, 2014) help to ensure that the change being implemented is not creating other problems throughout the system, e.g. a survey of student engagement might be a balancing measure to ensure that curriculum is not being narrowed due to focus on test scores.

Criticisms. However, some scholars raise questions about the wisdom of importing TQM principles into schools. In a survey of 30 CEOs of for-profit companies, Powell (1995) found that higher performance was not explainable due to the presence of TQM tools. Instead, higher performance was linked to underlying principles connected to TQM, such as open culture and employee empowerment, suggesting that imposing TQM tools (and perhaps by extension improvement science tools) on organizations not built upon these basic principles will have limited impact. In another study, Peck and Reitzug (2012), through close textual analysis of business management and educational leadership textbooks, charted the trend of how business management ideas, including TQM, become popular, lose popularity, and then excitedly become popular trends in educational leadership despite already having faded in the business world. A more global concern about importing TQM and Deming's ideas into schools comes from Alfie Kohn (1993). In addition to arguing that many advocates of bringing Deming and TQM into schools fail to interpret these ideas correctly, Kohn (1993) goes further to argue that importing business ideas, even properly understood, into education is inappropriate in the first place. For example, Kohn (1993) argues that focusing on data will almost certainly result in schools reducing the curriculum to a focus on standardized test scores.

These critiques of TQM and Deming in education certainly give pause and should be taken seriously. However, although it is important not to become uncritically

enthusiastic of business ideas, particularly those that have fallen out of fashion, the underlying principles behind these ideas may still have merit, even if the brand is no longer trendy. Schmoker and Wilson (1993a) respond to Kohn’s critique by arguing that TQM principles should be adapted for education, not wholesale uncritically adopted.

Improvement science practices. Improvement science as a field has a number of practices that are typically utilized in the course of an improvement project (Bryk et al., 2015; Langley et al., 2009). There are two broad methodological activities within improvement science: understanding the problem and taking action.⁵ Understanding the problem is an important step because it is easy to jump directly to solutions without fully understanding the problem you are actually trying to solve or what Bryk et al. (2015) refer to as “solutionitis.” Root cause analysis is an effort to dig deeper into a problem to better understand not just the first layer of understanding a problem but to get down into deeper causes of the problem. Part of understanding the problem includes using analysis of data to better see the system (Bryk et al., 2015). Examples of tools for understanding the problem include the fishbone or ishikawa diagram (Langley et al., 2009), the 90 day cycle report (Park & Takahashi, 2013), empathy interviews (“Method: Interview for empathy,” n.d.) with people closest to the issue (e.g. recent high school graduates), and “expert convenings.” At the same time, understanding the problem exists in tension with

⁵ This conceptualization of improvement science came from a conversation with Anna Kavar from the Carnegie Foundation for the Advancement of Teaching on October 13, 2015. Kavar observed that driver diagrams were developed as a tool in healthcare because teams tended to spend too much time analyzing the problem and needed a push to action. According to Kavar, as improvement science has been implemented in education, there is a tendency for teams to rush to action, and yet these teams may not be spending enough time on deep problem analysis. My colleague Stacey Caillier and I thought that naming “understanding the problem” and “taking action” might help educators recognize both phases as important and complementary.

taking action. One can imagine a group spinning its wheels on root cause analysis and not getting going with solving the problem. Tools for taking action include the Plan-Do-Study-Act (PDSA) cycle, change ideas, and improvement reviews (Reinertsen, Pugh, & Nolan, 2003). The driver diagram (Langley et al., 2009) is a theory of action that sits at the intersection of understanding the problem and taking action. Underlying all of the work is a system of measurements that are practical measures (Yeager, Bryk, Muchick, Hausman, & Morales, 2014). I organized several of the tools of improvement science in figure 1.

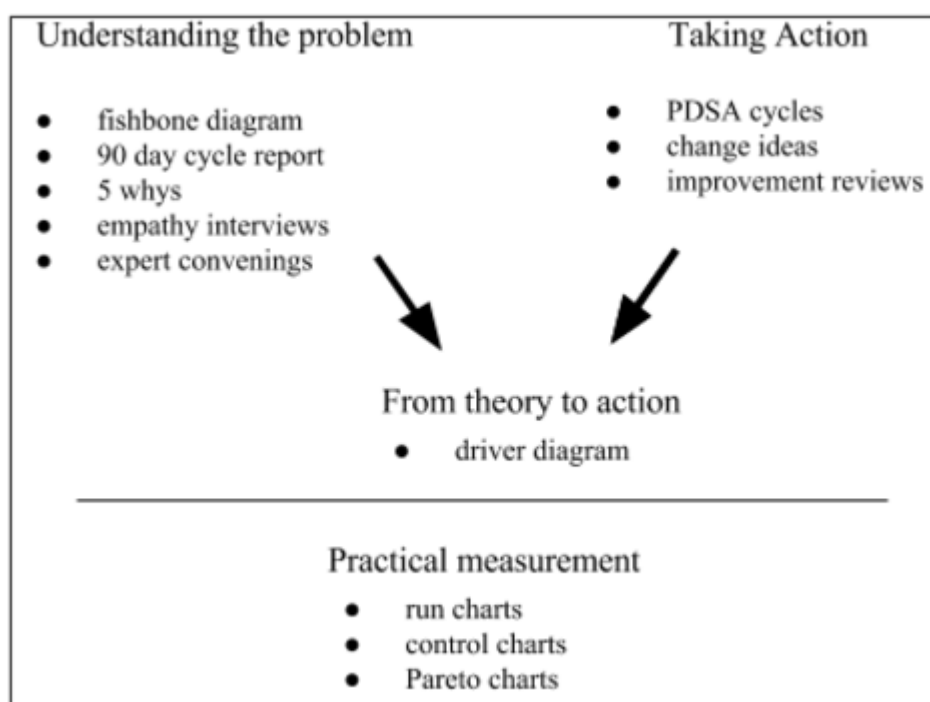


Figure 1: The tools of improvement science

The fishbone or ishikawa diagram (Langley et al., 2009) is an organizing tool that helps people explore root causes of problems. Fishbone diagrams are divergent tools (Kaner, 2014) that enable teams to brainstorm all the possible causes of the problem they are aiming to improve, and then to group those different causes into common “bones” of

the diagram to represent the big causes of the problem. Such root cause analysis is important to ensure that teams do not rush to action without fully understanding the problem (Bryk et al., 2015). The 90-day cycle report (Park & Takahashi, 2013) is a structured and systematic method to rapidly gather information about a topic and results in a product intended to be useful to an improvement team. Steps in producing a 90-day cycle report include consulting relevant academic literature and interviewing experts (broadly defined) as well as prototyping tools such as driver diagrams, measurement tools, or processes. Empathy interviews, popularized by (among others) the d.school at Stanford University (“Method: Interview for empathy,” n.d.) are a method for learning more about a system from the point of view of participants in the system (e.g. students, parents, teachers). As noted by Bryk et al. (2015), it is important to frame the problem from the point of view of the user so that the work is addressing a felt need. A related concept is the expert convening, which is similar to empathy interviews but includes participants from within the system as well as people from outside the system who have particular expertise in the subject of interest, whether as someone who has had success in improving that outcome in another context or someone who has developed scholarly knowledge (Grunow, 2015).

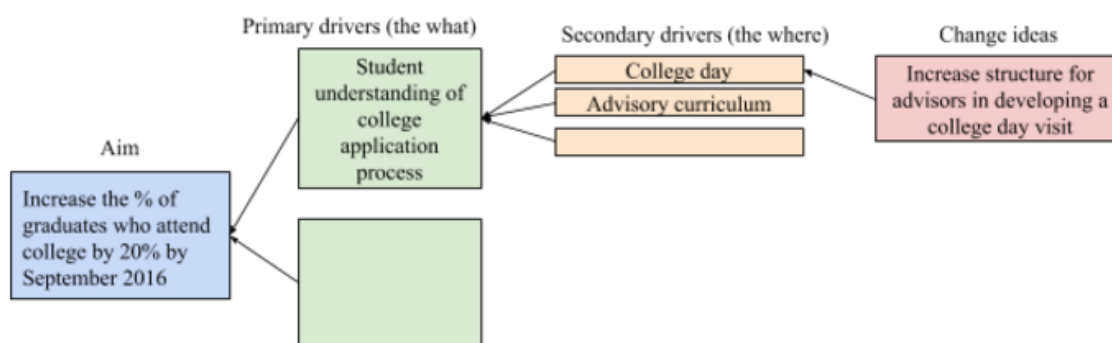
The plan-do-study-act cycle is a method for implementing the model for improvement (Langley et al., 2009). In the PDSA cycle, teams (a) create a plan, which includes making specific predictions about what will happen as a result of a change; (b) do the change (a “change idea”) in a small-scale manner; (c) study the results of the change, including seeing whether the predictions came true or not; and (d) act to make the change permanent or to try a different change. According to Perla et al. (2013), PDSA

cycles are consistent with seeing improvement science as part of the scientific method, because the steps include predictions, data gathering, and data analysis, all of which leads to another cycle of inquiry.

In the improvement review (Reinertsen et al., 2003), an improvement team shares their aim statement, driver diagram, and measures (aka goal, theory, and data). Other people in the organization not on that team ask questions about the work and then discuss the work while the presenters only listen. Then the presenters come back into the conversation to share what they've learned from the conversation. The High Tech High version of the improvement review is roughly that of the consultancy protocol (McDonald, Mohr, Dichter, & McDonald, 2007). The improvement review may be an effective way to build a culture of improvement within an organization or improvement community. The review encourages the presenting team to get organized, to complete some partially finished work, and to push the work forward. For others, the review appears to get everyone up to speed on work happening in the organization, builds deeper understanding of the improvement process, and develops enthusiasm for the work.

Sitting at the intersection of understanding the problem and taking action is the driver diagram (see figure 2). The driver diagram (Bryk et al., 2015) is a tool for developing and articulating a theory of action. On the left of the diagram is the aim or the goal. Immediately to the right of the aim are the primary drivers which are the presumed causes for why the aim is not already being met. Next are the secondary drivers which are where in the system there is an opportunity to impact the primary driver. For example, if an obstacle to students going to college is an understanding of the college application process, an advisory or counseling program might be a place in a school where an

intervention could occur to try to increase student understanding of the application process. This leaves open the question of what to do in this advisory program. All the students in the advisory group might visit a college on a college day. There could be a formal college counseling curriculum during advisory sessions. Advisors and advisees might meet to discuss the status of the college application or to give feedback on the advisee's college essay. With an improvement science lens, these ideas could be viewed as change ideas. Even within these different change ideas, there are change ideas about specific aspects of each approach. For example, "holding a college day" still leaves many open questions. Advisors might schedule this on their own. There could be school structures to support advisors in planning this college day. Diving down into the details of a specific change idea, there is an opportunity to learn about how to make that intervention most effective and to occur consistently across the system. The PDSA cycle is a mechanism that helps to formalize learning about how to improve the change idea as well as to help effective ideas travel from one context to another.



If we want to improve our aim, then we need to focus on a primary driver, at the secondary driver, and one way to do that is through a change idea.

Figure 2: Idealized example of a driver diagram

In conducting an improvement science project, the team must define a common

aim, and this aim must be measurable (Bryk et al., 2011). Yeager et al. (2014) describe two traditional needs of educational measurement, for accountability and for theory development. Measuring for accountability is about knowing how individual actors (e.g. students, teachers, schools, states) are doing. Measuring for theory development is about helping to determine what is happening conceptually. Yeager et al. (2014) argue that for practitioners on the ground, a different type of measurement is needed, which they define as “practical measurement.” Practitioners engaged in improvement science require measures that directly measure the target, that are contextualized to the appropriate audience under study, and that are designed to work within the constraints of day-to-day practice. For example, a survey might need to be answerable in only three minutes and as such must have carefully selected questions that eliminate redundancy and precisely give practitioners of improvement science information about their targeted goal (Yeager et al., 2014).

Frequently utilized ways to analyze data in an improvement science project include run charts, control charts, and Pareto charts. Run charts display data over time which enables the team to place data in historical context and to identify patterns in data. Run charts are useful for making process data visible and for understanding if change ideas have led to an improvement (Perla, Provost, & Murray, 2011). Figure 3 shows an example of a run chart showing HTH graduates self-report data on 4-year college going. Prior to this year, High Tech High would look at a snapshot of data like this every year, but never displayed the data longitudinally. While in retrospect this seems shocking, I suspect that it is rather common practice in schools.

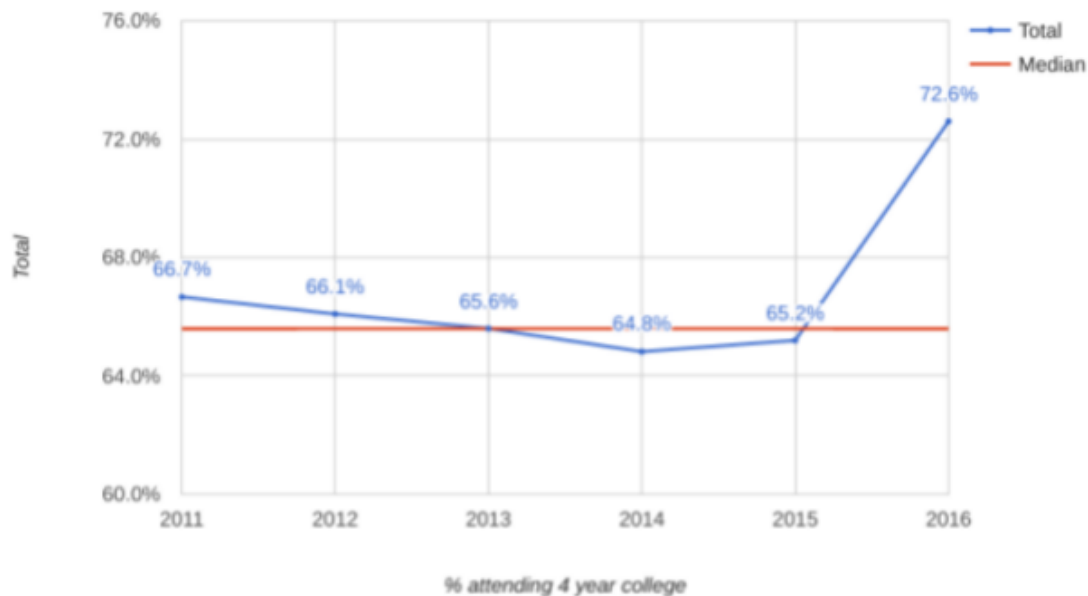


Figure 3: Percentage of HTH graduates attending 4-year colleges (self report)

Thus far in our work, most of the data we have collected and charted has been annual data (e.g. percentage of graduates applying to college, average attendance for the year). We have found tracking annualized data through run charts to be very useful for understanding our system and identifying trends in the data related to our nascent improvement efforts. However, with such infrequent data collection, run charts have small numbers of data points, which limits our ability to make statistically sound claims about the data. More than 10 data points are required to run statistical tests on run charts (Perla et al., 2011). Additionally, annual data does not allow for rapid cycles of inquiry.

Statistical tests when analyzing run charts and control charts are different than traditional methods for determining statistical significance because of the focus on the time order of the data (Perla et al., 2011). Because this type of statistical analysis is relatively uncommon in educational research, the details of creating such charts and statistically analyzing them is presented here. To construct a run chart, data of interest for

improvement is charted over time and the median of the data is plotted as a straight line through the data points. The danger in looking at a run chart is that it is easy to overreact to a small number of data points or the most recent data point, which may be due to random chance as opposed to improvement efforts (Perla et al., 2011). To guard against this trend, there are a series of rules used to interpret the data, which are based on the $p < 0.05$ level of significance and which therefore assure greater likelihood that observed changes are not due to chance (Perla et al., 2011). These rules include shift (six or more consecutive points all above or below the median line), trend (five or more consecutive points all going up or all going down), and runs (data crosses the median line too often or not often enough to be due to random chance) (Perla et al., 2011; Provost & Murray, 2011). If there is an observable shift, trend, or run in the run chart (as formally defined here), then although there is not certainty of a causal relationship, there is at least statistically suggestive evidence that changes in outcomes are due to changes implemented as opposed to random fluctuations in data.

Control charts (Shewhart, 1926), also known as statistical process control charts, SPC charts, or Shewhart charts, provide information on whether changes in data are due to random fluctuation or due to intentional changes to the system. Shewhart (1926) observed that repeatedly measuring any process will result in data that varies; for example, if someone shoots at a target, all the shots will not land exactly on the bullseye. However, if the shots are clustered around some spot other than the bullseye, it would seem clear that there was some reason for this (e.g. the gun sight was out of alignment), and Shewhart referred to this as “special cause variation” in contrast to “common cause variation” which is just variation due to natural fluctuations (Benneyan, Lloyd, & Plsek,

2003). The key insight is that people tend to assume that there is a reason for variation (e.g. improvement efforts are working) when much variation is actually just natural fluctuation (Shewhart, 1926). Control charts are similar to run charts, but have a mean line rather than median and also include upper and lower control limit lines. The purpose of the control limits is to identify whether changes in data are due to common or special cause, or put more simply whether the changes are important. If data points vary but remain within control limits, then the variation is not important from an improvement perspective. It is only when data moves beyond the control limits that a statistical argument can be made that the changes introduced into the system are potentially causing a meaningful change in outcomes.

The Pareto Principle states that 80% of the variation in an outcome is often due to 20% of the possible causes of that outcome (Bryk et al., 2015). A Pareto chart makes it easier to see the causes most responsible for the variation in outcomes. An example of a Pareto chart is shown in figure 4. High Tech High has begun an improvement project focused on how to improve support for new teachers, with a focus on improving the mentoring process. Our first assumption was that we should concentrate our efforts on the first year of teaching as we thought that many teachers either made it or did not in their first year at High Tech High. To our surprise, 92% of new teachers stay on for a second year at High Tech High. The Pareto chart quickly shows that of teachers who leave, they are most likely to leave after their second year.⁶ While this does not mean that teachers in

⁶ Note that this chart shows teachers leaving HTH, not leaving the profession, which is the more commonly presented data. To be clear, 100% of teachers do not leave HTH within 5 years. The chart is only of the teachers who left.

their first year would not benefit from more support, it does suggest looking more closely at the second and third year teaching experience, as 63% of teachers who leave HTH do so after their second or third year. Pareto charts are one example of a tool for analyzing and displaying data that is useful to improvement teams both for understanding the system they are trying to improve as well as communicating information to others.

