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IMPLEMENTATION OF STATWAY® FOR NON-STEM MAJORS AT TWO-YEAR
COMMUNITY COLLEGES WITH FOCUS ON THE TEACHERS' EXPERIENCE.

by

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IMPLEMENTATION OF STATWAY® FOR NON-STEM MAJORS AT TWO-YEAR
COMMUNITY COLLEGES WITH FOCUS ON THE TEACHERS' EXPERIENCE

Joan Zitur Carter

The purpose of this report is to study the implementation of Statway® at three community colleges with an emphasis on the teachers' experience. A qualitative study, with a survey and a focus group, is undertaken to ascertain the teachers' experiences. Through the analysis of the qualitative data collected, lessons that can be applied to teaching in general are noted. Recommendations for improvements from the teachers' perspectives are given.

We need to find a better path for students, especially for our under-represented minority, first-generation, and low-income students. They are counting on us for the chance to prepare for a better future. To do this, we as teachers need to be brave enough to address our own implicit and explicit biases. We need to be qualified, caring teachers with growth mindsets who embrace learning and understand that it is a journey. We must provide critical thinking content and problem-solving skills in a well-planned curriculum, with expectations that are rigorous and clearly communicated. Value affirmation and/or brain malleability exercises have been shown to help ease stereotype threat and fixed mindset. We can systematically incorporate active learning and group-work in our classes and work with students on their mindset to encourage resilience and persistence. Active learning and group-work have been shown to be very effective for student learning and for providing the social support piece in the classroom. Social support builds student trust; increases willingness to ask questions, to put forth effort, and to learn from failures or setbacks, qualities necessary for higher-level learning. Acknowledging that this is a challenge, not easily faced. If we embrace discomfort and act with empathy, we will build a community of learners in our classrooms, then the students will leave prepared with skills needed to adapt to the ever-changing future.

Approved by



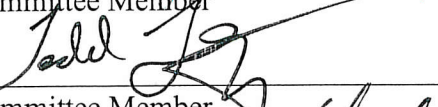
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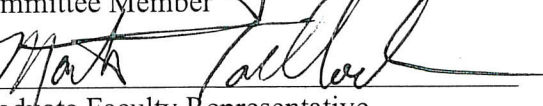
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Chapter 1: Introduction

“Well, we have to stick to it, we signed a contract.”¹

On community college campuses, each new semester is filled with expectations and excitement. Often for students this is a short-lived feeling or possibly the start of a long, slow end to their dreams of a better future. This is because many students are ill prepared to take college courses, specifically college mathematics. Some will put off taking the math they dread. Others will find they have several semesters ahead of them to get to the college level. These semesters amount to money, time, and too often disappointment. Many that do start the math sequence find they lack not only the math expertise, but also the necessary study skills and even a basic belief that they will be successful. A better path is needed for students, especially for our under-represented minorities, first generation college students, and low-income students. They are counting on us for the chance to prepare for a future workforce that has not yet been envisioned – a better future.

Community College 1 (CC1)², a two-year college, is located in the downtown of a large metropolitan area. A member of a State College and University (SCU) system, CC1 enrolls nearly 14,000 students annually. The Office of Institutional Research at CC1 provided the following statistics in the fall of 2013. 77% of CC1 students are students of color, low-income and/or first-generation college students. 98% of first-time, degree-seeking students have at least one developmental education placement. The most

¹ Statway® students overheard by their teacher. Recounted at Statway® Teacher Focus Group on May 3, 2014.