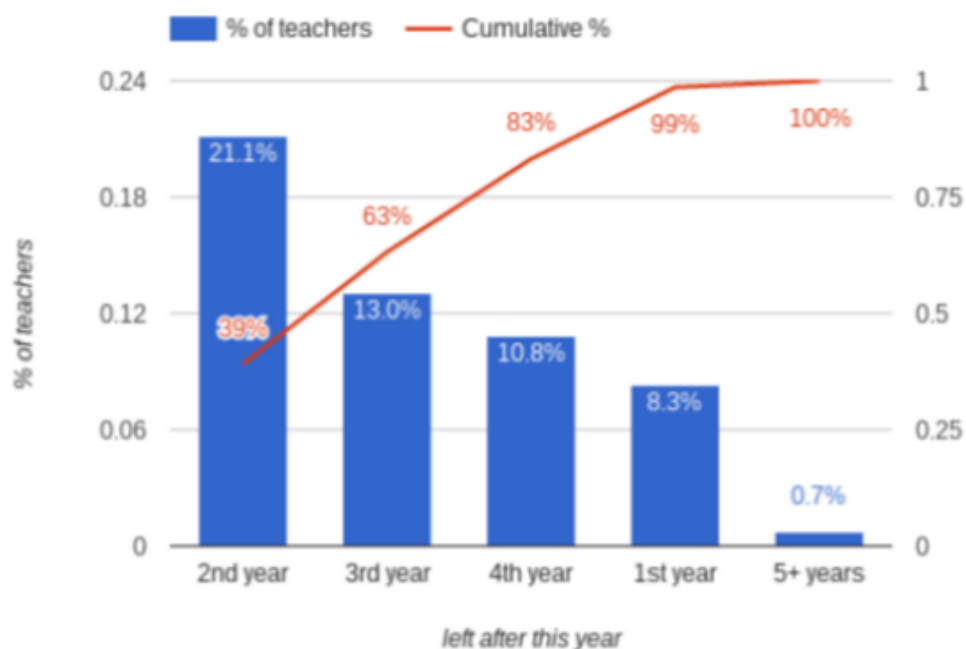


Figure 4: For teachers who left HTH, percentage who left after each year of teaching (2006 and later)

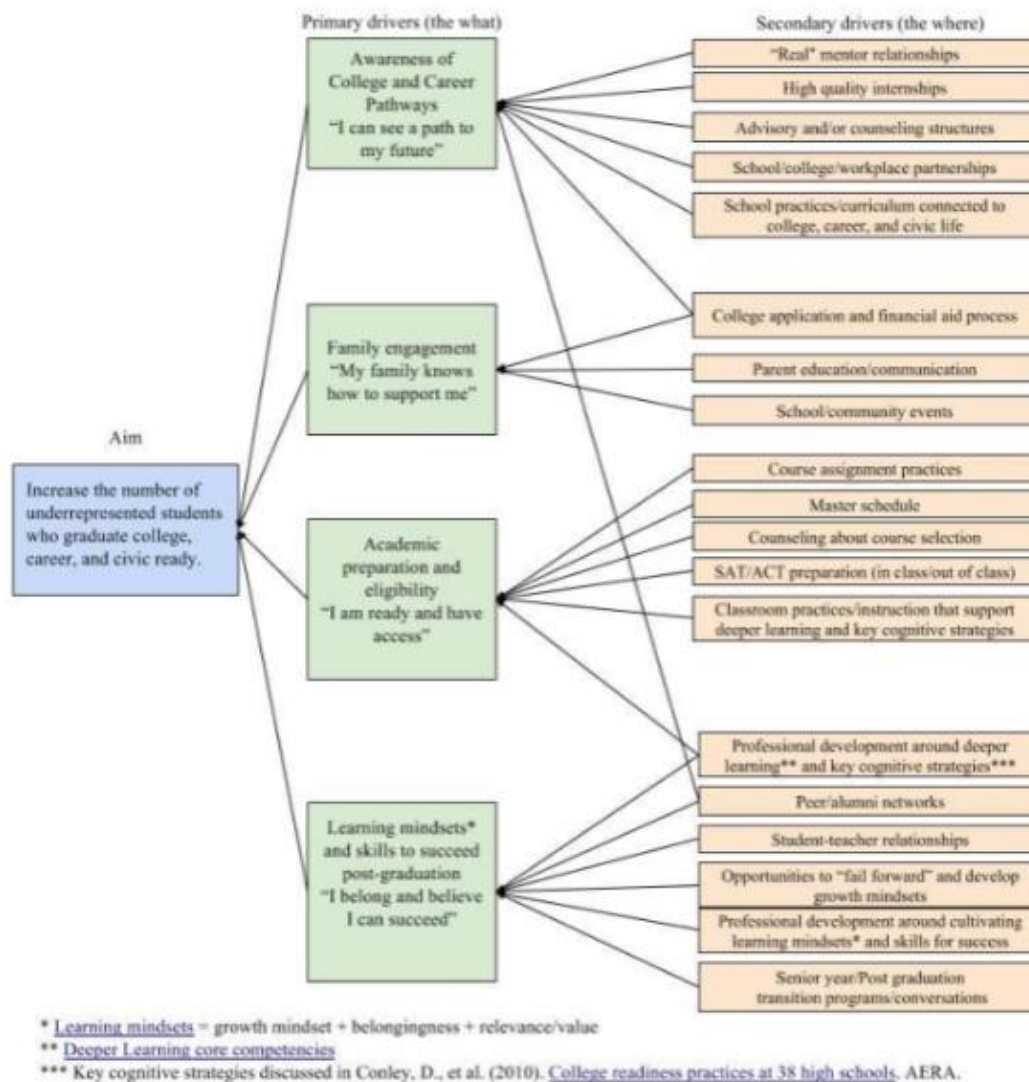
To summarize, key practices within improvement science include tools for understanding the problem a team is trying to solve, tools for taking action, and tools for understanding if actions taken are leading to an improvement towards desired aims. Having described these tools, I now turn my attention to the results of improvement science in a range of industries and nascent efforts to bring improvement science into education.

Results of improvement science. Scholars and practitioners have had success using improvement science methods to solve important problems of practice across different disciplines. U.S. domestic airlines dramatically reduced fatalities in airline takeoffs (M. Smith et al., 2013). Toyota famously achieved high reliability in auto manufacturing with the Toyota Production System using these methods (Rother, 2010). Hospitals across the state of Michigan reduced catheter-related infections by 66% by increasing the frequency of desirable clinician behaviors, e.g. hand washing (Pronovost et al., 2006). Researchers in the UK reduced errors by 42% during transfer of pediatric heart surgery patients to the intensive care unit by improving the process using a handover protocol modeled after a Formula-1 pit-stop team (Catchpole et al., 2007). Researchers studied patient outcomes before and after implementing a surgical safety checklist in eight hospitals around the world and reduced death rates and complications by 33% (Haynes et al., 2009).

While improvement science has achieved dramatic results in industry and healthcare, there are now efforts underway to improve educational outcomes using improvement science methodology. The Carnegie Foundation for the Advancement of Teaching began a project known as Pathways to improve outcomes in developmental math classes beginning in fall 2011 (Van Campen, Sowers, & Strother, 2013). According to baseline data, at the community colleges participating in this project, only 15% of developmental math students had received credit for college level mathematics within two years, while within the intervention group, this number rose to 52% in one year. In other words, over three times as many students earned college mathematics credit in half the time (Van Campen et al., 2013). There are other efforts in K12 education underway as

well. These projects include improving the frequency and quality of feedback and mentoring for new teachers (Hannan, Russell, Takahashi, & Park, 2015; Park, 2014), helping students to persist through challenging learning opportunities (Bryk et al., 2013), and increasing the quality of secondary mathematics teacher preparation (Martin & Gobstein, 2015). Building upon this improvement science work in education, the aim of this project is to improve college, career, and civic readiness outcomes using improvement science principles and practices.

College, career, and civic readiness. Our team reviewed literature and talked with experts (including high school students and recent graduates) to develop a theory of action about how to organize our improvement efforts. This theory of action is organized in the form of a driver diagram (see figure 5), which articulates a goal, the drivers we believe can lead to that goal, and the secondary drivers that describe where in the system we might focus our efforts. The development of an explicit theory of action is an important aspect of the improvement process (Davidoff, Dixon-Woods, Leviton, & Michie, 2015) because an improvement project will be strengthened with clearly thought through potential areas for change and an understanding of the likely highest priorities for action, developed through a combination of systems analysis, relevant literature, and expert practitioner judgement (Bryk et al., 2015). Further, a well-developed and explicit theory of action helps everyone working on the team have a common language and shared understanding of where the work that they are doing fits within the larger context of the project (Bryk et al., 2015).



If we want to improve our aim, then we need to focus on a primary driver, at the secondary driver, and one way to do that is through a change idea.

Figure 5: Driver diagram of college, career, and civic readiness

We became interested in four aspects (drivers) of college, career, and civic readiness: (a) family engagement, (b) sense of belonging, (c) raising awareness of college and career pathways, and (d) academic preparation and eligibility. These drivers have changed multiple times thus far in the project, but these four drivers as currently articulated represent our team's understanding of literature, the voice of students and

educators, and an understanding of our organizational system that we believe may help us organize the work that hopefully leads to the desired outcome. Of note, as the work continues and we learn new things, the team may find that some of these areas are more important than others or that other issues rise in prominence. The spirit of definitely incomplete and possibly incorrect pervades the work (Bryk et al., 2013). The first driver is family engagement.

Family engagement and college readiness. The role of families in supporting student success is well documented. Family involvement is positively correlated with numerous student outcomes, including higher grades and greater likelihood of attending and graduating from college (Hines, Borders, Gonzalez, Villalba, & Henderson, 2014; Holcomb-McCoy, 2010; Yamamura, Martinez, & Saenz, 2010). However, while the importance of engaging with families is widely recognized, actually doing so tends to drop to the bottom of educators' priority list (Tierney, 2002). In this section, I aim to outline the history of family engagement by educators in the U.S., describe evidence of the positive impacts of engaging families in supporting students, and list some suggestions for practice that come from the literature.

Historically, families have not always been seen as important actors for educators to engage with to improve educational outcomes. Tierney (2002) developed a three-phase model of educators' beliefs about families. In phase one, educators thought of parents as part of the problem. This belief was most strongly evidenced by the Bureau of Indian Affairs creating boarding schools to educate Native American children away from their families, under the theory that staying with their families was impeding students' ability to assimilate into the mainstream, i.e. white America (Tierney, 2002). Similarly, Tinto

(1975) argued that for students to assimilate into college culture successfully, students needed to move away from family and old relationships. In phase two, educators could be seen as indifferent to families, in that educators focused their efforts on improving schools, independent of the families (Tierney, 2002). In phase three, the importance of engaging with families in supporting student success became more broadly recognized (Tierney, 2002). In contrast to Tinto, other scholars argue that maintaining connections with family, friends, community, and culture can be important aspects of transitioning to college (Barbatis, 2010). Relatedly, educators tend to have a deficit model of parent participation in their children's educational lives (Holcomb-McCoy, 2010). Contrary to the view of many (white, middle class) educators, low income parents and parents of color hold a high value on the importance of education (Ceja, 2006; Holcomb-McCoy, 2010; Kimura-Walsh, Yamamura, Griffin, & Allen, 2009). The challenge for these parents is that they often do not have access to information that helps them understand the college application process (Holcomb-McCoy, 2010) and do not have the cultural capital to reproduce their knowledge of the system in their children (Tierney, 2002). This is quite different than saying that families do not value education or that there is something wrong with the culture of families that possess less cultural capital (Tierney, 2002).

Family involvement is positively correlated with student outcomes such as higher achievement, attendance, willingness to take on academic work, grades, and aspirations for higher education (Holcomb-McCoy, 2010). Low income students and students of color are more likely to get admitted to a 4-year college if their parents are involved in their education, and students who are strongly encouraged to attend 4-year colleges by

their parents are more likely to attend (Holcomb-McCoy, 2010). Parental expectations that students go to college is the largest factor influencing college going rates, more than parent education level or student academic achievement (Hines et al., 2014).

From the literature, there are several suggestions for how to engage with families to improve educational outcomes for students. Hossler and Gallagher (1987) developed a three-stage model of college choice: predisposition, search, and choice. Others have argued that when working with underrepresented students, educators should focus on the predisposition stage where parents can encourage their children to aspire to college (Ceja, 2006; Hines et al., 2014). The predisposition phase is made up of two aspects: parental encouragement (psychological components like high expectations for going to college) and parental support (behavioral components like going on college visits and saving for college) (Hines et al., 2014). During the college search and choice stages, others (siblings, high school counselors) who have specialized knowledge about the college application process may be more important (Ceja, 2006). A related observation is that for the first generation of college goers in a family, the oldest sibling can play a critical role in college going for that family (Ceja, 2006). The oldest sibling often needs to develop college knowledge, i.e. knowledge of the college going process (Conley, 2008a) “on their own” but then also act as a teacher of this knowledge to younger siblings (Ceja, 2006). For this reason, it may be wise to have siblings and family members join with students on college visits (Yamamura et al., 2010). Another suggestion for engaging with families is that for African American families, educators might build upon the central role of African American churches and clergy, who often serve as important sources of information within the African American community (Hines et al., 2014). In summary, engaging

families in how to support their children in the college going process is an important issue that merits greater attention from K-12 educators. The second driver our team focused on is whether students have a sense of belonging both in high school and in college.

Sense of belonging. Having a sense of belonging is a fundamental human need (Walton & Cohen, 2011). Human beings learn through social interaction (Dewey, 1938; Vygotsky, Hanfmann, Vakar, & Kozulin, 2012). Students feeling that they are part of a community is essential to a strong learning environment (Osterman, 2000). Feeling a sense of belonging has been shown to lead to positive outcomes in schools, as students who feel that they belong are more likely to have positive academic behaviors, see themselves as competent, have more intrinsic motivation, have a stronger sense of identity, have more positive attitudes towards school, classmates, and teachers, and put more of themselves into the learning process (Farrington et al., 2012). Astin (1984) posed “student involvement” as a useful construct for understanding what leads to students persisting in college versus dropping out. Students who study a lot, join clubs, live on campus, attend full time, and work on campus are more “involved” and all of these factors correlate with persisting in college (Astin, 1984). On the other hand, “rejection or the sense of exclusion or estrangement from the group is consistently associated with behavioral problems in the classroom (either aggression or withdrawal), lower interest in school, lower achievement, and dropout” (Osterman, 2000, p. 343). Astin (1984) argued that dropping out of college is the ultimate form of being “uninvolved.” Arguably, being absent from school a lot, i.e. chronic absenteeism, is on the spectrum of uninvolved. It may be that chronic absenteeism is correlated with less student involvement and feelings

of belongingness at school. Further, first generation, traditionally underrepresented students are less likely to feel a sense of belonging in college (Walton & Cohen, 2007), and thus, improving a feeling of belonging among underrepresented students may be an effective strategy for improving educational outcomes for such students.

Belongingness is just one of many noncognitive factors⁷ that have been proposed as potential factors in educational outcomes. Scholars developed a framework of five noncognitive factors that lead to academic performance: academic behaviors, academic perseverance, social skills, learning strategies, and academic mindsets (Farrington et al., 2012; Nagaoka et al., 2013). Academic behaviors refer to the behaviors of a good student, including regularly attending class, participating in discussions, and completing assignments. Academic perseverance refers to the ability to stay focused and persist with a challenging task. Social skills include qualities such as cooperation, assertion, responsibility, and empathy. Learning strategies include a broad basket of tactics such as mnemonic devices, metacognitive strategies, and self-regulation. Academic mindsets are beliefs and attitudes that lead to better academic performance, including sense of belonging, growth mindset, self-efficacy, and relevance. Noncognitive factors may be more predictive of college persistence and graduation than other cognitive measures such as SAT scores (Farrington et al., 2012). Among all noncognitive factors, some have argued that belongingness is the most important, as it was found to be most predictive of college full time enrollment persistence of all noncognitive factors (Logel, Murphy,

⁷ As noted by Duckworth and Yeager (2015), nobody likes the term “noncognitive,” yet everyone knows roughly what it means; these scholars argue that the name may not be the most important thing to focus on and propose “personal qualities” as a flawed alternative.

Walton, & Yeager, n.d.). Additionally, we conducted a series of interviews with first generation college graduates in Fall 2015 and found that feeling a lack of belonging in college was a universal challenge for the graduates we interviewed.

Transitions are a particularly salient moment for people to question their sense of belonging in a new environment. Transitions from one school to another are connected to lower academic performance and worse attitudes about school (Farrington et al., 2012, p. 33). During a transition to a new school, students need to adapt to new norms, new friends, and a new sense of self in an unfamiliar place (Farrington et al., 2012). A sense of belonging does not exist within a person; it exists in the interaction between a person and their context. In other words, belongingness does not automatically travel with a person to a new environment. Unfortunately, this means that a student feeling a greater sense of belonging in, for example, high school does not mean that this feeling of belongingness will carry over to feeling a sense of belonging in college, and in fact, feeling a strong sense of belonging in (a small, personalized) high school might impede a sense of belonging in (a large) college (D. Yeager, personal communication, November 10, 2015). Fortunately, students' sense of belonging has been found to be malleable through targeted interventions (Farrington et al., 2012). Of note, some of these interventions are brief, cheap, and theoretically scalable, suggesting that if these results can be replicated with larger numbers of students, this could have a dramatic impact on educational outcomes for traditionally underserved student populations.

Walton and Cohen (2011) implemented a one time, one hour intervention aimed at boosting social-belonging with 92 first year students at a selective college and then followed these students' academic and health outcomes over the next three years. Despite

the limited nature of the intervention, African American students (N=49) halved the gap in GPA with their white student peers (N=43) by their senior year. Further, African American students improved self-reports of health and reduced their reports of doctor visits three years after the intervention. In brief, the intervention involved looking at survey data about and quotes from upperclassmen students from their college. These data and quotes gave a message along the lines of “When I first got to college, I wondered if I belonged. Then I realized that everyone feels that way. Eventually, I worked through that feeling and managed to succeed here.” Freshmen were encouraged to consider this message, write their own such stories for future new students, and videotape similar messages for future students. This entire experience took one hour. These researchers believe that the improvements in GPA for African American students can be explained by the fact that African American students typically experience the transition to college as an event marked by feelings of lack of belongingness (Walton & Cohen, 2011).

In a related study, Yeager et al. (2015) implemented a similar intervention through a series of three experiments with a much larger group of first year college students (N>9500). Using a short, online, double-blind randomized experiment design targeting students potential sense of belonging uncertainty, they raised first year full-time college enrollment for socioeconomically disadvantaged students entering a flagship public university and increased cumulative grade-point-average for socioeconomically disadvantaged students at a selective private university.

These authors and others emphasize three points about the unexpected power of this brief intervention. First, the intervention targets students’ subjective experiences. “Critical to [the intervention’s] rationale is the insight that it is people’s subjective

interpretations of the quality of their relationships, more so that the objective number or attributes of those relationships, that strongly affects well being” (Walton & Cohen, 2011, p. 1448). In other words, this brief intervention can make a large difference because it does not aim to change all the students’ relationships in college but rather to change how students view those relationships. This is connected to a second point, which is that this intervention and others like it benefit from “recursive effects” (Yeager & Walton, 2011). For students who experience belonging uncertainty (Walton & Cohen, 2007), a negative cycle can propagate whereby belonging uncertainty leads to lower academic performance which itself leads to greater belonging uncertainty and so on. These types of interventions can interrupt that vicious cycle and even introduce a virtuous cycle in which having belonging uncertainty normalized leads a student to reinterpret everyday challenging events not as further evidence of belonging uncertainty but rather as just part of the normal experience of transitioning to a new environment. This alternative interpretation of everyday life events can then allow students to experience greater academic success in college, leading to a greater feeling of belongingness, which can lead to great academic success, and so on (Yeager & Walton, 2011). Finally, scholars emphasize that these interventions are not magic cure-alls and passing out a worksheet about belongingness is unlikely to lead to significantly improved outcomes (Yeager & Walton, 2011). On the other hand, such interventions do in fact have a theoretical basis and should not be dismissed out of hand. Indeed, any such interventions must be

specifically tailored to the particular context of the environment and cognizant of the particular challenges students are likely to experience (Yeager & Walton, 2011).⁸

In summary, there are several non-cognitive factors likely to influence college success, and having a sense of belonging is both particularly important and particularly likely to be lacking for traditionally underrepresented students. Further, major life transitions are likely to bring on questions of belonging uncertainty, and significantly, feeling a sense of belonging on one side of the transition (e.g. high school) does not translate to feeling a sense of belonging on the other side (e.g. college). Fortunately, there are relatively simple interventions that have been shown to reduce belonging uncertainty, specifically for traditionally underrepresented students. Reducing belonging uncertainty is one possible driver of college, career, and civic readiness, and raising students' awareness of college and career pathways is another.

Raising awareness of college and career pathways. Lack of awareness of the college application process, including financial issues, and lack of awareness of possible career pathways are impediments to graduating students from high school ready for success in college and career, particularly for traditionally underserved students. In one study, only 12% of high school students surveyed knew the subjects required to be taken for admittance into the universities in their area (Venezia & Kirst, 2005). In another, Latina students at a large comprehensive public high school relied almost exclusively on school resources for college access information, yet these school resources were not equitably distributed, and in fact students not in the top ten percent of their class were

⁸ For additional information on this work, see http://www.nytimes.com/2014/05/18/magazine/who-gets-to-graduate.html?_r=0

denied access to college information by the counseling staff (Kimura-Walsh et al., 2009). Hoxby and Turner (2013b) note that high achieving students from low income families do not apply to even one selective college, despite the fact that those who do apply to such colleges are admitted, enroll, persist, and graduate at the same rate as higher income students at the same schools with similar grades and test scores.

College knowledge or transition knowledge and skills is “the privileged information necessary to navigate the college admissions and financial aid processes and to understand how college operates as a system and a culture” (Conley et al., 2010, p. 7). Conley (2008b) observes that in the college application process, college knowledge takes the form of a significant body of technical know-how, while in the first year of college, required college knowledge is more about cultural understanding of a new environment. As noted earlier, Hossler and Gallagher (1987) developed a three-phase model of college choice made up of predisposition, search, and choice, which can be viewed as one lens for understanding the type of college knowledge that students must develop to successfully navigate the college admissions process. College knowledge can also be understood from a cultural capital perspective, where families that have more cultural capital pass on their college knowledge to their children (Tierney, 2002).

Making better connections between college and career may be both a way to improve career readiness and paradoxically to graduate more students from high school interested in and ready to succeed in college (Bailey & Merritt, 1997). Scholars note that traditionally, “school learning is abstract, theoretical and organized by disciplines while work is concrete, specific to the task, and organized by problems and projects” (Symonds, Schwartz, & Ferguson, 2011, p. 19). While vocational education was

historically a dumping ground for students who could not succeed in the academic track, developing school programs that integrate vocational education into the program for all students may engage more students to stay in high school and thrive there (Schwartz, 2014). In fact, Hoffman (2015) notes that many adolescents find school boring because it does not match their developmental needs and that apprenticeship with a mentor is likely to re-engage them. Students who attend career academies that encourage internships and work-based learning are more likely to graduate from high school, attend postsecondary education, and attend four year colleges (Brand, 2009).

Financial literacy for students and families is a significant component of understanding possible college options. The financial side of attending college is an increasingly important issue in our society. The cost of attending college is rising dramatically (“The rising cost of college,” 2010), while income inequality increases in the United States to levels not seen since the Great Depression (Allen, 2012). The combination of these two factors has resulted in increasing levels of student loan debt (Izzo, 2014). Disturbingly, although low income families pay less net tuition for college due to financial aid, the net price of tuition for low income families as a percentage of family income has skyrocketed in recent years (Cahalan & Perna, 2015). This raises the question of whether going to college is still a wise investment, particularly for low income students (e.g. see Cassidy, 2015). Tuition is projected to continue to rise for the foreseeable future (“The rising cost of college,” 2010), yet there may not be enough high skill, high paying jobs to justify, from a financial perspective, the increasing cost of college. Note still, however, that a college degree remains a strong predictor of both lower unemployment and higher lifetime earnings (Bureau of Labor Statistics, 2015).

One study found that the most common reason for African American young men to drop out of college is connected to not being able to pay tuition, and relatedly that it often takes this population more than six years to graduate because of off-campus jobs (Dukakis, Duong, de Velasco, & Henderson, 2014). In 2007-2008, 42% of community college students eligible for Pell grant funding did not fill out the Free Application for Federal Student Aid (FAFSA), making them unable to receive federal aid to which they were eligible (McKinney & Novak, 2013). According to this same study, for first year community college students, not filing the FAFSA negatively impacts persistence from fall to spring semester in the first year and is the strongest predictor of persistence of all factors studied (McKinney & Novak, 2013). Further, application fees and testing fees can be waived for low income students, removing those barriers if students are aware of this option (Hoxby & Turner, 2013b). Thus, assisting traditionally underserved students in completing FAFSA and filling out fee waivers related to college attendance may be high leverage strategies.

Students and families in general and low income, first generation, and students of color in particular hold inaccurate information about the cost of college (Bettinger, Long, Oreopoulos, & Sanbonmatsu, 2009). In a study of family predictions of college cost, all parents over-predicted the cost of college, but middle class parents over-predicted the cost by five percent, while low income families and families of color over-predicted the cost by up to 228% (Holcomb-McCoy, 2010). Similarly, low income parents and parents of color were less likely relative to higher income white parents to know about grants (75% vs. 50%) and scholarships (83% vs. 58%) as possible ways to pay for college (Holcomb-McCoy, 2010). One way this plays out is that low income students are likely

to be dissuaded from applying to highly selective colleges, believing that they cannot afford to attend, based on tuition sticker price (Hoxby & Turner, 2013b). However, for low income families, the more selective the college, the lower the net price of the school when factoring in financial aid (Hoxby & Turner, 2013b). Further, more selective colleges tend to have better outcomes for college graduation for traditionally underserved students, so low income students are avoiding more selective colleges because they think they cannot afford it, when in fact the cost would be lower and the results likely better (Hoxby & Turner, 2013a, 2013b).

Several studies report on successful efforts to increase financial aid for students. Bettinger et al. (2009) suggests that relatively small interventions around college financial literacy could have significant impacts on college attendance and persistence outcomes. Testing the idea that lack of awareness of the FAFSA was an impediment to students and families filling out the form and then going on to college, researchers partnered with H&R Block to implement an intervention (Bettinger et al., 2009). One group received information on the FAFSA and help with filling the form out, the other group only received the information but no assistance with filling out the form. The first group was more likely to fill out the FAFSA, more likely to submit the FAFSA, 25-30% more likely to enroll in college the next fall, and obtained more financial aid. Similarly, two recent studies found that a text message based intervention could lead to increased FAFSA completion rates for high school students (Page & Castleman, 2016) and for increased FAFSA re-application rates for community college students (Castleman & Page, 2016). Additionally, the Cal Grant is a program in California that provides college tuition for low and moderate income families meeting certain academic requirements.

Bettinger et al. (2016) found that earning a Cal Grant predicted increased college persistence. Thus, financial literacy may be a significant aspect of helping students to forge their path to and through college, and it may be the case that educators can have an impact on this issue with methods that are both within their control and their capabilities.

To review, issues related to improving student awareness of college and career pathways include the inequitable distribution of college access information, transition knowledge and skills, making connections between college and career, and unequal knowledge about the financial side of the college application and attendance process. In addition to these issues, to improve the college, career, and civic readiness of all students, students must become eligible to attend college and prepared to succeed once there.

Academic preparation and eligibility. Preparation and eligibility for college are two important components of college, career, and civic readiness. Eligibility for college can be thought of as “checking the boxes” of the college application process. This includes taking entrance exams, scoring high on entrance exams, signing up for and successfully completing appropriate college preparatory classes (known in California as the University of California A-G requirements), and successfully completing college applications. College preparation refers to a deeper set of knowledge and skills necessary for success in college such as literacy and numeracy skills, critical thinking and problem solving, and other skills. In this section, I will describe the current state of publicly available data on college eligibility and preparation, with a focus on California and looking at subgroups of students. I will then describe findings from literature on this topic.

In California, to successfully apply to a University of California or California State University school, a high school student must complete a series of courses known as the University of California A-G requirements.⁹ It is significant to note that this is not only for the flagship University of California campuses but is now also a requirement for California State University campuses. This means that a California high school student must complete this sequence of courses to apply to a public four-year California college. However, significant disparities exist by demographics in terms of which students complete this sequence of courses. For the high school class of 2014, only 27% of African American, Latino, Native American, and Pacific Islander male graduates had completed those courses, compared to 60% of White, Asian, and Filipino female graduates.¹⁰

Similarly, in most cases, students must take a college entrance exam (e.g. SAT, ACT) to be admitted to a four-year university. Again, disparities exist in which students take the SAT. For the class of 2014 in California, over 80% of Asian and Pacific Islander graduates took the SAT, compared to 55% of white and African American graduates and 43% of Latino graduates (Gao & Johnson, 2015).

In terms of college enrollment, in 2012, 82% of 18 to 24 year olds in the top family income quartile had enrolled in college while only 45% of young people from the bottom quartile could say the same (Cahalan & Perna, 2015). While this 37% gap represents a modest improvement compared to the 46% gap from 1970, the college going

⁹ Requirements found at <http://admission.universityofcalifornia.edu/freshman/requirements/a-g-requirements/>

¹⁰ Info available at <http://dq.cde.ca.gov/dataquest/stgradnum.asp?cChoice=StGrdEth&cYear=2013-14&cLevel=State&cTopic=Graduates&myTimeFrame=S&submit1=Submit>

gap is far from closed (Cahalan & Perna, 2015). Further, as noted earlier, 77% of students from top quartile families by income earned a 4-year college degree by age 24 compared to only 9% of students from the bottom quartile of family income (Cahalan & Perna, 2015).

Which kind of colleges students attend is one factor that is correlated with this large gap between college enrollment and college graduation (see figure 6). For students from the top quartile by family income, 76 percent of students who enrolled directly in a four-year college obtained a bachelor's degree within six years while only 18 percent of such students who began at a public two year institution could say the same (Cahalan & Perna, 2015, p. 33). For students from the bottom quartile of family income, 47 percent of students who enrolled directly in a four-year college obtained a bachelor's degree within six years while 13 percent of those who began at a public two year institution had earned such a degree (Cahalan & Perna, 2015, p. 33). Of note, while only 13 percent of low income students who began at a two-year institution had earned a college degree within six years, that number was not that much higher at 18 percent for high income young people. Thus, the large gap in bachelor's degree attainment by family income level is much more highly correlated with the type of college the student begins at than their family income level. Of course, students who struggle in school are more likely to go to a community college, which are open enrollment schools, so it is not fair to entirely "blame community colleges" for this situation. Unfortunately, for students who do go on to college, low income students are much more likely to begin at a community college (62%

vs. 29%),¹¹ which explains the large gap in college completion by family income.

Community colleges present the opportunity (or more darkly, the appearance) of college eligibility and access for all, yet the data suggests that 2-year colleges, regardless of family income level, are not a clear path for obtaining a 4-year degree.

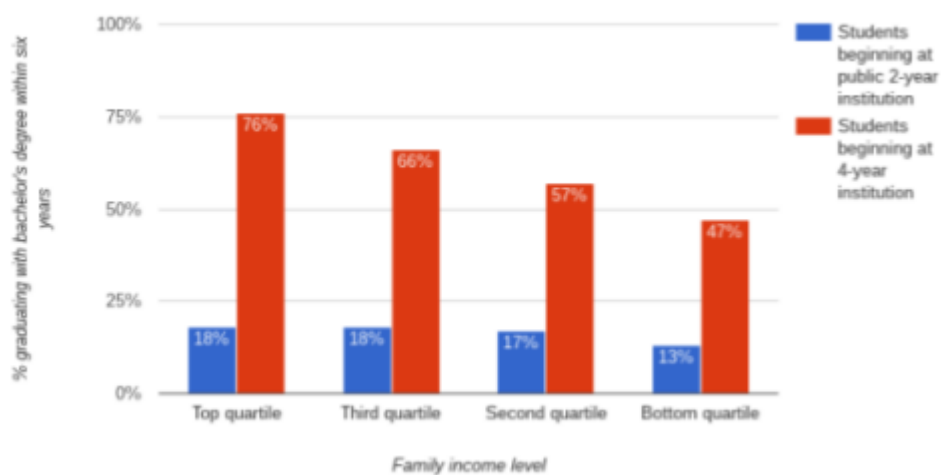


Figure 6: Percent of dependent first-time students who first enrolled in a postsecondary education institution in the 2003-04 academic year who obtained a bachelor's degree within six years by level of first institution attended and family income quartile. Data from Cahalan and Perna (2015).

Taking courses and tests can lead to college eligibility. Success in higher education is another, arguably more important, issue. Venezia and Jaeger (2013) state that “college readiness is commonly understood as the level of preparation a student needs to enroll and succeed in a college program ... without requiring remediation” (p. 118). As noted earlier, Conley (2014) lists four elements of college readiness: cognitive strategies, content knowledge, learning skills and techniques, and transition knowledge and skills.

¹¹ Calculated by the author based on data from Cahalan and Perna (2015).

Students with effective cognitive strategies utilize these strategies so that they do not get stuck. Key cognitive strategies for success in college include the ability to formulate questions as opposed to merely answering teacher questions, as well as higher order thinking skills such as the ability to analyze and evaluate (Conley, 2014). By key content knowledge, Conley (2014) refers to factual information but also to high level ideas as well as features of the students' beliefs about learning this knowledge. Key content knowledge is not merely about information transfer but also includes understanding the structure of knowledge.

Conley (2014) observes that many educators and policy makers talk about the achievement gap and refer primarily or exclusively to gaps in literacy and numeracy, and yet schools can reduce test score gaps without this significantly impacting college persistence and graduation. Thus, Conley (2014) posits that there are key learning skills and techniques beyond literacy and numeracy that students must develop to achieve college success. Conley (2014) argues that the most important learning skills can be understood as ownership of learning. When students own their own learning, they can seek out people and resources who can help them to achieve. Lacking such ownership, students sit back and wait for others to help them. Recognizing that students often lack such ownership, models of more active or "intrusive" counseling programs (Dukakis et al., 2014) have become more popular with the idea that support programs should not sit back and wait for students to access them but rather to actively seek out students who need support. However, if more students had greater ownership of their learning, students would be better able to access existing support structures.

The final component in the Conley college readiness framework is key transition knowledge and skills. Conley (2014) observes that the United States is unique in the complexity of its college application process, with a complex system of private and public, nonprofit and for-profit, colleges and universities that is almost entirely separate from the K-12 system of schools. For this reason, transition knowledge and skills are particularly necessary in the U.S. context and are particularly acute for parents who have not attended college in the U.S. themselves. Conley (2014) breaks down transition knowledge and skills into five areas: contextual, procedural, financial, cultural, and personal. Contextual knowledge and skills includes predisposition to want to attend college (Hossler & Gallagher, 1987), and information on which types of college would be a good match for them, described as search and choice by Hossler and Gallagher (1987), as well as the likelihood of which colleges are likely to accept them. Procedural knowledge and skills includes the steps to completing the college application process described in college eligibility above. Financial issues with attending college include affording college, understanding the true cost of college, knowing about scholarships, and knowing how to fill out financial aid forms, such as FAFSA and Cal Grant. The thoroughness and completeness of the Conley framework for college readiness may be useful in guiding improvement teams in thinking through all aspects of working to improve college readiness.

To summarize, based on interviews with first generation and other traditionally underrepresented college graduates, a review of the literature, and our own professional expertise, our team developed a theory of action (represented in a driver diagram) for how to improve college, career, and civic readiness outcomes of high school graduates.

The four primary drivers are (a) family engagement, (b) sense of belonging, (c) raising awareness of college and career pathways, and (d) academic preparation and eligibility. These drivers form the basis of a theory of action for attempting to improve college, career, and civic readiness.

Improvement science and college, career, and civic readiness. Improvement science may be a set of practices and theories well situated to help a K-12 organization improve college, career, and civic readiness of its graduates. A key feature of improvement science is a focus on measurable data. While not all aspects of college, career, and civic readiness are easy to measure, there are several relatively obvious process measures (e.g. graduates applying to college, graduates taking entrance exams, graduates filling out financial aid forms) and outcome measures (college attendance, persistence, and graduation) linked to college, career, and civic readiness outcomes. Other measures such as the percentage of students receiving a positive performance rating from an internship mentor (Darche & Stern, 2013) or registering to vote may help to round out career and civic readiness outcomes.

For the purposes of this dissertation, the focus was on increasing Cal Grant award rates and reducing chronic absenteeism. The effort to increase Cal Grant award rates is most connected to the driver of college pathways, and specifically to the logistics of the application process, i.e. successfully completing the FAFSA and other steps necessary to earn a Cal Grant. Reducing chronic absenteeism has a connection to the belongingness driver via the idea that students who are frequently absent may not feel as much belonging to their school and may not be as involved (Astin, 1984). As described earlier, other secondary goals of this dissertation were to learn about improvement science in the

educational context, to experiment with improvement science as a methodology for a dissertation, and to report on improvement projects in education guided by a set of reporting standards developed in healthcare to improve the quality of reports on improvement science projects.

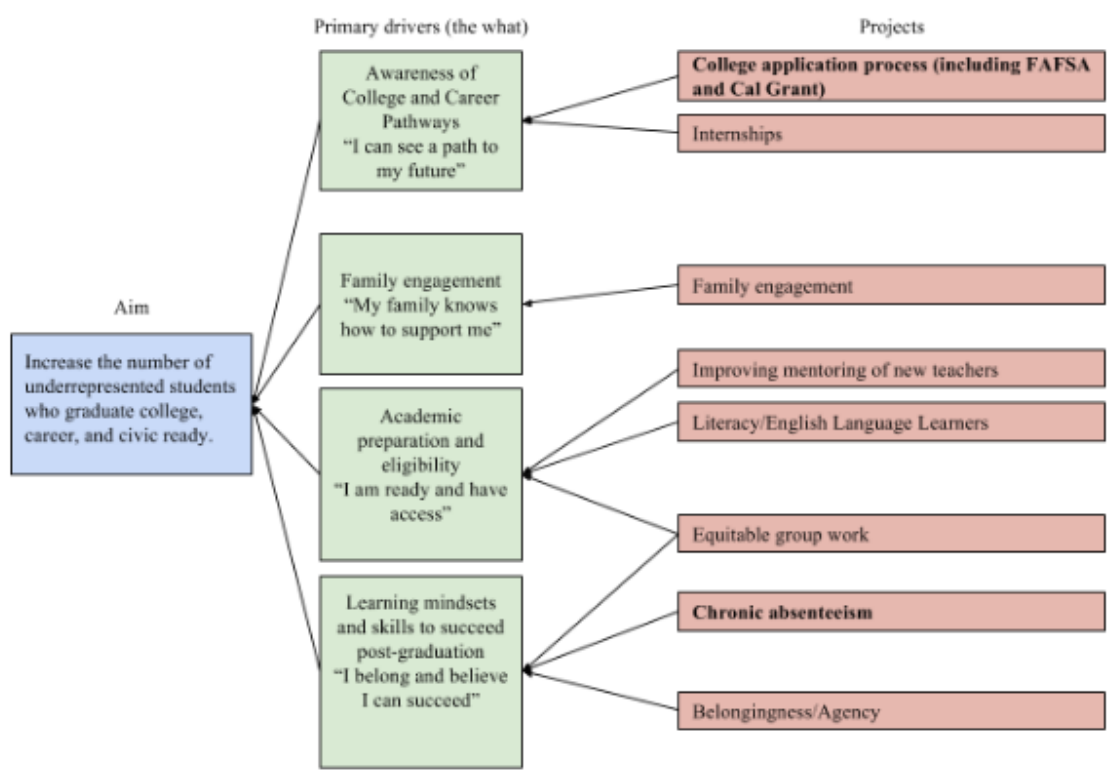


Figure 7: Key HTH improvement projects aligned to driver diagram

Chapter III: Methodology

An improvement science project typically does not attempt to answer a research question but rather is focused squarely on improving an outcome (Archbald, 2010), which is consistent with the Carnegie Project on the Educational Dissertation argument that a dissertation in an Ed.D. program should “impact a complex problem of practice” (“About Us,” n.d.). Thus, the aim of this dissertation is to improve college, career, and civic readiness of HTH graduates. To do that, I utilized improvement science methods as a set of practices and ideas to attempt to make progress on this goal. To document our work and learning in this project, I wrote up two specific improvement projects that are part of this larger project following the format of the SQUIRE 2.0 (Standards for Quality Improvement Reporting Excellence) standards (Ogrinc, et al., 2008) for reporting on improvement projects (see Appendix). These two projects are on reducing chronic absenteeism across HTH and on increasing the percentage of low income students who were awarded a Cal Grant. Because the methods of each of these projects are well specified in the stand-alone reports, in this chapter I describe the methods of each project at a high level, leaving the details for the SQUIRE reports.

Context

HTH is a group of thirteen public charter schools spread across San Diego County in three locations (North County, Point Loma, and Chula Vista). The organization began in 2000 with one high school with 200 students and 20 staff and has grown in 2017 to serving approximately 5,300 K-12 students and employing approximately 700 staff. That number of students places HTH, if it were a school district, in the top 28% of districts by

enrollment in the state of California.¹² This is significant because realizing that HTH is effectively a larger than average school district has had a profound influence on my understanding of my role and makes improvement science, with its emphasis on consistent quality at scale, particularly appealing. I was a founding teacher at the first HTH, became the second principal of the first school, and now have the title of Chief Academic Officer for the organization. I formally introduced improvement science methodology into our organization in June 2014 by bringing ten educators (teachers, deans, school directors, and HTH Graduate School of Education faculty) to a three-day workshop facilitated by the Carnegie Foundation for the Advancement of Teaching. At that workshop, our team co-developed an aim to improve the percentage of African American and Latino young men who go directly to four-year college. Since that time, many faculty and staff (n = ~220) across the organization have become engaged in improvement science work towards that aim.

Project Orientation

In this project, I focused on two specific improvement projects within the organization. The purpose of this focus was to bring me closer to the work of improvement happening in our schools, to work on spreading promising change ideas from one school across the broader organization (which I am uniquely positioned to advance), and to model a potential new way to report on improvement science projects in education, based on a model for reporting from healthcare.

Of the many improvement projects underway at HTH, our improvement team met

¹² Calculated by the author [here](#).

to discuss which projects were most promising and should be highest priority for our team to support. This was based on existing enthusiasm for the project, current momentum and progress, and strategic choices both about the likelihood of the project impacting our broader aim and other internal reasons why we felt making progress on these projects was important. These most high leverage projects are displayed back in figure 7. Of these projects, I selected two for deep dives as part of this dissertation. These two projects are on reducing chronic absenteeism and on increasing the percentage of low income students awarded a Cal Grant. These projects were selected for several factors, most particularly because in both cases there had been some local success and the projects were now in a spreading phase. Given my role within the organization, learning how to spread change ideas across the organization is both salient and something I am uniquely positioned to work on. Hopefully lessons learned about spreading change for these two projects will help develop knowledge about spreading change that can apply to other projects as well as how to spread change outside of our organization.

For this reason, it is important to think about how to report on the results of improvement science projects in education so that learning can spread throughout the larger educational system. The SQUIRE guidelines offer a model for how to improve the quality of reporting on healthcare improvement projects. In this project, I reported on two educational improvement projects following the SQUIRE guidelines to test how and whether these guidelines might be useful in education.

Project 1: Increasing Cal Grant award rates, especially for low income students

Introduction. In 1970, 40% of 24 year olds in the top quartile by family income had earned a Bachelor's degree, compared to 6% from the bottom quartile (Cahalan &

Perna, 2015). In 2013, the top quartile number had leaped to 77% even as the bottom quartile had barely budged to 9% (Cahalan & Perna, 2015). Only 13% of low income students (and only 18% of high income students) who begin at a two-year institution earn a B.A. within six years, compared to 47% of low income students (and 76% of high income students) who begin at a four-year institution (Cahalan & Perna, 2015). One reason low income students begin at a 2-year college is to save money, even though this may lower their odds of completing a B.A. Meanwhile, the Cal Grant is a California program that provides significant financial aid to low and moderate income students meeting certain academic requirements. Although the Cal Grant is a generous program for students, there are multiple opportunities for students to fail to obtain the Cal Grant. While preparing more students to be successful in college is a complex and multifaceted issue, it may be possible to make significant improvements to college completion via relatively simple tweaks, including an effort to increase Cal Grant award rates, particularly for low income students.

Intervention. The first aspect of this project can be described as general awareness raising across students and staff about the details of the Cal Grant process. It was not a clear, time-bound intervention per se, but as information on both the importance and the process of the Cal Grant became more well understood, staff undertook several steps aimed at helping more students earn a Cal Grant award. These steps include improving the internal process for uploading GPA information to the state and working to reduce failing grades, especially for traditionally underrepresented students.