² To keep the identities of the research participants anonymous, the institutions will not be identified by name so as not to connect the individuals to a specific institution.

common placement for students entering CC1 is placing into pre-algebra or beginning algebra and college-ready reading. Two-thirds of students are at least three classes away from being college ready in math. More starkly, 40% of students do not pass their initial developmental education course. Fully 25% of students who enroll do not earn a credit in their first term. And 20% of students are non-starters, in that these students never earn a single credit.³

There is considerable existing research to show that this trend, although generally at a lower percentage overall, is not unique to CC1 in both the students requiring developmental education and in the students not successfully making it through to college level courses. A recent United States Government Accountability Office (GAO) report on Community Colleges and Developmental Education to the US House of Representatives Committee on Education and Workforce notes:

The [US] Department of Education (Education) estimated that 42 percent of entering community college students were not sufficiently prepared for college-level courses and enrolled in at least one developmental education course—also known as remedial education. Researchers have also reported that fewer than 25 percent of developmental education students will complete a degree or certificate in 8 years. The President has set a national goal of increasing the number of community college graduates by 5 million by the year 2020, which likely cannot be accomplished without improving current developmental education outcomes.

(United States Government Accountability Office, 2013, p. 1)

Other sources report similarly alarming statistics:

³ Office of institutional research at CC1 created a document entitled “*Data that Tell a Story*”, this is from v. 1 of this report dated August 20, 2013.

The academic success rate of developmental mathematics students at community colleges is alarmingly low. Over 60 percent of the nation's 14 million community college students are required to take at least one developmental mathematics class before they are eligible to enroll in college-credit courses (Achieving the Dream, 2006; Bailey, Jeong, & Cho, 2010). However, 80 percent of the students who place into developmental math do not successfully complete any college-level mathematics courses within three years (Bailey, Jeong, and Cho, 2010). Instead, many students spend long periods of time repeating courses and leave college without a credential. This means that millions of students each year fail to acquire essential mathematics skills and are unable to progress toward their career and life goals. (Van Campen, Sowers & Strother, 2013, p. 1)

Dr. Paul Nolting is a national expert in assessing individual math learning problems, developing effective student learning strategies, and assessing institutional variables that affect math success. According to Dr. Nolting (Boylan, 2011), factors leading to so few students who place into developmental math successfully completing college include: the length of course sequence; anxiety or math phobia (increased with repeated course); lack of study skills; personal problems; reading skills; learned hopelessness (lack of persistence); the linear nature of the math sequence – missing a few topics in one level (ie: earning a C) can lead to not understanding or failure later in the sequence; procrastination; and lack of abstract reasoning skills needed to understand the math. Dr. Nolting further highlights that developmental math students need an integrated approach that includes lecture, use of manipulatives, math study skills, group-work, learning math vocabulary, using web-based support, tutoring, frequent quizzes and tests,

and test anxiety reduction techniques. College mathematics teachers need assessment tools but they could be better, and institutions need to evaluate the placement process (Boylan, 2011). The developmental math student is complicated, often having many of these factors at once.

To address the issue of high failure rates in developmental math courses, the Carnegie Foundation for the Advancement of Teaching (Carnegie) has developed Statway[®] as part of the Community College Pathways program. This is a one academic year program for non-STEM (non - Science, Technology, Engineering, and Math) majors. Statway[®] is designed for students who test into developmental math to earn college credit in statistics in just two semesters. It replaces the traditional algebra path. Considerable research has gone into the development of this program. Statway[®] design takes a rounded view of the developmental math student, addressing the key risk indicators for students. These student risk indicators include math anxiety, fixed mindset, sense of belonging, comfort asking questions, perception of stereotype threat, and grit. Teaching strategies include mindset activities, a cohort contract, in-class group-work, homework (take-it-homes), and an on-line component (MyStatway). Additionally, Carnegie provides support and training for the teachers participating in this program. The Statway[®] model at each community college has a team of (at least) three teachers and an academic dean or vice-president. All Statway[®] teams are encouraged to be part of a networked improvement community (NIC) which strives for a continuous improvement approach toward solving complex educational problems. Statway[®] teachers encourage productive persistence and productive struggle in the students. The students are asked to sign a Statway[®] Cohort Contract that emphasizes personal responsibility and attitude *and*

the responsibility to help and contribute to the cohort members and classroom (Carnegie Foundation, n.d. c).