The second aspect of this project was FAFSA information. HTH college counselors have always worked to ensure that students complete the FAFSA. Awareness that FAFSA completion data, including errors not yet resolved by families, is available within the California Student Aid Commission (CSAC) web portal was unevenly distributed among college counselors and almost unknown with other staff. Prior to beginning this project, although theoretically HTH had organizational access to CSAC data, this was not widely understood, and there was not widespread knowledge across the organization about how to run reports that provide information on FAFSA completion and Cal Grant awards. Learning how to access CSAC data, understand it, and then report on it to college counselors and school directors was a significant aspect of the work.

The third aspect of this project was a specific intervention aimed at helping staff and students get clearer on exactly what a student needs to do to earn a Cal Grant GPA of 3.0 or better. At one HTH high school, the director, college counselor, and an improvement coach focused their efforts on a target population of juniors with a Cal Grant GPA between 2.2 and 3.4. The purpose was to try to move students below a 3.0 to above and to keep students just above the 3.0 mark staying above. The intervention involved sharing student transcripts with the advisor and teaching the advisor to do a grade tally for academic classes that count for a graduation requirement for grades earned so far in grades 10 and 11. This intervention was piloted at High Tech High Media Arts in spring 2016 with a young men of color support group and then tested again at High Tech High Chula Vista (HTHCV) in fall 2017 with all students with a Cal Grant GPA between 2.2 and 3.4.

Measures. All HTH graduates from 2011-2016 with student level demographic data was exported from the student information system and matched with CSAC data on whether graduates had been uploaded to the CSAC web portal, if the FAFSA had been successfully completed on time, and the Cal Grant GPA. Another data source was that CSAC staff agreed to find all HTH graduates in their system, see if they had earned a Cal Grant, and send us these data directly. These data were also matched with student information system data on HTH graduates. The number of students successfully completing the FAFSA at each HTH high school was obtained from U.S. Department of Education data and compared to the number of graduates in that class. Across all measures, low income students (qualified for Free or Reduced lunch) were a focus, even though Cal Grant is available for moderate income families.

For the grades intervention, HTHCV staff and an improvement coach calculated a rough Cal Grant GPA using an automated process within the student information system to determine which students in the class of 2018 were in the “conversion zone” at the end of 10th grade (GPA between 2.2 and 3.4). To determine the Cal Grant GPA after 1st semester junior year, transcripts were printed for the students in the conversion zone and the Cal Grant GPA was hand calculated as of that moment in time. For the class of 2017, the same automated process was followed to find students who were in the conversion zone after 10th grade and then similarly printed transcripts and hand calculated Cal Grant GPA after 1st semester junior year.

Study of the intervention. For “raising awareness,” there was not a clear, specific intervention. Rather, over several years school staff became increasingly aware of the significance of the Cal Grant and the process for obtaining a Cal Grant. For this

reason, the “intervention” was not formally studied. Instead, trends in Cal Grant award outcome data for low income graduates through 2016 were reported as well as process level data that leads to a Cal Grant award (e.g. percentage of graduates uploaded to CSAC, percentage of graduates with a GPA greater than 3.0).

For the FAFSA information intervention, the theory of action was that communicating FAFSA application status information to school staff would enable targeted interventions with students and families that would lead to more students earning a Cal Grant. To study this intervention, the percentage of low income and all graduates earning a Cal Grant award and completing the FAFSA from 2016 to 2017 was compared and tested for statistical significance. Email records were examined to see if information was shared with college counselors and school directors in the manner that had been planned.

For the “plus one, minus one” intervention, the theory was that by increasing student and staff awareness of what grades are needed to earn a Cal Grant, more students would earn the necessary grades leading to more Cal Grant awards. To study this intervention, the number of students in the “conversion zone” (Cal Grant GPA between 2.2 and 3.4) at the end of 10th grade and then after semester one in 11th grade was examined. The class of 2018 who received this intervention at HTHCV in fall 2017 (their junior year) was examined and then compared to the same data for the class of 2017 who had not received the intervention. The results of the study of all three interventions is included in chapter IV.

Project 2: Reducing chronic absenteeism

Introduction. It is estimated that 5 to 7.5 million U.S. K-12 students are chronically absent every year, where chronic absenteeism is often defined as a student missing 10% or more of school per year, for whatever reason (Balfanz & Byrnes, 2012). Nationally, chronic absenteeism cuts across race, gender, and age (Balfanz & Byrnes, 2012), although some studies have found that Native American students and low income students are more likely to be chronically absent (Buehler, Tapogna, & Chang, 2012).

Chronic absenteeism matters to school performance. Frequent absences in kindergarten have been found to be predictive of a lower likelihood of reading proficiency by the end of third grade (Bruner, Discher, & Chang, 2011; Ginsburg, Jordan, & Chang, 2014), and lower achievement on test scores in fifth grade (Bruner et al., 2011; Buehler et al., 2012). Chronic absenteeism has been found to predict lower NAEP scores (Ginsburg et al., 2014), dropping out of high school (Henderson, Hill, & Norton, 2014), and lower rates of college persistence (Ginsburg et al., 2014). Efforts to reduce chronic absenteeism in Chicago and New York City were linked to better graduation rates (Ginsburg et al., 2014). Not only does chronic absenteeism affect the absent student, but it can have negative impacts on the rest of the class as well, possibly because the teacher needs to spend class time bringing the absent students up to speed (Gottfried, 2015). The negative effects of chronic absenteeism are more pronounced for low income students (Gottfried, 2014).

Intervention. Staff at High Tech High North County (HTHNC) developed a chronic absenteeism intervention over three years as part of an effort to increase attendance at the school more generally. This school historically had lower attendance

than the other four high schools at HTH (e.g. 94% in 2010-11). While there are several aspects to the work, the core intervention can be summarized simply as “Notice and Act.” First, a weekly report of which students are currently chronically absent is produced and examined by the director, site manager, and dean. Second, an increasingly escalated intervention is enacted. For students who have been absent five times, a letter is sent home noting the number of absences and the importance of school attendance. For students who have been absent ten times, a similar letter is sent home with an additional request for a meeting between the family, student, and dean. The site manager phones home to set up a time for that meeting. Letters and requests for meetings continue to occur at 15, 20, 25, etc. absences.

Measures. Primary outcome data in this project were student absences, as measured in the student information system. In analyzing these data, we found that different methods of reporting absenteeism from within our student information system led to discrepancies on the order of 20% across different reporting methods. Another issue was that due to data system errors, sometimes students were reported to be absent many times and yet when checked by hand the students were not absent that many times. For cases where students had ten or more absences yet no intervention was performed, student records were hand-checked to ensure that the students had actually been absent as reported.

At all three schools, school staff kept local detailed records of efforts to intervene with families. Process data collected and analyzed from the 2015-16 school year include requests for letters to be sent home, requests for meetings with families, and documentation of meetings that occurred with the dean of students. When there were still

discrepancies after hand-checking numbers of absences (e.g. a student had been frequently absent but there was no record of an intervention), school staff were interviewed to gather more information.

Study of the intervention. To determine if the intervention was having the intended impact, average annual chronic absenteeism both before and after intervention at each school was compared. Average annual chronic absenteeism at intervention schools versus non-intervention schools was also compared. From an improvement science perspective, annual data is too infrequent to be useful for action and learning. In fall 2015, two middle schools expressed interest in implementing this intervention, so weekly data was tracked for both schools. One school ended up not implementing the intervention, creating a type of natural experiment between the two schools. This weekly data was compared visually and year end chronic absenteeism differences were assessed for statistical significance. To determine the extent to which the intervention was being implemented as expected, student information system data on numbers of absences per student was compared with school level records of letters sent home and meetings held with school staff. This information, along with results and conclusions is contained in the chapter V.

Reporting on improvement

In place of the traditional educational dissertation chapter four, I developed two improvement project reports written up in a format inspired by the SQUIRE standards (see below). These two projects are on reducing chronic absenteeism and on increasing the percentage of low income students who were awarded a Cal Grant. Reporting on these two projects enables us to share what we are learning about each of these

improvement projects. In addition to attempting to contribute to our collective understanding on how to make improvements on these issues, an additional contribution of this dissertation is to produce the first improvement project reports in education aligned to the SQUIRE standards. Hopefully, this report can serve as a starting point for guiding other improvement practitioners towards producing reports on improvement with “completeness, precision and transparency” (Ogrinc et al., 2015, p. 1).

In healthcare, improvement researchers have found it useful to develop standards for how to report on improvement projects, known as SQUIRE 2.0 (Standards for Quality Improvement Reporting Excellence) (Ogrinc et al., 2015). Prior to the development of these standards (see Appendix), reports on improvement science projects were not consistent and reliable. One of the primary purposes of improvement science is to encourage improvement teams to report findings to the broader community of healthcare, so that best practices can quickly spread across the world, leading to improved outcomes at lower costs for all. The purpose of the SQUIRE 2.0 standards is to improve the quality of improvement reporting so that those seeking to replicate reported findings have the requisite information to do so. SQUIRE 2.0 standards prompt reporting on four high level questions: “Why did you start? What did you do? What did you find? What does it mean?” (Ogrinc et al., 2015, p. 4). Further, SQUIRE 2.0 standards emphasize key components of reporting on improvement projects, including the use of formal and informal theory in improvement work (Ogrinc et al., 2015).

According to Ogrinc et al (2015), healthcare improvement projects sometimes suffer from a lack of connection to formal theory in their development and implementation. “Many professionals, including improvement practitioners, are

unfortunately mystified - and alienated - by theory” (Davidoff et al., 2015, p. 1).

However, all improvement projects are based on some kind of theory, some idea as to why the ideas for improvement could work, so the question is not whether improvement projects are based in theory but whether the practitioners make their informal and formal theories of action explicit (Davidoff et al., 2015). Benefits of making this theory explicit include surfacing unarticulated assumptions and identifying previously unrecognized areas of disagreement on the team (Davidoff et al., 2015). Additionally, as an improvement idea travels to new practitioners, it is possible for implementation of surface level features without an understanding of the underlying reasons why the practice works, which can lead to poor or incomplete implementation of the practice (Davidoff et al., 2015). Making the theory more explicit, particularly in the reporting of the project may improve success in spreading effective practices to new contexts (Ogrinc et al., 2015).

Although improvement science has been at work in healthcare for at least 30 years, standards for reporting on improvement science projects were not developed until 2008 as the SQUIRE 1.0 standards (Ogrinc et al., 2008). Improvement science has been operating in an educational context for a few years, and while there have been a few reports published on improvement science projects (e.g. see Edwards, Sandoval, & McNamara, 2015; Hannan et al., 2015), practitioners within the field report that there “exists no genre of writings for reporting improvement work in education. As such, there is no body of literature and no conventions of a genre to draw upon to organize and apply explicit or even implicit standards of reporting” (LeMahieu, Edwards, & Gomez, 2015, p. 448). With this concern in mind, it is hoped that this project, by reporting on

improvement projects in education following the SQUIRE 2.0 standards, can play a useful role in providing an example of how to report on improvement projects in education and that lessons learned from trying to implement these standards may provide guidance as to the suitability of the SQUIRE 2.0 standards in education.

Chapter IV: The \$50,000 Prize: An Improvement Project to Increase Cal Grant Award Rates¹³

Abstract

Among many issues involved in students accessing and persisting in 4-year colleges, affording college is a major barrier. The Cal Grant is a California state program that provides full tuition to many California colleges for low and moderate income students meeting certain academic requirements. Through a variety of methods, High Tech High public charter schools steadily increased Cal Grant award rates for low income students from 51% to 61% over six years. A concentrated effort to provide information to school staff on which students had not yet completed FAFSA correlated with a further increase of Cal Grant award rates for low income students to 69% and an increase for all students from 35% to 46%. A specific academic intervention attempting to raise student GPAs at one High Tech High school was correlated with increased student GPAs, but was not statistically significant compared to the prior year.

Introduction

Problem description. In 1970, 40% of 24 year olds in the top quartile by family income had earned a Bachelor's degree, compared to 6% from the bottom quartile (Cahalan & Perna, 2015). In 2013, the top quartile number had leaped to 77% even as the bottom quartile had barely budged to 9% (Cahalan & Perna, 2015). Only 13% of low income students (and only 18% of high income students) who begin at a two-year institution earn a B.A. within six years, compared to 47% of low income students (and

¹³ This manuscript was prepared using the SQUIRE guidelines, v. 2.0 - Standards for QQuality Improvement Reporting Excellence (Goodman et al., 2016; Ogrinc et al., 2015).

76% of high income students) who begin at a four-year institution (Cahalan & Perna, 2015). One reason low income students begin at a 2-year college is to save money, even though this may lower their odds of completing a B.A. Meanwhile, the Cal Grant is a California program that provides significant financial aid to low and moderate income students meeting certain academic requirements. Although the Cal Grant is a generous program for students, there are multiple opportunities for students to fail to obtain the Cal Grant. While preparing more students to be successful in college is a complex and multifaceted issue, it may be possible to make significant improvements to college completion via relatively simple tweaks, including an effort to increase Cal Grant award rates, particularly for low income students.

Available knowledge. The Cal Grant is a California based program offering up to \$50,000 in tuition costs based on income and GPA that can be used at most private or public California colleges. However, only 41% of California Latino 18-24 year olds reported being aware of Cal Grant requirements (Zarate & Pachon, 2006), and only half of eligible California students received a Cal Grant (Tierney & Venegas, 2009). To be awarded a Cal Grant, a series of steps must be completed. First, moderate income students must earn a Cal Grant GPA of at least a 3.0 based on grade 10 and 11 classes, while low income students need at least a 2.0. In the senior year, the school uploads student information to the California Student Aid Commission (CSAC) website, including (a) name, birthdate, home address, and Cal Grant GPA or (b) social security number and Cal Grant GPA. Next, the family successfully completes the FAFSA before March 2 and names a California college on the FAFSA. The family must fall below

income and asset ceilings, e.g. \$95,400 for a family of four.¹⁴ Undocumented students may complete a California Dream Act application and use this ID for upload to the CSAC system. Documented students whose parents are undocumented (and thus unlikely to complete the FAFSA) may file the FAFSA themselves. Finally, the uploaded student and GPA information must be matched by CSAC with the FAFSA information. There are opportunities for errors at each of these steps.

The issue of FAFSA completion has received national attention recently. Every year, two million Pell grant eligible students do not file the FAFSA, which has been found to be an unnecessarily complex and poorly timed process (Gates Foundation, 2015). One of the most common reasons for failing to complete the FAFSA is the mistaken belief that the family wouldn't qualify for financial aid (Davidson, 2013). Several studies have found that supporting families with the financial aid process leads to better student outcomes. In one study, merely giving families information about applying for financial aid did not have an impact while accompanying this information with help directly filling out the application led to more FAFSA filing, more financial aid received, and more students enrolling in a four year college, a 7.7 percentage point increase (Bettinger, Long, Oreopoulos, & Sanbonmatsu, 2009). In 2007-2008, 42% of community college students eligible for Pell grant funding did not fill out the Free Application for Federal Student Aid (FAFSA), making them unable to receive federal aid to which they were eligible (McKinney & Novak, 2013). In a study of first year community college students, not filing the FAFSA negatively impacted persistence from fall to spring

¹⁴ See [Income and asset ceilings](#) for the Cal Grant program.

semester in the first year and was the strongest predictor of persistence of all factors studied (McKinney & Novak, 2013). Relatedly, earning a Cal Grant has been found to increase college persistence (Bettinger et al., 2016).

Prior to the 2016-17 school year, families were required to use the most recent tax returns to complete the FAFSA. Families do not receive tax documents from employers and others until January 31, yet were required to complete their taxes prior to submitting the FAFSA by the Cal Grant deadline of March 2, even though taxes are not actually due until April 15. This tight window likely caused many families not to apply for the FAFSA on time, leading to Cal Grant ineligibility. In 2016, changes to the FAFSA have made it easier for families, as they are now able to use the tax data from the previous year, meaning they do not need to wait to do their taxes this year prior to submitting the FAFSA. FAFSA also created a tool to enable families to copy over their tax data into FAFSA electronically.¹⁵ In tandem with that, the window for submitting the FAFSA moved earlier to October 1 from January 1 (and practically from February 1 when families receive tax data), giving more time for school-based interventions. Finally, in 2015, the U.S. Department of Education began publicly publishing data on the number of graduates starting and completing FAFSA for every high school in the country, giving school staff access to data that previously had been challenging to find.¹⁶

Rationale. There are two theories of action in this project. First, if many students do not receive the Cal Grant due to logistical issues, then raising awareness among staff,

¹⁵ See [IRS data retrieval tool](#). Note that this tool was taken off-line in March 2017 because of security concerns.

¹⁶ See [FAFSA completion](#) by high school and public school district.

students, and parents of the importance of the Cal Grant and current information on which students have completed Cal Grant steps will lead to more students successfully completing the steps so that more students will earn a Cal Grant, enroll directly in a 4-year college, and persist to graduation. Second, if some students do not receive the Cal Grant because students and their advisor do not know how their grades impact Cal Grant awards, then simplifying how to communicate with students and advisors about exactly what grades are needed to qualify for Cal Grant will lead to more students earning above the GPA threshold which again will lead to more Cal Grant awards and more 4-year college enrollment and persistence.

Specific aims. The purpose of this project is for more HTH graduates to earn a Cal Grant. The goal was to increase FAFSA completion rates from 73% to 85% for the class of 2017. A goal for FAFSA completion for low income students was not set because baseline data was unknown when this project began. A goal for Cal Grant award rates was not set for the same reason.

Methods

Context. HTH is a system of public charter schools in San Diego County. Five high schools, four middle schools, and four elementary schools with a total enrollment of roughly 5300 students are spread across three locations in San Marcos, Point Loma, and Chula Vista, California. As schools of choice, students are accepted via a competitive yet non-meritocratic zip-code based lottery system. HTH employs a full-time college counselor at each high school, who has had primary responsibility for guiding students to earn a Cal Grant, with significant support from the Student Information System manager. At HTH, Ds are not passing and students must meet the University of California “A-G”

requirements to graduate from high school, so students must all eventually earn a C- or better in all core academic classes. Practically, this means that most students who earn a D or F in a core academic class end up re-taking the class during summer school. This factors into the way that grades are counted in the intervention described below. It also means that most graduates will have a Cal Grant GPA greater than 2.0 (the threshold for a low-income student qualifying for a Cal Grant).

Raising awareness intervention. The first aspect of this project can be described as general awareness raising across students and staff about the details of the Cal Grant process. It was not a clear, time-bound intervention per se, but as information on both the importance and the process of the Cal Grant became more well understood, staff undertook several steps aimed at helping more students earn a Cal Grant award. Although it is not a clear intervention, the work was important to HTH staff and may be useful to others.

One idea was to describe the Cal Grant to students and staff as “the \$50,000 prize.” Cal Grant has been around for many years, but has not been well understood by many HTH staff and students. Many staff did not realize how much money was available and did not understand the relatively high income limits of the program. Although the amount of a Cal Grant varies depending on several circumstances, the maximum benefit is full University of California tuition (currently \$49,176 over four years), so the idea arose to use the language of “the \$50,000 prize,” which might be more compelling than “complete the Cal Grant application.”

The second issue was the GPA upload process. Historically, the primary process at HTH has been to ask students for their social security number (SSN) so that student SSN

and GPA could be uploaded to the CSAC web portal. Many students do not provide their SSN in a timely manner, for reasons such as not being able to find their social security card, parents not wanting to share this information with the school, or lack of follow through by students. While there is an alternative method for uploading GPAs to the CSAC web portal without SSN, there was uneven knowledge across college counselors about the alternative process, as well as almost no knowledge across other staff about the process at all. As awareness of the importance of Cal Grant grew within the organization, staff began uploading more student GPAs, either via SSN or the alternative method.

The third issue was the actual GPA. Low income students need to earn a Cal Grant GPA of 2.0 and moderate income students need to earn a Cal Grant GPA of 3.0. Independent of this project, there has been a focus at HTH schools on improving the academic performance of traditionally underserved students, including reducing the gap in D/F rates by ethnicity and gender. The gap in D/F grades for boys of color vs. white and Asian boys reduced from 7.6% in 2010 to 1.2% in 2015. Although comparable data for low income students is not readily available, it is likely that these efforts have led to fewer Ds and Fs for low income students.

FAFSA information intervention. The second aspect of this project was a FAFSA information intervention. HTH college counselors have always worked to ensure that students complete the FAFSA. Awareness that FAFSA completion data, including errors not yet resolved by families, is available within the CSAC web portal was unevenly distributed among college counselors and almost unknown with other staff. Prior to beginning this project, although theoretically HTH had organizational access to CSAC data, this was not widely understood, and there was not widespread knowledge

across the organization about how to run reports that provide information on FAFSA completion and Cal Grant awards. Learning how to access CSAC data, understand it,¹⁷ and then report on it to college counselors and school directors was a significant aspect of the work. The intervention plan was to send monthly FAFSA completion data to college counselors and school directors at the end of each month in the fall and then on a bi-weekly basis in February leading up to the March 3 deadline.