The Carnegie Foundation defines “**Productive Persistence**” as a set of behaviors that involves the **tenacity** and **good strategies** students need to be academically successful. Many students work hard in developmental math classes—studying long hours, nights and weekends—yet many of them do so using ineffective strategies. Others simply withdraw effort soon after the course begins. To help more students be academically successful, we want them to continue to persist when faced with challenges (*tenacity*) and to do so efficiently and effectively (*good strategies*). (Carnegie Foundation, n.d. a, para. 1)

The developmental math student arrived at this juncture due to a myriad of circumstances. It takes a holistic approach to overcome the obstacles. Ultimately, it is up to the student to learn. For the teaching methods to be successful, the student must show-up, try, and believe in the potential to learn. The Statway® Cohort Contract sets the student up for success by establishing course and classroom expectations. “Well, we have to stick to it, we signed a contract”¹ may be just what it takes.

Statement of the Problem

The purpose of this study is to look at the implementation of Statway® at three community colleges with an emphasis on the teachers’ experiences. The focus of this report is a qualitative study undertaken to ascertain the teachers’ experience. Through the analysis of the qualitative data collected, patterns will be noted and strengths, weaknesses, and aspects that can be applied by other teachers, will be ascertained.

Student learning outcome data and key indicator survey results from CC1 are available and will be included in this report for additional background information.

In fall, 2013 CC1 and two other Community Colleges in the same State College and University system began teaching the first semester of Statway®. Community College 2 (CC2) and Community College 3 (CC3) are in the same metropolitan area as CC1, although located in suburbs. In spring 2014, these three schools taught the second semester of Statway® and two, CC1 and CC2, added additional sections of first semester of Statway®. As is the Statway® model, each community college's Statway® team has at least three teachers and an academic dean or vice-president. Altogether there were ten Statway® teachers at these three schools.

Quantitative data from CC1 will be reviewed: 1) to compare the completion rates of the first-semester Statway® students with the completion rate of the students in the traditional developmental math track; and 2) to present attitude survey results that assess key risk indicators for students.

Qualitative studies will be conducted: 1) a survey of Statway® teachers at the three institutions; and 2) a focus group of the instructors regarding their experiences.

Research Questions

Are the teachers who participated in the implementation of Statway® satisfied with their experience? Because this research is qualitative this question is purposefully open-ended. Were the teachers supported in this effort? How could this experience be improved from a teaching perspective? What lessons-learned by the Statway® teachers will transfer to the way they teach in general? What lessons are applicable to other teachers? Statway® is intended for non-STEM majors. Should this experience be

transferred to the STEM track students? If so, how? Are there lessons applicable to teaching STEM students?

For background, quantitative questions will be considered. Were the students taking first-semester Statway[®] at CC1 more or less successful than their counterparts in a traditional developmental math track? How do CC1 Statway[®] student counts at each juncture in the Statway[®] pathway (see Table 1) compare to previous year Statway[®] schools count rates (see Table 2)? How did the students perception of four key risk indicators: fixed mindset, uncertainty about belonging, comfort asking questions, and stereotype threat, change over the academic year (Figures 1-4)?

Significance of the Research Problem

The hope is that the implementation of Statway[®] leads to an increase in the number of non-STEM developmental math students successfully completing college level math. If this is the case, then what can we learn from this experience that is applicable to our traditional track?

Limitations and Assumptions

Although given as background, this research report does not attempt to fully describe the issues within the community college systems, nor developmental math issues, nor to fully describe Statway[®], its development, and its methods. The focus of this report is the analysis of qualitative data, a survey and a focus group, to ascertain the first-year Statway[®] teachers' experience.

This study is limited to the first year that Statway[®] is taught at CC1, CC2 and CC3. This constitutes a relatively small group of teachers and students to study. For instance, at the start of the fall 2013 at CC1 there were three teachers and 73 students in

the first semester of Statway[®]. Comparatively, there were approximately 10 teachers and 400 students in the equivalent CC1 developmental math classes.

In the survey for the qualitative study, the teachers were not asked for their statistics coursework and teaching experience; their previous experience with group-work; nor any demographic characteristics. Were this study to be done again, it is suggested those questions be added to the survey.