“Plus one; minus one” intervention. The third aspect of this project was an intervention aimed at helping staff and students get clearer on exactly what a student needs to do to earn a Cal Grant GPA of 3.0 or better. Although low income students only need a Cal Grant GPA of 2.0 to be awarded a Cal Grant, there was a focus on the 3.0 standard so that there could be a common message for all students and because a 3.0 conveys additional benefits such as the ability to apply to the University of California. At one HTH high school, the director, college counselor, and an improvement coach focused their efforts on a target population of juniors with a Cal Grant GPA between 2.2 and 3.4. The purpose was to try to move students below a 3.0 to above and to keep students just above the 3.0 mark staying above. The intervention involved sharing student transcripts with the advisor and teaching the advisor to do a grade tally for academic classes that count as a graduation requirement for grades earned so far in grades 10 and 11. This grade tally ignores pluses and minuses and counts up the number of grades above and below a B. Ds and Fs are not counted because in most cases, students will need to attend

¹⁷ The data on the CSAC web portal was challenging to understand and use. Revamping this website to make FAFSA completion data and Cal Grant award data more accessible to California educators could be a high leverage policy opportunity to significantly improve college persistence and completion. Washington State provides [one example](#).

summer school and get a C- or better in order to progress towards graduation; this summer school grade will end up replacing the failing grade during the Cal Grant GPA calculation. As an example, if through semester one of junior year, a student has 3 As, 8 Bs, and 4 Cs, this student is at “minus one” because the student has one more C than A. Next semester, the student needs to earn one more A than C to be eligible for the Cal Grant. The advisor can now share this information with the student to clearly communicate what grades the student needs to earn to “win the \$50k prize.” This intervention was piloted at High Tech High Media Arts in spring 2016 with a young men of color support group and then tested again at High Tech High Chula Vista (HTHCV) in fall 2017 with all students with a Cal Grant GPA between 2.2 and 3.4.

Study of the intervention. For “raising awareness,” there was not a clear, specific intervention. Rather, over several years school staff became increasingly aware of the significance of the Cal Grant and the process for obtaining a Cal Grant. For this reason, the “intervention” was not formally studied. Instead, trends in Cal Grant award outcome data for low income graduates through 2016 were reported as well as process level data that leads to a Cal Grant award (e.g. percentage of graduates uploaded to CSAC, percentage of graduates with a GPA greater than 3.0).

For the FAFSA information intervention, the theory of action was that communicating FAFSA application status information to school staff would enable targeted interventions with students and families that would lead to more students earning a Cal Grant. To study this intervention, the percentage of low income and all graduates earning a Cal Grant award and completing the FAFSA from 2016 to 2017 was compared and tested for statistical significance. Email records were examined to see if information

was shared with college counselors and school directors in the manner that had been planned.

For the “plus one, minus one” intervention, the theory was that by increasing student and staff awareness of what grades are needed to earn a Cal Grant, more students would earn the necessary grades leading to more Cal Grant awards. To study this intervention, the number of students in the “conversion zone” (Cal Grant GPA between 2.2 and 3.4) at the end of 10th grade and then after semester one in 11th grade was examined. The class of 2018 who received this intervention at HTHCV in fall 2017 (their junior year) was examined and then compared to the same data for the class of 2017 who had not received the intervention. Although this intervention was piloted the year before at another school, data for this effort was not readily available and so this version of the intervention was not rigorously studied.

Measures. All HTH graduates from 2011-2016 with student level demographic data was exported from the student information system and matched with CSAC data on whether graduates had been uploaded to the CSAC web portal, if the FAFSA had been successfully completed on time, and the Cal Grant GPA. A challenge with these data is that if a student has not been uploaded to the CSAC web portal, then the student’s Cal Grant GPA¹⁸ and if the family completed the FAFSA is not known, making it difficult to disentangle improvements in Cal Grant GPAs and FAFSA completion from improvements to the CSAC upload process. Another data source was that CSAC staff agreed to find all HTH graduates in their system, see if they had earned a Cal Grant, and

¹⁸ HTH college counselors have not historically stored Cal Grant GPAs in any accessible manner.

send us these data directly. These data were also matched with student information system data on HTH graduates.¹⁹ The number of students successfully completing the FAFSA at each HTH high school was obtained from U.S. Department of Education data and compared to the number of graduates in that class. Cal Grant GPA currently needs to be calculated by hand at HTH due to several data storage issues.²⁰ Because this is a time-consuming process, an automated GPA calculation was used within the student information system to get an approximate measure of historical unweighted grade 10 and 11 GPAs for each graduating class.²¹ Across all measures, low income students (qualified for Free or Reduced lunch) were a focus, even though Cal Grant is available for moderate income families. This is because one can be reasonably sure that low income families will fall below the income/asset thresholds and thus be eligible for Cal Grant if all other requirements are met. In contrast, for the general student population, students may or may not be eligible for Cal Grant due to income/asset thresholds, even if all other requirements are met, complicating analysis efforts.

For the “plus one; minus one” intervention, HTHCV staff and an improvement coach calculated a rough Cal Grant GPA using an automated process within the student

¹⁹ This was useful because data on Cal Grant awards accessible from the CSAC web portal was difficult to accurately match with internal records of graduates, due to inconsistent student ID numbers, differences in exact student names across systems, and multiple records for students based on years after initial high school graduation.

²⁰ Pluses and minuses need to be removed, failing grades need to be replaced by summer school grades, honors classes need to lose their weighting, and only classes that count for high school graduation should be included; there is not currently an automated way to complete these steps. This introduces obvious possibilities for errors in the CSAC GPA upload process. It also makes it challenging to quickly obtain Cal Grant GPA data to share with staff and students as well as obtaining these data historically. An automated solution is in development.

²¹ This process includes pluses and minuses, does not replace summer school grades, and may include some classes that are not required for graduation. While it is not the same as the Cal Grant GPA, it provides an overall sense of trends in student grades over time.

information system to determine which students in the class of 2018 were in the “conversion zone” at the end of 10th grade (GPA between 2.2 and 3.4). To determine the Cal Grant GPA after 1st semester junior year, transcripts were printed for the students in the conversion zone and hand calculated the Cal Grant GPA as of that moment in time. For the class of 2017, the same automated process was followed to find students who were in the conversion zone after 10th grade and then similarly printed transcripts and hand calculated Cal Grant GPA after 1st semester junior year.

Analysis. For raising awareness, trends in Cal Grant award rates and in process steps were examined but were not analyzed statistically, because data on Cal Grant GPA upload, Cal Grant GPA, and FAFSA completion are all interwoven in that data set.

For the FAFSA information intervention, Pearson’s chi squared test was used to examine changes in FAFSA completion from 2016 to 2017 for all students and low income students using CSAC data. Pearson’s chi squared test was also used to examine changes in FAFSA completion from 2016 to 2017 for all students using U.S. Department of Education data. Changes in Cal Grant award rates from 2016 to 2017 for all students and low income students were tested for statistical significance using Pearson’s chi squared test. To test whether changes in FAFSA completion at HTH were due to changes in national policy around the FAFSA process, changes in HTH FAFSA completion data were compared to California data, but were not tested for statistical significance because raw data files for California were not available. Finally, email records were examined to determine whether the FAFSA information intervention was delivered as intended.

For the “plus one; minus one” intervention, changes in GPA for the class of 2017 (no intervention) and the class of 2018 (intervention) were compared.

Ethical considerations. Improvement science projects are often considered exempt from human subjects review because these projects' primary purpose is to improve educational outcomes rather than creating generalizable knowledge.²² Consistent with this, this project was reviewed by the Director of the University of California, San Diego Human Research Protections Program and was certified as exempt from IRB review (Project #160709XX).

An ethical issue that arose in this project is that school staff do not have detailed information on families' financial status. This can lead to potentially awkward situations where students are encouraged to improve their grades to get a Cal Grant, when their family is not eligible as well as other potentially awkward conversations about family income and assets. To be clear, the intervention does not involve raising this issue with students, but the issue can easily arise. However, in California, a weighted 10th/11th grade GPA of 3.0 is required to apply to the University of California and a GPA of 3.0 causes students to be eligible to apply to a California State University regardless of SAT or ACT score. So, although the Cal Grant GPA is calculated somewhat differently than the weighted UC GPA, students earning a 3.0 is beneficial regardless of Cal Grant eligibility. Similarly, if low income students with a GPA less than 3.0 earn a Cal Grant, they are unlikely to be admitted to a UC or CSU school with that GPA, so even though low income students only need a 2.0 GPA to obtain a Cal Grant, the scholarship is of less value without acceptance into a UC, CSU, or other prestigious university.

²² e.g. see <https://www.hhs.gov/ohrp/regulations-and-policy/guidance/faq/quality-improvement-activities/index.html>

Another potential issue is teachers feeling pressure to raise grades regardless of student performance so that students obtain a Cal Grant. Thus far, there has not been enough system wide understanding of the connection between grades and Cal Grant for teachers to likely feel this pressure. As more students and teachers begin to understand exactly how the Cal Grant system works, this issue is likely to become more salient. Going forward, it will be important to work to mitigate this.

Results

Raising awareness. Figure 8 shows Cal Grant award rates for all students and low income students. Through 2016, there had been modest, uneven growth in the percentage of low income students earning a Cal Grant award each year. To better understand what has led to that increase, Cal Grant process data for low income students is displayed in Table 1. To have more low income graduates earning a Cal Grant, it could be because more students were uploaded to the CSAC web portal, more students earned higher grades, or more families successfully completed the FAFSA. In fact, all these factors may be true. From 2014 to 2016, 6% more graduates received a Cal Grant award. During that same time period, 10% more low income graduates were uploaded to the CSAC web portal, 5% of low income graduates increased their unweighted GPA above 2.0, and 8% more low income graduates had their GPA uploaded, had a Cal Grant GPA above 2.0, and completed the FAFSA on time.²³ As noted earlier, it is difficult to

²³ Although 80% of low income graduates in 2016 had their GPA uploaded, had a GPA above 2.0, and completed FAFSA on time, only 61% were ultimately awarded a Cal Grant. This may be because the student did not meet the income/asset test despite qualifying for free or reduced lunch at some point in high school, did not apply to a California College, did not attend a California college so later had the Cal Grant taken away, did not properly document high school graduation, or other reasons. Reasons why individual students did not earn a Cal Grant despite appearing to complete the steps on the surface are not available.

disentangle Cal Grant GPA upload from FAFSA on time completion and Cal Grant GPA. However, noting that the percentage of low income graduates uploaded to CSAC and completing FAFSA on time from 2014 to 2016 (72% to 80%) is the same as the percentage of low income graduates uploaded to CSAC, completing FAFSA on time, and having a Cal Grant GPA above 2.0, it may be that on time FAFSA completion and CSAC upload were the more important factors.

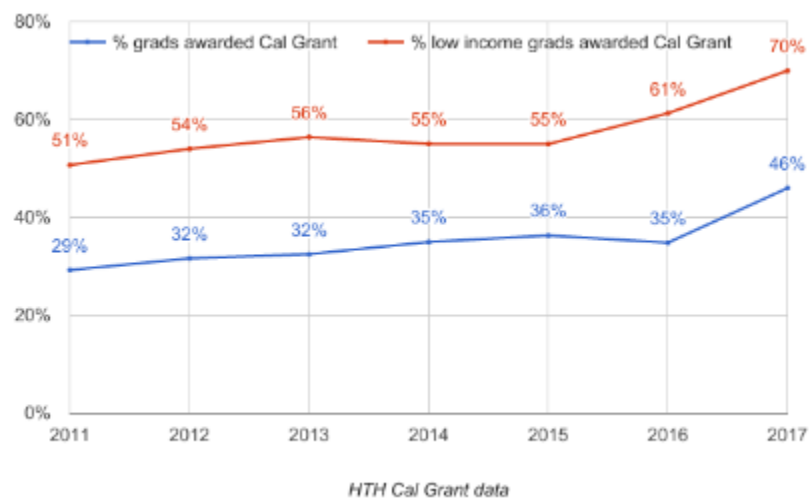


Figure 8: Cal Grant award rates at HTH schools

Table 1: Cal Grant process data

Low income students	2011	2012	2013	2014	2015	2016	2017
% Uploaded to CSAC web portal	82%	80%	81%	83%	86%	93%	98%
% Uploaded & Cal Grant GPA>3.0	50%	50%	49%	49%	61%	71%	80%
%Uploaded & Cal Grant GPA>2.0	79%	79%	78%	82%	85%	93%	97%
% Unweighted GPA>3.0	56%	57%	57%	56%	61%	67%	79%
% Unweighted GPA>2.0	95%	98%	94%	94%	96%	99%	98%
% Uploaded & FAFSA on time	70%	72%	68%	72%	77%	80%	84%
% Uploaded, FAFSA on time, & Cal Grant GPA>2.0	69%	71%	68%	72%	77%	80%	83%

FAFSA information. As shown in Figure 9, there has been a steady increase in low income graduates FAFSA completion from 2013 to 2017 according to CSAC data with a small increase (80% to 84%) from 2016 to 2017 ($p=.25$), during the time of the email information to college counselor intervention. There was also a marked increase (72% to 85%) in overall graduate FAFSA completion from 2016 to 2017 according to CSAC data ($p<.0001$). As noted earlier, FAFSA completion data according to CSAC combines FAFSA completion with the GPA upload process. Independent evidence of an increase in FAFSA completion is provided by U.S. Department of Education data, which also showed an increase from 73% to 85% for overall graduates from 2016 to 2017 ($p<.0001$). Further, Cal Grant award rates increased from 35% to 46% for all students ($p=.0003$) and from 61% to 70% for low income students ($p=.06$) for the class of 2017.

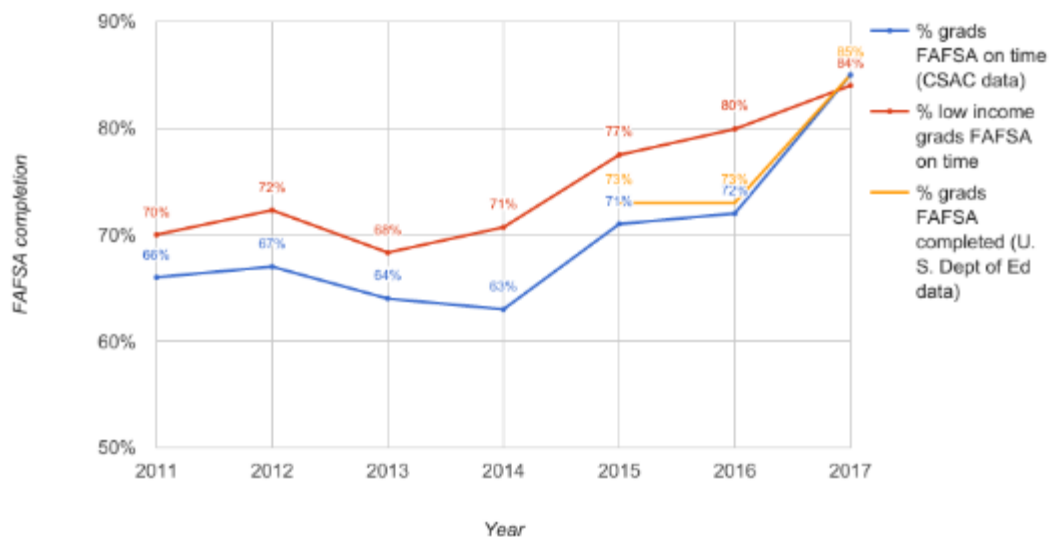


Figure 9: FAFSA completion data at HTH schools

As noted earlier, the U.S. Department of Education changed the FAFSA completion process before the 2016-17 school year, making it easier for families to complete the FAFSA. This raises the question of whether improvements in FAFSA completion are related to High Tech High interventions or are actually due to a broader contextual shift. Table 2 shows that the increase in students at HTH completing the FAFSA in 2016-17 is almost 10 percentage points higher than the increase for students across California.²⁴

Table 2: The increase in the percent of students completing FAFSA from 2016 to 2017 at HTH and in California as of March 3

	FAFSA complete Mar 3, 2016	FAFSA Complete Mar 3, 2017	Difference between 2016 and 2017
All High Tech High (~600 total students)	61.8%	78.4%	+16.6%
All California (~480,000 total students)	40.4%	47.3%	+6.9%

²⁴ For California data, the numerator comes from U.S. Department of Education data, while the denominator comes from California Department of Education data.

In any intervention, there is always a gap between intended practice and actual practice (Pfeffer & Sutton, 2013). One reason that an intervention might not be working is that it might not actually be happening as expected. For this reason, email records were checked for frequency and types of communications with school staff about college counselors. The plan had been to send college counselors and school directors monthly FAFSA completion data from October through January and bi-weekly data in February leading up to the March 3 deadline. There was a total of four emails sent to both college counselors and school directors and an additional two emails sent only to college counselors. Only one email was sent in the fall, on November 8, because getting data from the CSAC web portal proved to be more challenging than anticipated. From January 2 through March 1, five emails were sent roughly every two weeks, three times with a list of names of students not yet completing FAFSA, one time with only a graph of current FAFSA completion, and finally with a list only of students who still had an error with the FAFSA.²⁵ While this intervention was not completed precisely according to plan, the general plan was basically followed.

“Plus one; minus one.” Results of the analysis of the plus one; minus one intervention are shown in Table 3. For the class of 2018, five additional students were above the 3.0 GPA threshold after receiving this intervention, representing an increase of 11.9% of the students in the conversion zone after the 10th grade (unweighted GPA between 2.2 and 3.4). However, when the class of 2017 was analyzed, which had not received the intervention, five additional students also were above the 3.0 GPA threshold,

²⁵ A “NO EFC” (expected family contribution) error in the CSAC web portal.

which is a slightly smaller increase (10.2%) due to the larger number of students in the conversion zone in 2017. Thus, the intervention does not appear to have had a practical impact.

Table 3: Data on “plus one; minus one” intervention

Students in the target zone 2018	After 10th grade	After S1 11th grade	Change
3.0 or above	14	19	+5
Below 3.0	28	23	-5
% above 3.0	33.3%	45.2%	+11.9%
Students in the target zone 2017	After 10th grade	After S1 11th grade	Change
3.0 or above	12	17	+5
Below 3.0	37	32	-5
% above 3.0	24.5%	34.7%	+10.2%

Discussion

As HTH staff learned more about the importance of the Cal Grant and the FAFSA completion process, there was modest growth in FAFSA completion and Cal Grant award rates from 2013-14 to 2015-16. A focused intervention in 2016-17 communicating information about current student FAFSA completion to college counselors and school directors correlated with 13 percentage point more students completing FAFSA on time, although only 4 percentage point more low income students. This intervention also correlated with 11 percentage point more students in the class of 2017 being awarded a Cal Grant and 9 percentage point more low income students. Another intervention aimed at communicating information to students and advisors about grades needed to earn a Cal Grant GPA of 3.0 did not have a statistically significant effect.

Interpretation. These results are consistent with two other recent FAFSA intervention studies. In one recent randomized control study, Texas families who opted into an intervention received weekly text messages from February through April about the FAFSA process and the status of their FAFSA application; this led to a six percentage point increase in FAFSA completion rates (Page & Castleman, 2016). The same authors performed a similar intervention with community college first year students which led to 14 percentage points more students persisting through spring of their second year (Castleman & Page, 2016).

A surprising result was that non-low income students increased FAFSA completion rates more than low income students. Because low income students were already completing FAFSA at higher rates, perhaps there will be practical ceiling effects in how much higher FAFSA completion can be increased, either due to lack of family interest, families or students who are undocumented, or other reasons. This will require further investigation. Also, there is some variation across the five high schools, partly connected to different processes for uploading Cal Grant GPAs to the CSAC web portal. Further analysis of this variation is left to future reports.

Limitations. One issue with the data reported on in this paper is the discrepancy between Cal Grant data reported on for previous years compared to data for 2016-17. Cal Grant award rates may continue to go up throughout spring 2017 as paper FAFSA forms are filed, as CSAC processes applications, and other issues. Conversely, if students do not report that they graduated high school²⁶ or if they do not go to a California college, they

²⁶ Some HTH graduates lost the Cal Grant due to this factor in the past. Now that it is clear that high school graduation information can be entered by school staff on behalf of graduates, it is unlikely that HTH graduates will lose Cal Grant for this reason this year or in the future.

may lose the Cal Grant. It is not entirely clear how these different factors will impact final Cal Grant award rates by fall 2017. Still, FAFSA on time completion rates did increase, as did the number of students uploaded to the CSAC website, suggesting that it is likely that some increase in Cal Grant award rates did occur.

Another issue is that data on FAFSA completion was not regularly collected throughout the school year, primarily due to confusion about how to collect this information. By collecting these data on a weekly basis in the future, it will be possible to more closely track how particular interventions impacted FAFSA completion. For example, it would be possible to see if a family financial aid information night correlated with an increase in FAFSA filing soon after that event. Collecting more frequent data and comparing to specific interventions as a cycle of rapid inquiry is more consistent with gold standard improvement science methodology.

Conclusion. Providing information to school staff about which students have not yet completed the FAFSA may be a useful tool in other contexts. Learning how to access information on the CSAC web portal may be the primary barrier to spreading this intervention more widely in California. The costs of this intervention were staff time, both in processing the data and then following up with students. However, HTH college counselors were already following up with students in the past but did not have definitive information on which students had not yet successfully completed the FAFSA, so this intervention may have enabled counselors to work more effectively, not just more.