Summary Statement

In fall 2013, three institutions in the same SCU system each began with three sections of the first semester of Statway[®]. In spring 2014, there were nine sections of the second semester of Statway[®] and three sections of the first semester of Statway[®].

The purpose of this report is to study the implementation of Statway[®] with emphasis on describing the teachers' experiences. Student learning outcome data and key indicator survey results from CC1 are available and will be included in this report for additional background information. A qualitative research study will be conducted including both a survey and a focus group to seek to provide understanding and insight from the teachers' perspectives. The focus group will be conducted using a scientific approach and process of disciplined inquiry that is systematic and verifiable. The focus group transcript will be analyzed for themes and patterns. The analysis will attempt to ascertain the strengths, weaknesses, and aspects that carry over to other areas of the teachers' experiences. The hope is that the lessons learned from this experience will be applicable to other math and STEM teachers.

Looking back over the past few decades it is clear that we cannot envision what the workforce needs will be in the future decades. Teachers best prepare students for the

un-envisioned future with critical thinking and problem solving skills, as well as experience working in teams. The developmental math student arrived at this juncture due to a myriad of circumstances. It takes a holistic teaching approach to overcome the obstacles. Ultimately, it is up to the student to learn. For the teaching methods to be successful, the student must show-up, try and believe in the potential to learn. The teacher's job is to support the learning of every student in the classroom.

Chapter 2: Review of the Literature

Summary of Research Sampling

Developmental education. The necessity for developmental education and the low number of students actually completing the degree they start (US GAO report, 2013; Van Campen et al., 2013) was previously outlined in Chapter 1. Additional sources are found in the annotated bibliography, Appendix B. The reader is specifically directed to the longitudinal studies (Asmussen, 2013; Waycaster, 2011). Dr. Nolting (Boylan, 2011) is previously mentioned as a comprehensive source in defining the factors leading to so few students who place into developmental math actually completing college and the necessity of an integrated approach to teaching the developmental math student. In the annotated bibliography, Appendix B, there are several additional articles supporting the premise that the circumstances and solutions are complicated. The reader is referred to these articles that highlight the problem and the need for an integrated approach (Merseeth, 2011; Woodward, 2004). Other articles examined specific aspects or approaches: a specific teaching method, personalized approach, or multimedia instruction (Bissell, 2012; Vasquez, 2004; Zavaralla & Ignash, 2009); advocating for accelerating course timing or reducing the number of credits (Edgecombe, Smith Jaggars, DeLott Baker, & Bailey, 2013; Hern, 2012; Woodward & Burkett, 2005; Woodward & Burkett, 2010); and making the case against delayed enrollment (Fike & Fike, 2012). In sum, it is clear that there is not a single, straightforward solution to a complicated problem.

Characteristics of successful students and successful schools. As highlighted above, it is a complicated mix of factors that leads a student to developmental math and further to not completing college. It is equally interesting to study the factors that lead to

success, especially for students who succeed against the odds. Difficulty in math knows no boundaries. Students from all walks struggle to learn math. However, these issues are more pronounced for African American students.

Williams and Bryan (2013) conducted a qualitative multi-case research study to identify the characteristics that contributed to the success of eight urban, African American students from single-female households. The characteristics were identified as falling into three main categories. 1) Home factors, which included a positive relationship with a mother or grandmother, who in-turn cared about the student's schooling, personal hardship, and an extended family network. 2) School factors, which included a supportive school-based relationship, school friends, good teaching, and extracurricular school activities. 3) Community factors which include social support networks and other non-school activities – religious or other community based. Every student identified school-related parenting practices and a supportive school-based relationship as essential to their academic success. The researchers felt that parents who cared about the student's education acted as a buffer to external environmental issues. Each student also had at least one positive relationship with a school official. The students identified these beneficial school characteristics: high standards and expectation, challenging curriculum and instruction; extended after school learning opportunities and activities; positive relationships with other resilient students, and well-qualified teachers (Williams & Bryan, 2013).