These interventions will continue to be refined over time. One next step is that for the 2017-18 school year, all student GPAs, excepting families who opt out, will be uploaded in October. If families also complete the FAFSA early, students will know in the

fall that they have “won the \$50k prize.” It may be that by knowing that college tuition costs are covered, some students might choose to apply to the California State University or the University of California by the November 30 deadline who might not have done so in the past for financial reasons. This might lead to a greater number of graduates enrolling directly in a four-year college, which might then lead to higher levels of college persistence and graduation. Another is to consider interacting more directly with students and families, potentially using a text message based system to provide information about Cal Grant and FAFSA completion. Using such a text message system to help students re-apply for the FAFSA and the Cal Grant during the first year of college may be a particularly promising strategy. Finally, although the “plus one; minus one” intervention did not prove to be effective based on one semester’s worth of data, there still may be a seed of a good idea here. Some school staff are likely to continue to test ways to make that intervention more effective. Hopefully these findings and the continuing evolution of the work may prove to be useful to others in increasing FAFSA completion and Cal Grant award rates in their settings.

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Chapter V: Notice and Act: An Improvement Project to Reduce Chronic Absenteeism in a System of Public Charter Schools²⁷

Abstract

5 to 7.5 million U.S. K-12 students are chronically absent every year, an issue which is growing in prominence in national education reform conversations. High Tech High (HTH) schools developed an intervention that systematically tracked students on the path towards chronic absenteeism and intervened with families via letters, phone calls, and meetings. The intervention began development at one school in 2013 and then spread to two additional schools in 2015-16. Chronic absenteeism was reduced at all three schools by up to 85% ($p < .0001$). Low income students in intervention schools were less likely to be chronically absent than non-low income students in non-intervention schools by a factor of almost two ($p = .004$). Future directions are to further simplify the intervention, spread it to additional HTH schools, and ultimately spread to other interested school systems.

Introduction

Problem description. High Tech High (HTH) has embarked on an improvement project to increase 4-year college attendance and completion, with a focus on traditionally underrepresented students. The HTH improvement team hypothesized that one of the drivers of college going and completion is having a sense of belonging in the community, both at HTH schools and in the college setting. Research on “student involvement” posits that when students are more involved in their school they are more

²⁷ This manuscript was prepared using the SQUIRE guidelines, v. 2.0 - Standards for Quality Improvement Reporting Excellence (Goodman et al., 2016; Ogrinc et al., 2015).

likely to be successful and that dropping out of school is an extreme form of being uninvolved (Astin, 1984). The team believed that frequent absences might be connected to being less involved and having less sense of belonging. The hope was that reducing frequent absences might ultimately help with the goal of increased 4-year college attendance and completion.

Available knowledge. It is estimated that 5 to 7.5 million U.S. K-12 students are chronically absent every year, where chronic absenteeism is often defined as a student missing 10% or more of school per year, for whatever reason (Balfanz & Byrnes, 2012). Nationally, chronic absenteeism cuts across race, gender, and age (Balfanz & Byrnes, 2012), although some studies have found that Native American students and low income students are more likely to be chronically absent (Buehler, Tapogna, & Chang, 2012).

Chronic absenteeism matters to school performance. Frequent absences in kindergarten have been found to be predictive of lower likelihood of reading proficiency by the end of third grade (Bruner, Discher, & Chang, 2011; Ginsburg, Jordan, & Chang, 2014), and lower achievement on test scores in fifth grade (Bruner et al., 2011; Buehler et al., 2012). Chronic absenteeism has been found to predict lower NAEP scores (Ginsburg et al., 2014), dropping out of high school (Henderson, Hill, & Norton, 2014), and lower rates of college persistence (Ginsburg et al., 2014). Efforts to reduce chronic absenteeism in Chicago and New York City were linked to better graduation rates (Ginsburg et al., 2014). Not only does chronic absenteeism affect the absent student, but it can have negative impacts on the rest of the class as well, possibly because the teacher needs to spend class time bringing the absent students up to speed (Gottfried, 2015). Chronic absenteeism in one year predicts chronic absenteeism in the next (Attendance Works,

2014), and as few as two absences in September are a strong predictor of chronic absenteeism by the end of the year (Olson, 2014). The negative effects of chronic absenteeism are more pronounced for low income students (Gottfried, 2014). Parents of frequently absent students underestimate how often their children are absent from school and the extent to which their children are absent more often than the average child (T. Rogers & Feller, 2016).

One reason that chronic absenteeism has historically not been discussed nor addressed is that it is frequently not measured (Balfanz & Byrnes, 2012). Only six states systematically measure chronic absenteeism, and these states do not measure chronic absenteeism in the same way (Balfanz & Byrnes, 2012). School systems typically focus on average daily attendance (ADA), which can mask the underlying prevalence of chronic absenteeism, because a school with 95% ADA can still have 30% or more of the students chronically absent (Bruner et al., 2011). A school with greater than 97% ADA probably does not have an issue with chronic absenteeism, a school with lower than 93% ADA almost certainly does, and schools with ADA between 93% and 97% need to examine their data for chronic absenteeism problems (Bruner et al., 2011).

Examination of data at HTH indicated that although average daily attendance has generally hovered annually between 94%-96%, chronic absenteeism at individual schools in some years has been as high as 21%, which was both surprising and concerning. From 2010-2015, low income high school students were more likely to be chronically absent than non-low income high school students (15.1% vs 11.1%, $p < .0001$).

Rationale. The theory of action in this project was: two drivers of student chronic absenteeism are families not noticing how often their children are absent and families not

prioritizing getting their students to school. Thus, school staff systematically tracking student absences and communicating with families will lead to fewer absences, so that these students will have more learning opportunities, which will ultimately lead to higher college going and persistence. The primary change idea in this project was closely monitoring student absences, communicating to families that staff noticed, and offering support to help students be at school. This change was focused on the logistics of school staff noticing and intervening as well as working with families.

Specific aims. The purpose of this project is to reduce chronic absenteeism across the thirteen HTH schools. A method for reducing chronic absenteeism was developed at one of the schools from spring 2013 through spring 2015. In fall 2015, two additional schools adapted this change idea at their site with the goal of achieving similar improvements, although staff did not name a clear, measurable aim at that time. This paper reports on results of this effort at these three schools.

Methods

Context. High Tech High is a system of public charter schools in San Diego County. Five high schools, four middle schools, and four elementary schools with a total enrollment of roughly 5200 students are spread across three locations in San Marcos, Point Loma, and Chula Vista, California. As schools of choice, students are accepted via a competitive yet non-meritocratic zip-code based lottery system. Because families apply and because families often feel “lucky to have gotten in,” families may be more engaged than average and thus this change idea may have been particularly likely to succeed in this context. One High Tech High design principle has been “teacher as designer” (“HTH Design Principles,” n.d.) which sometimes translates into strong skepticism by both

teachers and school leaders of top down solutions or even taking up a solution from another school. This was the first systematic effort to spread a particular change idea across this system of schools using an improvement science framework.

Intervention. The dean, director, and site manager at High Tech High North County (HTHNC) developed this chronic absenteeism intervention over three years as part of an effort to increase attendance at the school more generally. This school historically had lower attendance than the other four high schools at HTH (e.g. 94% in 2010-11). While there are several aspects to the work, the core intervention can be summarized simply as “Notice and Act.” First, a weekly report of which students are currently chronically absent is produced and examined by the director, site manager, and dean. Second, an increasingly escalated intervention is enacted. For students who have been absent five times, a letter is sent home noting the number of absences and the importance of school attendance. For students who have been absent ten times, a similar letter is sent home with an additional request for a meeting between the family, student, and dean. The site manager phones home to set up a time for that meeting. Letters and requests for meetings continue to occur at 15, 20, 25, etc. absences.²⁸

Of note, an important aspect of the meeting is that it is not intended to be a punitive conversation. The purpose of the meeting is to let the family know that the school has noticed that the student has been frequently absent, the importance of school attendance, and an offer to help clear obstacles getting in the way of school attendance. For example, one school prepared clean clothes for one student for whom this was barrier

²⁸ These interventions are consistent with “Tier 2” interventions as described in the California School Attendance Review Board [handbook](#).

to school attendance. With that said, when students reach high levels of absences, staff sometimes implement an “attendance contract” indicating that course credit may be lost if students are absent a specific number of additional times. These contracts are common across HTH schools. What is different about this intervention is the systematic, earlier communication with families.

While this intervention may seem like common sense, it has not been standard practice at High Tech High schools, and from conversations with other educators, the same is often true nationally, even when it is the stated policy. Further, while this intervention may sound simplistic, the challenges associated with consistently executing this intervention were significant. For example, when the project began, there was no easy way to access chronic absenteeism data from the student information system.

Study of the intervention. The theory of this project was that communicating with families about frequent absences and the importance of school attendance would lead to reduced chronic absenteeism. To test this theory, the consistency of school to family communications was checked as well as changes in attendance outcomes during the time period of the intervention. To determine if the intervention was having the intended impact, average annual chronic absenteeism both before and after intervention at each school was compared. Average annual chronic absenteeism at intervention schools versus non-intervention schools was also compared. These data were disaggregated for low income students (students who qualify for free or reduced lunch) as well. From an improvement science perspective, annual data is too infrequent to be useful for action and learning. In fall 2015, two middle schools expressed interest in implementing this intervention, so the team began tracking weekly data for both schools. One school ended

up not implementing the intervention, creating a type of natural experiment between the two schools. This weekly data was compared visually²⁹ and year end chronic absenteeism differences were assessed for statistical significance. To determine the extent to which the intervention was being implemented as expected, student information system data on numbers of absences per student was compared with school level records of letters sent home and meetings held with school staff.

Measures. Primary outcome data in this project were student absences, as measured in the student information system. However, the question of whether a student is absent or not was more complicated than expected. For example, whether partial day absences or absences due to independent study days should count as absences is not fully resolved. In analyzing these data, different methods of reporting absenteeism within the student information system led to discrepancies on the order of 20% across different reporting methods. Another issue was that due to data system errors, sometimes students were reported to be absent many times and yet when checked by hand the students were not absent that many times. For cases where students had ten or more absences yet no intervention was performed, student records were hand-checked to ensure that the students had actually been absent as reported.

²⁹ The intention was to analyze these data using run charts and statistical process control charts. However, weekly chronic absenteeism data represents cumulative absences from the beginning of the year, meaning that the data points are not independent (a student frequently absent in the first weeks of school will remain on the chronic absenteeism list even without further absences). With non-independent data, it is not appropriate to apply standard rules for run charts or control charts (Provost & Murray, 2011). Many other ways to analyze data more frequent than annual were considered (e.g. number of students absent twice per month, total number of absences per month). However, because absenteeism data fluctuates throughout the year (e.g. students are frequently absent around holidays) and because student absences increase over the year, these analyses (even when a seasonal correction was applied) obscured more than they illuminated.

At all three schools, school staff kept local detailed records of efforts to intervene with families. Process data collected and analyzed from the 2015-16 school year include requests for letters to be sent home, requests for meetings with families, and documentation of meetings that occurred with the dean of students. When there were still discrepancies after hand-checking numbers of absences (e.g. a student had been frequently absent but there was no record of an intervention), school staff were interviewed to gather more information.

Analysis. The difference in annual chronic absenteeism before and after intervention was assessed using Pearson's chi-squared test for association (χ^2). The difference during the 2015-16 school year in annual chronic absenteeism between two intervention high schools and three non-intervention high schools as groups was compared. Similarly, the difference during the 2015-16 school year in annual chronic absenteeism between one intervention middle school and three non-intervention middle schools as a group was compared. High schools were compared to high schools and middle schools to middle schools because pre-intervention there was a large difference in average chronic absenteeism levels by school level (e.g. 15.2% for HTH high schools vs. 5.6% for HTH middle schools in 2012-13, $p < .0001$). To examine low income students, similar analyses were applied as above for low income and non-low income students. To determine whether the intervention was occurring as expected, student information system records of numbers of students with five and ten absences were cross checked with staff data on whether letters were sent home and whether meetings with school staff were held.

Ethical considerations. Improvement science projects are often considered exempt from human subjects review because these projects' primary purpose is to improve educational outcomes rather than creating generalizable knowledge.³⁰ Consistent with this, this project was reviewed by the Director of the University of California, San Diego Human Research Protections Program and was certified as exempt from IRB review (Project #160709XX).

An ethical issue that arose in the conduct of this study is the potential for student attrition, i.e. families potentially feeling pressured to leave the school due to this absenteeism intervention. This project focused on current students, so if a student left the school, they were no longer considered to be chronically absent. This choice was made because from the point of view of school staff, receiving a list of students on the chronically absent list who no longer attend the school is not actionable. Obviously, the intention of this project was not to encourage chronically absent students to transfer schools to improve chronic absenteeism numbers. One school did have one family that reported changing schools because they "wanted to attend a school that was less concerned about absences." For this reason, as a balancing measure, high school student attrition data pre and post intervention was analyzed; it was found that intervention schools had the same or less student attrition from pre to post intervention (e.g. one high school had 5.1% attrition pre-intervention and 5.2% attrition post intervention, $p=.997$), indicating that this concern, while important to attend to, was not likely causing the drop in chronic absenteeism.

³⁰ e.g. see <https://www.hhs.gov/ohrp/regulations-and-policy/guidance/faq/quality-improvement-activities/index.html>

Results

Evolution of the intervention. This intervention went through many iterations in its development by staff at HTHNC, and staff are currently working to simplify the process further to spread the intervention across all thirteen schools. This report focuses on how the intervention changed as it spread to two other schools in the 2015-16 school year.

Located just feet from HTHNC, High Tech Middle North County (HTMNC) staff took it upon themselves to adopt this intervention at their site. Despite it being their choice to take up this intervention, staff felt it was important to implement the practices with high fidelity. For example, staff at this site were concerned that the letters to families were overly “harsh,” so in the fall of 2015, the dean called each family to “warn” them about the letter they were about to receive. This had the unintended consequence of causing the dean to become engaged in extended conversations with families about their situation, taking up significant amounts of the dean’s time. They nonetheless persisted in this practice until months later when the HTMNC team was asked whether they had considered softening the language in the letter. The dean visibly exhaled as she asked, “Can we do that?” Because the school had chosen to take on these practices, it was surprising that there was a sense of needing “permission” to change them, but staff felt that the practices were working at one site and so they should implement the practices in the same way. After receiving encouragement, they changed the language in the letters so then stopped making the “warning” phone calls. One other significant change at this site was that at ten absences, rather than meeting face to face, the dean typically had a phone conversation with families.

Somewhat in contrast, High Tech High International (HTHI), located 30 miles south of HTHNC, appeared to feel less pressure to implement the intervention unchanged. Rather than sending a letter in the mail, this site sent an email instead.³¹ Additionally, while the other two schools intervened each week for any students who crossed an attendance threshold, this site sent letters in batches to any student past an attendance threshold on just four dates (December 15, March 2, April 20, and May 11). These changes appear to have been made to make the intervention easier to implement.

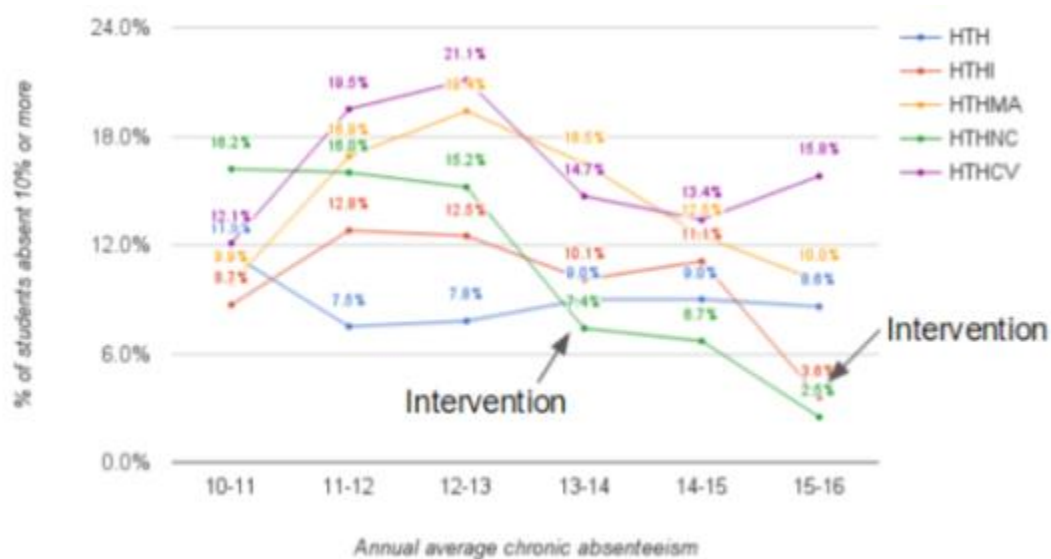
Process measures. In any intervention, there are always gaps between intention and action (Pfeffer & Sutton, 2013). An intervention might not be working because it is not actually happening as expected. For this reason, student information system data on numbers of absences was compared to internal data from school staff to check the frequency that letters were sent and meetings were held (see Table 4). For 15+ absences, staff records of interventions were inconsistent, so these data are not reported on. As noted earlier, HTHI conducted interventions in batches, with the last intervention on May 11, meaning that any student who crossed a threshold of five, ten, or fifteen absences after that date would not receive an intervention. This likely explains many of the students who did not receive an intervention. In summary, two sites (HTHNC, HTMNC) largely implemented the intervention as expected, while one site (HTHI) did not consistently implement the intervention as expected.

³¹ Note that staff from the two other schools believe that sending formal letters in the mail is important to convey seriousness.

Table 4: Process measures of intervention

School	# Students with 5+ absences	% Letter home	# Students with 10+ absences	% Second letter	% Meeting
HTHNC (high)	278	94%	85	91%	64%
HTHI (high)	259	36%	108	36%	19%
HTMNC (middle)	182	74%	59	75%	39%

Outcome measures. While HTHNC had the highest chronic absenteeism in 2010-11, there was a marked improvement starting in the 2013-14 school year, when this intervention was being developed and implemented (see Figure 10). This improvement increased through 2015-16. HTHI took up the intervention in the 2015-16 school year and also improved on this measure. Similarly, HTMNC also took up this intervention in 2015-16 and achieved similar improvements (see Figure 11).

**Figure 10:** Annual chronic absenteeism at HTH schools

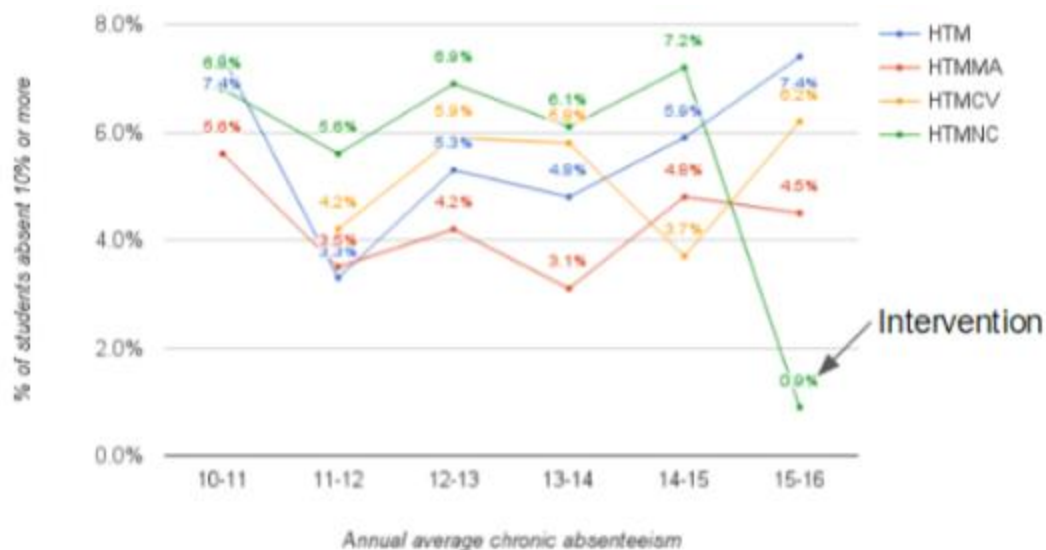


Figure 11: Annual chronic absenteeism at HTH middle schools

Pre-post intervention. Individual schools' chronic absenteeism rates before and after intervention were compared (see Table 5). Six years of data were collected because that includes the first year that HTHNC had seniors. For HTHNC, three years of data were pre-intervention and three years were post-intervention. For the other two schools, five years of data was pre-intervention and one year was post-intervention. Upon implementation of the intervention, average annual chronic absenteeism rates improved at all three sites and was statistically significant ($p < .0001$).

Table 5: Process measures of intervention

Chronic absenteeism	Pre-intervention	Post-intervention	Chi-Square	p
HTHNC	15.8%	5.7%	82.08	$p < .0001$
HTMNC	6.5%	0.9%	15.78	$p < .0001$
HTHI	11.0%	3.6%	19.95	$p < .0001$

Intervention vs. non-intervention. Annual chronic absenteeism rates at intervention and non-intervention schools during the 2015-16 school year were also

compared (see Table 6). Two intervention high schools were compared to three non-intervention high schools and one intervention middle school was compared to three non-intervention middle schools. Implementation schools had lower chronic absenteeism that was statistically significant for both high schools ($p < .0001$) and middle schools ($p = .0002$).

Table 6: Intervention vs. non-intervention schools comparison (2015-16)

Chronic absenteeism	Non-intervention	Intervention	Chi-Square	p
High Schools	11.8%	3.0%	53.47	$p < .0001$
Middle Schools	6.0%	0.9%	13.99	$p = .0002$

Low income students. The calculation above was also performed disaggregating low income students (see Table 7). Middle school and high school students were grouped together³² by intervention schools and non-intervention schools. Both low income and non-low income students had lower chronic absenteeism in intervention schools that was statistically significant. Historically, low income students have been more likely to be chronically absent than non-low income students at statistically significant levels. However, for the 2015-16 school year, although low income students were more likely to be chronically absent than non-low income students in both intervention and non-intervention schools, the differences were no longer statistically significant. In fact, low income students in intervention schools were less likely to be chronically absent than non-low income students in non-intervention schools (5.0% vs. 9.1%), which was statistically significant ($p = .004$).

³² These calculations were also performed separating middle schools and high schools, with similar results.

Table 7: Chronic absenteeism data disaggregated for low income students in 2015-16

Chronic absenteeism	Non-intervention schools	Intervention schools	Chi-Square	p
low income	11.4%	5.0%	16.59	p=.00005
non-low income	9.1%	3.2%	16.75	p=.00004

Beyond the 10% threshold. Because the chronic absenteeism cut-off of 10% is an arbitrary number and represents a large total number of absences for a student in one year (18 absences), other numbers of absences pre and post intervention at HTHNC were compared (see Table 8). Taken together, these data suggest that this intervention was not merely moving students from slightly above to slightly below the 10% cut-off but rather represents a broad reduction in absences across the school.

Table 8: Percentage of students with specified number of absences at HTHNC

# Absences	Pre-intervention	Post-intervention	Reduced by factor of	p
5+	67.3%	60.3%	1.1	p<.0001
10+	36.6%	25.6%	1.4	p<.0001
15+	20.7%	9.2%	2.3	p<.0001
20+	10.9%	3.2%	3.4	p<.0001
25+	6.6%	1.2%	5.4	p<.0001
30+	4.0%	0.5%	7.8	p<.0001

Weekly data. Because two middle schools had expressed interest in implementing this intervention in the fall of 2015, the current percentage of students on the chronic absenteeism list each week was collected (see Figure 12). For the first ten weeks of school, the data at both schools is quite similar. As the year progresses, the difference between intervention school and non-intervention school becomes clear. The

difference in annual chronic absenteeism at these two schools at the end of the year was 7.4% vs. 0.9% ($p=.0002$).³³

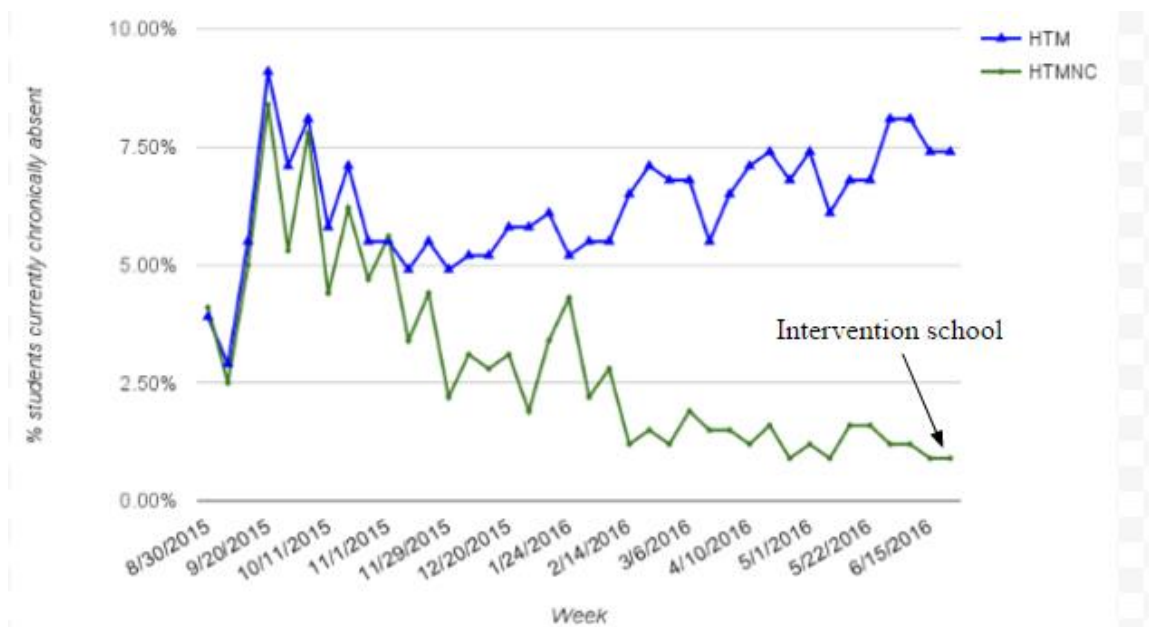


Figure 12: Weekly cumulative chronic absenteeism data in 2015-16

Discussion

After enacting an improvement science intervention at three public charter schools, there was a large and statistically significant improvement in chronic absenteeism at all three schools. At intervention sites, the percentage of students who were chronically absent at the end of the school year compared to previous years at the same school improved by 64%-86%. Students at intervention schools were 75% less likely to be chronically absent than students at control schools at the high school level and 85% less likely at the middle school level. These improvements impacted both low income and non-low income students. Pre-intervention, there was no systematic effort to

³³ The jigsaw pattern in the data early in the year is a statistical quirk related to the 10% threshold, because early in the school year, it is easy for a student to toggle above and below this threshold (e.g. a student only needs to be absent once during the first ten of days of school to meet the 10% absence threshold).

communicate with families about frequent absences, particularly not early in the year. At schools implementing this intervention in 2015-16, all three sites intervened far more frequently than in the past, although the consistency of implementation varied across sites. It is interesting that HTHI did not fully implement the intervention yet still experienced an improvement in outcomes, although not as much of an improvement as at the other two schools that more fully implemented the original intervention. This raises questions of whether the simpler intervention might be more effective from a cost-benefit perspective.

Interpretation. These results compare favorably to other recent reports of efforts to reduce chronic absenteeism. A low-cost, large randomized control trial in which all treatment families received up to five letters about absenteeism led to a difference in chronic absenteeism of 36% in the control group vs. 32% in the most effective treatment group or an improvement of 10%, meaning that the effect size of the intervention in this paper was 7-8 times larger (T. Rogers & Feller, 2016). In another recent study intending to improve attendance, parents were sent daily alerts and weekly attendance summaries via text message, but researchers found no statistically significant change in attendance rates or chronic absenteeism (Balu, Porter, & Gunton, 2016). Both of these studies aimed to make improvements in attendance using a low cost, easily scalable model. The intervention in this paper is more intensive and personalized than either of these approaches, yet is also significantly less costly and intensive than other approaches such as connecting students to social workers and mentors in the community (Balfanz & Byrnes, 2013). It is likely that the intervention described in this report will be insufficient to help students in the most challenging situations come to school more often. Still, these

results suggest that it would be wise to ensure that basic school-based interventions are enacted consistently prior to implementing more complex and potentially costly solutions.

Limitations. A limit to the generalizability of this work is the school context. As “schools of choice,” this intervention may be particularly likely to work in the context of relatively engaged families. HTH has begun work with three alternative high schools in a large urban district, which might be described as “schools of last resort” to help them implement this intervention in their context. Because of the difference in context, HTH was hesitant to suggest that this intervention would prove valuable to these schools, yet staff there have expressed enthusiasm for adapting this intervention to their schools. It is likely that the team will learn more about how to adapt this intervention to different contexts through these efforts.

Another limitation is that HTH schools may have been historically doing less about chronic absenteeism than some other school systems. It may be that the reason for such dramatic improvements in chronic absenteeism, particularly in contrast to other recent studies, is that other schools are already implementing a version of this intervention and are now trying to make improvements on top of this.

Another limit is in regards to the initial theory that improving chronic absenteeism might lead to an increase in four-year college going. Across all five HTH high schools, for the classes of 2015 and 2016, 62% of chronically absent students went directly to a four-year college, compared to 70% of non-chronically absent students ($p=.03$). Although this is a statistically significant finding, it may not be practically significant as the difference in 4-year going rate is not that large, and there are likely other characteristics

of students who go to four-year colleges that are more explanatory than chronic absenteeism. Thus, it is not clear from these data that reducing chronic absenteeism across more schools will help to achieve the larger aim. Nonetheless, more students coming to school more often is generally a good thing, and so HTH is likely to continue to pursue spreading this intervention across the organization. In fact, in the California context, schools are required by the new “data dashboard” to attend to chronic absenteeism, adding yet another reason to pay attention to chronic absenteeism rates.

Conclusions. Future directions for the team are to spread this intervention, with adaptation, both internally at HTH and to other interested school systems. Advocates of the intervention at current sites argue that it is simple enough as it is for others to incorporate into their workflow. However, before systematically attempting to spread this intervention across the rest of the organization, the team has been working to automate various aspects of the process³⁴ to make spreading and scaling this intervention more sustainable, believing that interventions must become more simple if they are to spread effectively (E. M. Rogers, 1962).

In the meantime, because a method for auto-emailing a list of chronically absent students was developed for internal data recording purposes, this fall staff began automatically sending this list to school leadership at each school on a weekly basis. This may lead to lower chronic absenteeism through a range of different school level responses.

³⁴ e.g. auto-creating the letters to send home from within the student information system.

In the end, it seems that the biggest issue for HTH was raising awareness of the issue of chronic absenteeism and the distinction between chronic absenteeism and average daily attendance. With the federal government now requiring schools to report on chronic absenteeism, awareness of this issue may be increasing nationally. Hopefully these findings will prove to be useful to others in reducing chronic absenteeism in their context.

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Chapter VI: Conclusion

The primary purpose of this dissertation project was to improve college, career, and civic readiness outcomes at my institution. To do so, our team developed four focus areas of college, career, and civic readiness, which guided several different improvement projects. From these projects, two projects were selected for focus in this dissertation: reducing chronic absenteeism and increasing Cal Grant award rates. In conducting these two projects, I learned several things, including issues of introducing improvement science practices into a system, engaging a system with improvement science, sustaining improvement science work, and some working ideas about connecting improvement work to state and federal policy.

Additionally, improvement science is not merely a set of useful practices for improving outcomes but also represents a model for thinking about organizations and leadership, and so connections between theories of improvement science and our experience are explored. Next, a few doctoral programs in education across the country are experimenting with implementing improvement science methods, and this project suggests practices for the field to consider. Finally, the Standards for Quality Improvement Reporting Excellence guidelines (Ogrinc et al., 2015) from healthcare were utilized as a reporting method for these two improvement projects, and I describe my experience translating these guidelines into education.

Four focus areas

To improve college, career, and civic readiness outcomes, our team developed four focus areas: family engagement, sense of belonging, raising awareness of college and career pathways, and academic preparation and eligibility. Several improvement

projects have launched at High Tech High over the past three years connected to these focus areas. In terms of family engagement, there has been greater focus on developing and connecting with parent groups, particularly a “Padres Unidos” (Parents United) group focused on Latino families, which works on building family knowledge of the college going process, High Tech High’s learning model, and other issues. For sense of belonging, one project is the Math Agency Improvement Community which has taken as a goal to eliminate the expression “I’m not a math person,” in other words, to increase students’ sense that they are the kind of people who can be good at math and belong in a community of math scholars. For raising awareness of college and career pathways, one project is focused on improving the quality of the internship experience, a requirement of all high school juniors. For academic preparation, there are improvement projects underway focused on improving literacy, math, and science instruction. For academic eligibility, there are projects aimed at increasing SAT or ACT taking, particularly among students of color, and on increasing the percentage of graduates who place directly into college level math and English courses, with a focus on students who are likely to attend community colleges.

Two deep dives

While there are many improvement projects underway which connect to the four focus areas, for this dissertation project I selected two projects to focus on and further develop: reducing chronic absenteeism and increasing Cal Grant award rates. Reducing chronic absenteeism is most closely connected to the focus area of belonging. Building upon the idea of student involvement (Astin, 1984), our team thought that chronically absent students were less likely to feel a sense of belonging at our school and so efforts to

reduce chronic absenteeism might increase student belongingness. Increasing Cal Grant award rates is most related to college pathways. Awareness of how to complete the FAFSA and earn a Cal Grant is an example of helping students develop the “college knowledge” (Borsato et al., 2013) for how to complete the steps on the path to college.

I selected these two projects for focus in this dissertation project because in both cases there was some preliminary success at one or more schools and so the project was in a phase of spreading to more schools, something that I was well positioned to work on from the role of a system level leader. In looking back upon these two projects in relation to the many other improvement projects happening across our organization, two other factors stand out about these projects in terms of why there was early success and traction with these projects. In both cases, there is clear, measurable evidence of impact, whether in reducing the number of students who are frequently absent or in increasing the number of students who completed the FAFSA and earned a Cal Grant. This is important, because improvement science presupposes that we cannot improve at scale that which we cannot measure. For other improvement projects in our organization, clear, measurable outcomes are not always as obvious, and so it remains an open question as to whether we will achieve as clear evidence of success in those projects.

The other factor that stands out is that in both projects, there was a clearly defined intervention, whether that was improving clarity in the system about which students were chronically absent so that staff could communicate with families or similarly increasing knowledge internally about which students had not yet completed the FAFSA so that staff could intervene with students and families. While it is true that these interventions seem more clear in hindsight than they did along the way, it is also true that some of our

improvement projects, particularly those focused on issues of instruction, have less clear interventions that can be tried in other contexts. So in summary, to the extent that these two projects were successful at improving student outcomes, having clear evidence of impact and clear interventions that could be spread across the system were two factors that helped. In aspiring to success for other improvement projects, these are two areas worthy of heightened attention.

Improving student outcomes

The effort to improve student outcomes in this dissertation began as a broad effort to improve the college, career, and civic readiness of HTH graduates. As the project progressed, it became clear that the improvement process needed to be targeted at clearer, more contained goals. These goals became increasing Cal Grant award rates, especially for low income students, and reducing chronic absenteeism (which we hypothesized, based on preliminary evidence, might lead to higher four-year college going).

For increasing Cal Grant award rates, as HTH staff learned more about the importance of the Cal Grant and the FAFSA completion process, there was modest growth in FAFSA completion and Cal Grant award rates from 2013-14 to 2015-16. A focused intervention in 2016-17 communicating information about current student FAFSA completion to college counselors and school directors correlated with 13 percentage point more students completing FAFSA on time, although only four percentage point more low income students. This intervention also correlated with 11 percentage point more students in the class of 2017 being awarded a Cal Grant and 9 percentage point more low income students. Another intervention aimed at communicating information to students and advisors about grades needed to earn a Cal

Grant GPA of 3.0 did not have a statistically significant effect.

In terms of chronic absenteeism, after enacting an improvement science intervention at three schools, there was a large and statistically significant improvement in chronic absenteeism. At intervention sites, the percentage of students who were chronically absent at the end of the school year compared to previous years at the same school improved by 64%-86%. Students at intervention schools were 75% less likely to be chronically absent than students at control schools at the high school level and 85% less likely at the middle school level. These improvements impacted both low income and non-low income students. From these two projects, there are several key takeaways, connected to introducing improvement into a system, engaging the system with improvement work, and sustaining improvement work.

Introducing improvement into a system

In June 2014, I invited a team of ten educators from across High Tech High, including teachers, deans, directors, and a graduate school of education faculty member to attend a three-day workshop on improvement science hosted by the Carnegie Foundation. This was essentially the first exposure of anyone in our organization other than me to the ideas of improvement science. At that meeting, we developed an aim statement (increase the percentage of young men of color who go directly to a four-year college) and a theory of action to guide our work. While the aim and theory of action have changed over the past three years, they remain surprisingly similar to our current iterations of both.

Perhaps because we were just learning improvement science methods and perhaps because of how the methods were introduced to us, we were originally overly concerned

with the details of the improvement science process, as best exemplified by the question, “Are we doing it right?” In the first year of doing this work, our team meetings often became consumed by questions like, “Is that really a secondary driver?” and “Is that the right way to fill out a PDSA form?” This is a current challenge in the improvement field in education, because although questions of methodological rigor are legitimate, pressuring busy practitioners on whether one is “doing it right” is not a helpful frame. To help with this issue, a leadership move is to ask teams if the current activity they are engaged in is helping them understand the problem they are trying to solve or helping them take constructive action. If so, then they are “doing it right.”

Our improvement team also initially was focused on what we called the meta-project, in which we tried to systematically apply improvement science practices to questions about how many staff were engaged in improvement projects, numbers of staff who showed up for improvement meetings, the number of improvement articles getting published, and other issues. Our intention was to lead by example by applying improvement methods to our own work about helping others do improvement work. However, a big shift for our team came when we got some critical feedback from Carnegie staff that we were spending too much time documenting our own efforts and not enough on actually improving student outcomes. When we shifted to focusing our energy on improving four-year college going rates for traditionally underrepresented students as well as other aspects of college, career, and civic readiness, the work started moving.

Finally, in introducing improvement science practices into our organization, it is notable that we have significant grant funding which enabled us to hire four staff members spread across three full time equivalent positions. Having staff dedicated to

improving outcomes using improvement methods clearly helped accelerate our work across the organization, particularly via data collection for projects, coaching of teams, and organizing school wide professional development. With that said, unlike most districts, HTH has historically had almost no central instructional staff (e.g. literacy coaches, department chairs, disciplinary coordinators), so other systems that do not have grant funding but do have such roles might reorganize those jobs to make improvement work some or all the work of those positions. Additionally, to be clear, those four staff members have a significant component of their work focused on external facing projects, as required by the terms of those grants, so it is not the case that we have had four staff primarily focused on implementing improvement science at High Tech High. After introducing improvement science into the system, another set of learnings relate to engaging the system.

Engaging a system with improvement

As we have continued to work to engage in improvement work across the organization, some learnings have emerged, connected to the use of data, setting goals, and connecting change efforts to both the rational and the emotional. In terms of data, just getting clear on the current state of data in our schools proved to be both challenging to do and helpful once done. For example, most of our staff had never considered current chronic absenteeism rates nor Cal Grant award rates. Simply shining a light on the data did lead to interest in improving on those issues.

Relatedly, setting clear, measurable goals (Bryk et al., 2015; Langley et al., 2009) seemed to be a useful practice that led to a whole set of behaviors among practitioners trying to reach those goals. For example, in a manner that was not particularly inclusive

of all voices, I set my own goals for SAT or ACT completion, FAFSA completion, and four-year college application rates. While two of these projects are still in progress, I was surprised by the extent to which these goals resonated for some people within our organization, even as I did not make a strong effort to publicize and push those goals. Building goals collaboratively and sharing them more widely will be important steps moving forward.

Improvement work has several features that attend to the rational, including systems thinking and the use of data. In any change effort, connecting to both the rational and the emotional are important (Goleman, 2006; Heath & Heath, 2010). As noted in chapter 2, empathy interviews targeted towards improvement goals struck me as powerful ways for people to make emotional connections to improvement work. For example, interviews with HTH graduates who both did and did not go on to college and who were and were not successful there proved to be moving learning experiences for those of us who participated. A related issue is that it is probably wiser to focus attention on improving outcomes than on improvement science as a methodology. Because I was enthusiastic about the promise of improvement science as a method, I was excited to share the principles with others. I found that some people became equally enthusiastic about the process of improvement science, but for many, I got greater traction when people heard about improvement science as a tool for closing equity gaps or as a tool to improve an outcome that people already cared about. So for example, in attempting to improve mathematics instruction, our team learned to lead with math instruction and place improvement science methods more, although not exclusively, in the background. This focus on closing gaps may connect more with people's emotional need to make a

difference in the world. Having engaged our system in doing improvement work, another question relates to keeping enthusiasm high and maintaining improvements that have been made.

Sustaining improvement work

In improvement science thinking, it is understood that there is a phase of initially learning more about the problem and developing change ideas, a phase for spreading changes through the system (with modifications to local context along the way), and a phase for maintaining improvements that have been made (Langley et al., 2009). Now that we have achieved some improvements within our organization, a new question for us is how we can continue to spread changes across our system, sustain improvements already made, and keep up enthusiasm for making improvements in other areas. A related question that we have wrestled with is the appropriate number of improvement projects an organization can sustain at one time. On the one hand, the many mandates from the state for areas for improvement (e.g. English Learners, students with special needs, math instruction, literacy instruction, science instruction, suspensions, chronic absenteeism, college and career readiness) can feel overwhelming, and it may not be possible to focus attention on everything at once. On the other hand, working in schools, it is hard not to feel urgency to make improvements everywhere improvements are needed. The hope is that improvement science offers a path to identify the most important problems worth focusing on and the highest leverage strategies (low effort, high value), and we are still learning how to do that.

Two years ago, I attended a Ford Motor Company quarterly quality review meeting and observed a team of thirty staff review around three hundred pages of graphs

in a two-hour meeting. Ford staff was quick to point out that it had taken them three decades to learn how to work in that way. So in the long term, it may make sense to monitor many different issues, responding to any concerning trends in data that arise. In the shorter term, we are trying to strike a balance of focusing on the most important improvement priorities and supporting our staff in the many issues that they are drawn to work on improving.

Another question about sustaining improvement work is whether this is merely a fad (“we tried improvement science; it didn’t work”). However, improvement science is not merely a package of tools to implement in a school system, it represents a different way of thinking about change itself. There are three fundamental improvement questions, (a) what are you trying to accomplish? (b) what will you change? (c) how will you know the change is an improvement? (Langley et al., 2009). In our schools, we have historically been good at the second question, let’s try changing something. Being clear at the outset about the specific goal and what will count as evidence of success has been a revelation, and for many of our staff, it has become a mindset shift that is unlikely to fade away. Whether the explicit tools of improvement science remain in use, some of the underlying thinking is likely to persist.

Connections to policy

Because I am involved in several ongoing conversations with state and federal policymakers, I am frequently given the opportunity to complain that policymakers do not listen enough to practitioners. This fall, one policymaker said to me, “I hear that, and my frustration is that when I ask practitioners how policy should be changed, they usually don’t have an answer.” This hit home for me because I have been better at criticizing

existing state and federal policies than proposing new ones. A theory of action about education policy emerging for me is related to a distinction I see between large scale Policy (e.g. No Child Left Behind) and small scale policy (e.g. how the California State Aid Commission presents data to schools). It may be that by working deeply on trying to improve problems, small barriers emerge that could be changed relatively easily by state or federal staffers (as opposed to requiring congressional action) that might lead to significant changes.

For example, many students in California lose the Cal Grant because they do not log onto the CSAC website to check a box that they have graduated from high school. It is not clear exactly what problem this self-report step is solving, because if a low or moderate income student who is attending a four-year college wanted to receive state tuition assistance but had not graduated from high school, they could just lie during this step, and it seems unlikely that the college would enroll the student in the first place. Removing this barrier could be a small change that might lead to more student enrolling in college (Pallais, 2015). Regardless of the merits of this particular proposed change to a policy, the only way that somebody would think of such an idea is by getting deeply immersed in the Cal Grant process, which happened for us because we were trying to systematically improve Cal Grant award rates. How to craft effective Policy remains an enigma, but it may be that improvement practices can help practitioners and policymakers work together to find small policy changes that make a big difference.

Three waves of education reform

As noted in chapter one, when this project began, I hoped that improvement science might offer a set of tools consistent with a third wave of school reform, drawing

upon the best ideas from progressive and “no excuses” style reform efforts. In fact, improvement science methods connected to third wave reform in a few ways. The use of data was critically important to guide our work, but significantly, a broad range of data including process data such as the number of seniors who have so far successfully completed the FAFSA. This third wave principle of using a broad range of data for improvement rather than accountability continues to seem promising. Second, the third wave principle of being systems oriented yet also user centered proved to be important for our work. Interviewing first generation college going recent alums about their experiences helped to keep our improvement efforts grounded in the right problems but were also used to modify our theory of action for systems change, for example elevating family engagement as an area for increased focus.

Third, the third wave principle of spreading practice but allowing for local adaptation was a useful way to think about the work. For example, the chronic absenteeism change package spread to multiple schools but also changed as it was taken up by staff at different schools. Finally, we have engaged with educators beyond HTH working together on common problems of practice, for example working with schools across the western United States to increase FAFSA completion rates. In that work, we have been able to cross traditional charter vs. district boundaries as we work together to try to achieve outcomes for all students. In summary, while there is much work to do, improvement science continues to appeal as a set of tools for enacting a new third wave of education reform.

Theoretical basis of improvement

Improvement science is not just a set of practices. It also represents a different

model for thinking about organizations and leadership. Four theoretical aspects of improvement science became particularly salient in this project. The first is the idea of seeing the system. Prior to learning about improvement science, “systems thinking” was merely a buzz phrase for me, which is to say something that people often say that I did not think had any meaning. An oft quoted expression in improvement science circles is “Every system is perfectly designed to get the results it gets” (Conway & Batalden, 2015). I realized the extent to which many of our improvement efforts historically had been about exhorting ourselves to try harder next time. Improvement work has pushed us to understand current processes and look to redesign those processes towards better outcomes.

Relatedly, Deming (1986) argued that quality comes from leadership helping people get better at doing their jobs in ways that require less effort. In the chronic absenteeism project, one school created a formal process for responding to chronic absenteeism. Guided by the idea of “better work - less effort,” we worked to identify the core features of that process (notice, respond) and then automate those steps. So reports about frequently absent students are now auto-emailed to school level staff, and if they want to send home a letter, there is a way to generate a customized letter with just a few mouse clicks. Similarly, we sent reports to school staff on which students had not yet successfully completed the FAFSA, although theoretically they had always had their own access to this information, so that staff could concentrate their efforts on particular students and families. In both cases, we were trying to help other staff do their job more easily, which arose from seeing the system and a particular view of the role of leadership.

Another issue is that improvement efforts should “focus on the customer” (Peck

& Reitzug, 2012) or perhaps more appropriately in education should “stay user centered” (Bryk et al., 2015). As noted earlier, empathy interviews and expert convenings were some ways that we tried to ensure that we understood the problem from the point of view of the person being impacted by the issue we were trying to improve upon. Finally, the use of data to guide improvement work but not to place blame upon employees (Schmoker & Wilson, 1993c) is a concept that we tried to implement in this project. With both chronic absenteeism and Cal Grant award rates, the use of data clearly guided our work. Modeling using data for learning rather than blame was not always easy but was something that I aspired to do. Throughout this project, I learned a lot about doing improvement work in our organization. I now shift focus to what I learned about doing improvement science as a dissertation project.

Improvement science as a dissertation method

While using improvement science as a methodology for a dissertation was successful in some ways, I experienced several challenges, some related to the current structures of graduate school and some related to improvement science work itself. These are related to scoping an appropriate project, the nature of a traditional literature review, and the nature of a traditional chapter on research methods. For graduate students and graduate programs interested in promoting improvement science methods, the field might consider modifying existing practices to better support improvement work.

Scoping a problem. The first challenge related to utilizing improvement science as the methods for a dissertation in practice relates to scoping an appropriate problem of practice. Of course, this challenge is not unique to improvement science methods, but because improvement science methodology is relatively new to education, learning how

to advise students on how to take on an appropriately scoped improvement project may be a particular challenge. For this project, I wanted to tackle a large, meaty problem like college, career, and civic readiness. I recognized that this was too broad and vague to be an appropriate problem for a one year improvement project, yet I was worried about doing a dissertation that was merely about, for example, chronic absenteeism, which seems a bit “small.”

Further, many of my preconceived notions about tackling college readiness proved to be incorrect. For example, I presumed that I would be able to gather data on how many seniors applied to a four-year college by March, but it turns out that we do not have access to verified data until June, later than I was willing to wait to still be in the drafting phase of my final product. Similarly, I did not understand enough about the Cal Grant process or its importance at the time of writing a dissertation proposal to be able to accurately write about this process when planning this project. For faculty looking to support such work, it may be wise to look for ways to accelerate doctoral students into the improvement process earlier in the program, preferably getting started on improvement efforts during the student’s first year.

Use of data. Relatedly, it proved to be much harder to get data systems in place than I anticipated. For example, getting access to student level FAFSA completion data took roughly six months, when I had expected this to take a few weeks. Similarly, I had hoped to make progress on spreading our chronic absenteeism intervention across all thirteen schools this fall. Making it easy for other schools to adopt this intervention via an automated process is still not complete, a full year after I had expected this to happen. For graduate students trying to complete an improvement project in a year or less, it may be

wise to determine what data related to the problem at hand is already available rather than hoping to make improvements based on data that is not yet accessible, no matter how trivial it might seem to begin collecting that data.

Connected to this is a challenge of implementing improvement science practices using educational data. It is well understood in improvement circles that annual data is not “learning data” and that more frequent data, e.g. weekly, is necessary to engage in iterative cycles of improvement such as the PDSA cycle. For an auto manufacturing plant, it is at least conceptually easy to collect data every few minutes as cars move down the factory line. Choosing problems that have readily available frequent data is a necessary step to successfully implement PDSA cycles. In my case, there were three problems with collecting frequent data.

In some cases, the obvious data to collect was annual in nature, e.g. the number of graduates who attend a four-year college. In other cases, there was frequent data that was hard to use, such as absenteeism data, which is readily available daily, but which fluctuates so much due to various issues (illnesses spreading through a school, absences around holidays) that it was challenging to construct useful run charts and control charts. Finally, there was frequent data that could have been useful, but that took too long for me to understand how to access to be able to engage in iterative PDSA cycles during the timeline of a doctoral program, e.g. weekly FAFSA completion data. If graduate schools can work to help students scope appropriate problems as well as to help students get started early in their program, this may allow some of these issues to be resolved earlier in the process. Additionally, as more improvement projects are completed in education, it will become easier for other graduate students to build upon existing work. For example,

other graduate students in California interested in improving FAFSA completion rates could build upon work I have done to collect weekly data on this topic.

Literature review. Connecting improvement science work to existing knowledge about how to improve that problem is key. Left to their own devices, practitioners may proceed with improvement work unaware of previous efforts. However, the current education research field has been criticized for producing knowledge too far removed from practice to be directly useful for practitioners (e.g. see Bryk & Gomez, 2008). Given the current state of educational scholarship, primarily privileging peer-reviewed published literature in literature reviews may lead to an incomplete understanding of existing knowledge on how to improve a problem. The 90-day cycle report (Park & Takahashi, 2013) offers a helpful model for how to rethink the traditional literature review with a particular emphasis on balancing traditional scholarship with practitioner craft knowledge.

There are at least three key distinctions between the 90-day cycle report and a traditional literature review. First, as the name suggests, a 90-day cycle report is completed in only 90 days. This is particularly significant in the context of a capstone doctoral project, because improving student outcomes takes time. To create more time in an Ed.D. program for improvement work, a 90-day cycle report might accelerate the student through the literature review earlier in the program. Second, the 90-day cycle includes a balance of reading peer reviewed literature and learning from craft knowledge by interviewing successful practitioners in the field. This balance of published academic literature and practitioner craft knowledge could help the student develop a more robust understanding of the problem the student is seeking to improve. Finally, the 90-day cycle

typically has a more focused purpose than synthesizing the relevant literature in the field. Common outcomes of a 90-day cycle include a prototype of a theory of action or an improvement tool and include a period of testing that theory or tool with feedback. Reframing the literature review as a 90-day cycle report may better support students attempting to engage in improvement work as a dissertation in practice.

Research methods. The traditional research methods chapter presents some challenges for engaging in improvement work as a dissertation in practice. In a traditional methods chapter, the student describes in detail all the steps the student will take in conducting the study which will then be submitted to an institutional review board to protect human subjects. For example, the student will submit interview protocols, survey questions, and consent forms, as well as details of numbers of subjects to be interviewed. The challenge, from an improvement point of view, is that knowing how to make progress on ill structured problems (Archbald, 2010) cannot be mapped out ahead of time. Writing a chapter of well specified research methods for the proposal defense prior to beginning the work proved to be quite challenging. Of course, any research project will evolve from conception to completion. However, it may be the case that making progress on improving problems of practice is a particularly challenging type of project to plan all the steps ahead of time. I did the best I could to make predictions about the types of organizational data I would want to or could collect. In practice, I was often incorrect because as I learned more about the problem I was trying to improve, I realized that I had not known what I didn't know.

For example, at the time of writing a dissertation proposal, I had only the haziest of understandings of what a Cal Grant is, let alone the process that a student must

complete to be awarded a Cal Grant. As the project progressed, it became clear that improving Cal Grant award rates was a key step in improving college access and persistence and that collecting Cal Grant process data was an important step to take. This was unknowable to me at the time that I wrote the dissertation proposal. For Ed.D. programs looking to support improvement science work, it may be helpful to rethink the dissertation proposal and the research methods section in particular to better align to the realities of improvement work. Clearly, students can be asked to develop a plan for the scope of the proposed project, but such a plan would likely include different details than what is expected in a traditional research methods chapter.

Related to the methods section, in healthcare, improvement science projects³⁵ are considered exempt from IRB review. The stated reason for this is that improvement science projects are not research because they do not lead to generalizable knowledge.³⁶ Because practitioners of improvement science do, in fact, aspire to create tools, processes, and materials that help other practitioners make similar improvements in their own context, I suspect that another reason that improvement science projects are considered exempt is a recognition that practitioners have always sought to improve their practices and do not need institutional approval to do so.³⁷ At my university, the coordinator of the IRB for the social sciences was familiar with improvement science projects in healthcare and had developed forms³⁸ to apply for exempt status specific to

³⁵ Often described in healthcare as Quality Improvement (QI) projects.

³⁶ e.g. see <https://www.hhs.gov/ohrp/regulations-and-policy/guidance/faq/quality-improvement-activities/index.html>

³⁷ Imagine a teacher needing IRB approval to modify her lesson plan between periods one and two.

³⁸ For examples, see https://irb.ucsd.edu/EBP_QA_QI_factsheet.pdf

improvement science projects in healthcare. It is likely that this awareness at the IRB staff level greatly facilitated my project moving through the IRB process relatively easily. At other institutions looking to support improvement science work as a dissertation in practice, it may be important to educate IRB faculty and staff about the exempt status of improvement science projects.

SQUIRE guidelines

The final aspect of this dissertation project was to explore alternative capstone writing products. The education field has a potentially highly effective abundance of capacity to advance the field, which is the roughly 5000³⁹ doctoral students in education completing a doctorate each year. Most of these students produce a traditional dissertation product that by one measure averages 175 pages⁴⁰ and is not widely cited. Having graduate students do projects that improve student outcomes and write up their work in a way that other graduate students could build upon could be a high leverage move to improve the P20 educational system.⁴¹ I began this project with the belief that most if not all Ed.D. students ought to do an improvement project and write up that work using the SQUIRE guidelines as a model. Having tried to do that, I now have a more nuanced perspective on the final written products of a dissertation in practice. I still think that most if not all Ed.D. students ought to do an improvement project of some type (e.g. action research, design based implementation research, improvement science) as their

³⁹ <https://www.nsf.gov/statistics/2017/nsf17306/datatables/tab-06.htm>

⁴⁰ <https://beckmw.wordpress.com/2014/07/15/average-dissertation-and-thesis-length-take-two/>

⁴¹ Note that in England, healthcare Ph.D. students do not write a traditional capstone dissertation and instead do a series of quality improvement projects that are each written up as short papers for sharing with the field.

capstone project. I now see at least four types of written products that would be suitable for a capstone dissertation in practice.

The first is a 90-day cycle report, which has been described earlier in this chapter. For Ed.D. programs looking to support improvement science work, the traditional literature review might be replaced with a 90-day cycle report. This report might exist as a stand-alone product intended to be of value to education practitioners. This product could be completed during the first semester of an Ed.D. program and could be published on the university's website, if not in a peer-reviewed journal. The second product is what we have begun calling a "hack." A hack is a one pager that describes a change idea for improvement and may include some evidence of effectiveness as available. The idea of a hack is to document practitioner craft knowledge that may not be developed enough for peer review publication or for which the practitioner may not have the time to write up a full paper for publication but would be willing to briefly write up their idea for sharing with the field. Ed.D. students might write up a hack during the second year of their doctoral program. The third product is a case study of an improvement project (e.g. see MacConnell & Caillier, 2016). A case study report describes the details of an improvement effort, with an emphasis on qualitative storytelling of the project, which may be an appealing method for describing improvement projects for both graduate students and their potential audience. The fourth product is a SQUIRE report. The SQUIRE guidelines emphasize articulating a clear rationale for an intervention and presenting careful evidence of whether the intervention was successful, consistent with the scientific method. Of the four written products described here, the SQUIRE report requires the most empirical evidence, so may be the best choice when enough data pre

and post intervention was collected. In other cases, a case study approach may be a more appropriate choice.

The SQUIRE guidelines were developed for reporting on healthcare improvement projects, so a question at the launch of this project was whether the SQUIRE guidelines would be useful in an educational context and how might they be changed to be more relevant in education. As a novice scientific writer, I found the SQUIRE guidelines to be invaluable in reminding me what to include. In particular, I found the explanation and elaboration document, which contains examples of each element in the guidelines, to be most useful (Goodman et al., 2016). While it would be helpful in the long run to develop an explanation and elaboration document using examples from education, I found the SQUIRE guidelines to be general enough as is to be usable in an education context without modification.

In summary, I began this dissertation process with a few questions. Could the tools of improvement science be useful in an educational context? Might improvement science provide a framework for a capstone project in a dissertation in practice that could lead to a doctoral project improving educational outcomes? Would the SQUIRE guidelines translate to education and provide a useful model for how to think about reporting on educational improvement projects? While there is much work to be done to continue to examine all three questions, my preliminary answer to all three questions is a resounding yes. I look forward to continuing to try to improve educational outcomes for students with a focus on students not currently well served by our educational institutions, and to embed improvement science principles in doctoral programs in education as well as in the education field more broadly.

Appendix: Standards for Quality Improvement Reporting Excellence (SQUIRE 2.0) publication guidelines

Text Section and Item Name	Section or Item Description
Notes to authors	<p>The SQUIRE guidelines provide a framework for reporting new knowledge about how to improve healthcare.</p> <p>The SQUIRE guidelines are intended for reports that describe system level work to improve the quality, safety, and value of healthcare, and used methods to establish that observed outcomes were due to the intervention(s).</p> <p>A range of approaches exists for improving healthcare. SQUIRE may be adapted for reporting any of these.</p> <p>Authors should consider every SQUIRE item, but it may be inappropriate or unnecessary to include every SQUIRE element in a particular manuscript.</p> <p>The SQUIRE Glossary contains definitions of many of the key words in SQUIRE.</p> <p>The Explanation and Elaboration document provides specific examples of well-written SQUIRE items and an in-depth explanation of each item.</p> <p>Please cite SQUIRE when it is used to write a manuscript.</p>
Title and abstract	
1. Title	Indicate that the manuscript concerns an initiative to improve healthcare (broadly defined to include the quality, safety, effectiveness, patient-centeredness, timeliness, cost, efficiency, and equity of healthcare).
2. Abstract	<p>a. Provide adequate information to aid in searching and indexing</p> <p>b. Summarize all key information from various sections of the text using the abstract format of the intended publication or a structured summary, such as background, local problem, methods, interventions, results, conclusions</p>
Introduction	Why did you start?
3. Problem description	Nature and significance of the local problem
4. Available knowledge	Summary of what is currently known about the problem, including relevant previous studies
5. Rationale	Informal or formal frameworks, models, concepts, and/or theories used to explain the problem, any reasons or assumptions that were used to develop the intervention(s), and reasons why the intervention(s) was expected to work
6. Specific aims	Purpose of the project and of this report
Methods	What did you do?
7. Context	Contextual elements considered important at the outset of introducing the intervention(s)
8. Intervention(s)	<p>a. Description of the intervention(s) in sufficient detail that others could reproduce it</p> <p>b. Specifics of the team involved in the work</p>
9. Study of the Intervention(s)	<p>a. Approach chosen for assessing the impact of the intervention(s)</p> <p>b. Approach used to establish whether the observed outcomes were due to the intervention(s)</p>
10. Measures	<p>a. Measures chosen for studying processes and outcomes of the intervention(s), including rationale for choosing them, their operational definitions, and their validity and reliability</p> <p>b. Description of the approach to the ongoing assessment of contextual elements that contributed to the success, failure, efficiency, and cost</p> <p>c. Methods employed for assessing completeness and accuracy of data</p>
11. Analysis	<p>a. Qualitative and quantitative methods used to draw inferences from the data</p> <p>b. Methods for understanding variation within the data, including the effects of time as a variable</p>
12. Ethical considerations	Ethical aspects of implementing and studying the intervention(s) and how they were addressed, including, but not limited to, formal ethics review and potential conflict(s) of interest
Results	What did you find?
13. Results	<p>a. Initial steps of the intervention(s) and their evolution over time (e.g., time-line diagram, flow chart, or table), including modifications made to the intervention during the project</p> <p>b. Details of the process measures and outcome</p>

Text Section and Item Name	Section or Item Description
	<ul style="list-style-type: none"> c. Contextual elements that interacted with the intervention(s) d. Observed associations between outcomes, interventions, and relevant contextual elements e. Unintended consequences, such as unexpected benefits, problems, failures, or costs associated with the intervention(s) f. Details about missing data
Discussion	What does it mean?
14. Summary	<ul style="list-style-type: none"> a. Key findings, including relevance to the rationale and specific aims b. Particular strengths of the project
15. Interpretation	<ul style="list-style-type: none"> a. Nature of the association between the intervention(s) and the outcomes b. Comparison of results with findings from other publications c. Impact of the project on people and systems d. Reasons for any differences between observed and anticipated outcomes, including the influence of context e. Costs and strategic trade-offs, including opportunity costs
16. Limitations	<ul style="list-style-type: none"> a. Limits to the generalizability of the work b. Factors that might have limited internal validity, such as confounding, bias, or imprecision, in the design, methods, measurement, or analysis c. Efforts made to minimize and adjust for limitations
17. Conclusions	<ul style="list-style-type: none"> a. Usefulness of the work b. Sustainability c. Potential for spread to other contexts d. Implications for practice and for further study in the field e. Suggested next steps
Other information	
18. Funding	Sources of funding that supported this work. Role, if any, of the funding organization in the design, implementation, interpretation, and reporting

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