Delpit (2012) writes about her interview with a group of African American men who were successful despite their adverse circumstances:

All of them insisted that their success was due in large part to the influence or intervention of one or more teachers during their school careers. These were teachers who *pushed* them, who *demand*ed that they perform, even when they themselves thought that they could not. The teachers gave them additional help and insisted that they were capable of doing whatever anyone else could do. (Delpit, 2012, p. 72)

Lee, Smith, Perry and Smylie (1999) studied Chicago-area middle schools, focusing on student ‘social support’ and ‘academic press’. Student social support is the relationships the student has in and out of school. “Social support also provides a sense of trust, confidence, and psychological safety that allows students to take risks, admit errors, ask for help, and experience failure along the way to higher levels of learning” (Lee et al., 1999, p. 9). School academic press involves both the teachers and the students, the content is clear, the expectations are high, and students are supported while being held accountable. It dispels past theories that emphasized *either* academic focus *or* social support models in favor of a model that includes both academic rigor *and* social support. In the schools studied, those with high levels of academic press and high levels of social support had average math gains of a 2.39 grade equivalency in one-year. Compared to average math gains of 0.63 grade equivalency for low levels of academic press and low levels of social support, and average math gains of 1.34 grade equivalency for high levels of academic press coupled with low levels of social support (Lee et al., 1999).

Barrier to success: fixed mindset and stereotype threat. Dweck (2006) details in *Mindset: the new psychology of success* that there are essentially two mindsets, the fixed mindset and the growth mindset. The **fixed mindset** is characterized by the need to

be thought of as smart. It leads people to avoid challenges and failures, to take the sure path and to give up easily. Effort is seen as a bad thing. 'If I am smart I wouldn't need to work hard.' Criticism and feedback is ignored and other people's success is threatening to the fixed mindset. This leads to a deterministic view of the world that limits achievement. Everything is predetermined and 'I am not to blame.' People with the fixed mindset generally achieve less than their full potential. We put students in the fixed mindset by praising their intelligence. The **growth mindset** is characterized by the belief that intelligence can grow and abilities can be learned. Challenges are embraced as learning opportunities. Effort is fundamental and necessary to gain expertise. Failures are setbacks and hurt but failures are surmountable, another opportunity to learn. The growth mindset learns from criticism and finds lessons and inspiration in other people's success. This leads to a greater sense of freewill and ever-higher levels of achievement. We put students in a growth mindset by praising their effort. On student achievement and mindset, Dweck (2006) writes about different studies. One study of middle school students followed for two-years: "In our study, only the students with fixed mindset showed the decline [in grades].... The students with the growth mindset showed an increase in grades over the two years" (p. 57). Similarly, in another study conducted with college pre-med students followed over a semester, the researchers found the grades of growth-mindset students were higher and "even when they did poorly on a particular test, they bounced back on the next ones. When students with the fixed mindset did poorly, they often didn't make a comeback" (Dweck, 2006, p. 61).

Stereotypes are the belief that most members of a group have some characteristic.

Some examples of stereotypes are the belief that women are nurturing or the

belief that police officers like donuts. An explicit stereotype [explicit bias] is the kind that you deliberately think about and report. An implicit stereotype [implicit bias] is one that occurs outside of conscious awareness and control. Even if you say that men and women are equally good at math, it is possible that you associate math with men without knowing it. In this case we would say that you have an implicit math-men stereotype. (Project Implicit, 2011b, para. 2)

The term ‘stereotype threat’ was first used in 1995 by researchers Claude Steele and Joshua Aronson (Dweck, 2006, p. 75). It is now a well-documented and accepted concept. Aronson, Fried and Good (2002) explain:

The basic notion behind the stereotype threat analysis is this: in situations where a stereotype about a group’s intellectual abilities is relevant—taking an intellectually challenging test, being called upon to speak in class, and so on—[the stereotyped group’s] students bear an extra cognitive and emotional burden not borne by people for whom the stereotype does not apply. This burden takes the form of a performance-disruptive apprehension, anxiety about the possibility of confirming a deeply negative racial [or gender] inferiority—in the eyes of others, in one’s own eyes, or both at the same time. (Aronson, Fried & Good, 2002, p. 113)

Dweck (2006) explains further:

Almost anything that reminds you that you’re black or female before taking a test in the subject you’re supposed to be bad at will lower your test score – a lot. In many of their studies blacks are equal to whites in their performance, and females are equal to males, when no stereotypes are evoked. But just put more males in

the room with a female [or more white people in a room with a black person] before a math test, and down goes the female's [or black person's] score. This is why. When stereotypes are evoked, they fill people's minds with distracting thoughts – with secret worries about confirming the stereotype. People usually aren't even aware of it, but they don't have enough mental power left to do their best on the test. This doesn't happen to everyone however. It mainly happens to people who are in a fixed mindset. It's when people are thinking in terms of fixed traits that the stereotypes get to them. (Dweck, 2006, p. 75)

Reducing fixed mindset and stereotype threat. To counteract the fixed mindset, Dweck (2006) writes about a workshop developed to teach the growth mindset. Students learn about brain malleability research, study skills, and to apply the growth mindset. The students are told (among other things):

New research shows that the brain is more like a muscle – it changes and gets stronger when you use it. And scientists have been able to show just how the brain grows and gets stronger when you learn. We then describe how the brain forms new connections and “grows” when people practice and learn new things.
(Dweck, 2006, p. 219)

To determine the effectiveness of the growth mindset workshop, math grades were checked at the end of the semester.

Before the workshops, students' math grades had been suffering badly. But afterward, lo and behold, students who'd been in the growth-mindset workshop showed a jump in grades. They were now clearly doing better than the students who'd been in the other [study skills only] workshop. (Dweck, 2006, p. 221)

Aronson, Fried, and Good, (2002) conducted an experiment with Stanford University students to test a brain malleability method of helping students resist these responses to stereotype threat. Race matters in student achievement; African American students get lower grades than their European American counterparts – even when they start college with similar test scores. There is significant research that points to psychological factors in African American underachievement. Stereotype threat has a role in this underperformance. In this study, students in the treatment group were encouraged to see intelligence—the object of the stereotype—as a malleable rather than fixed capacity. The treatment consisted of three repetitions, included information about the brain’s malleability and potential to grow, and required the student to write this information in the student’s own words.

The African American students (and, to some degree, the White students) encouraged to view intelligence as malleable reported greater enjoyment of the academic process, greater academic engagement, and obtained higher grade point averages than their counterparts in two control groups. (Aronson et al., 2002, p. 113)

The treatment had positive results and seemed to reduce stereotype threat. And yet, [African American] students received significantly lower grades, showed significantly lower identification or engagement with the schooling process, and reported enjoying themselves less than their White classmates. This finding—as well as the additional finding that controlling for stereotype threat did not fully eliminate this gap in performance and engagement—underscores the difficulty

these students face on predominantly White campuses. (Aronson et al., 2002, p. 123)

The authors suggest combining strategies, including collaborative learning (Aronson, et al., 2002). Note: This brain malleability activity is similar to the “Brain Activity” used at the beginning of first-semester Statway®.

Women are underrepresented in many science, technology, engineering, and mathematics disciplines and professions. Stereotype threat is seen as a factor here too. Miyake, Kost-Smith, Finkelstein, Pollack, Cohen, and Ito (2010) conducted a randomized double-blind study with 399 introductory physics students at the University of Colorado to test the effectiveness of a psychological intervention, called values affirmation, to counteract stereotype threat and reduce the gender achievement gap. The treatment group wrote about their most important values, like family or friends, twice at the beginning of the 15-week course. The women in the values affirmation condition had a modal grade increase from the C to B range. Scores on an end of the semester standardized test were also compared. The women with the value affirmation condition actually had a slightly higher mean score than the men. The values affirmation exercise seems a hopeful way help address the gender achievement gap. The cumulative recursive effect of success (or failure) is noted. Breaking the cycle early is especially important in math and science courses where later material generally builds on earlier material. It is noted that this course has a good curriculum and qualified teachers, without those in place the benefits of any psychological intervention would be limited (Miyake, et al., 2010).

A values-affirmation experiment has been conducted with positive results with middle school students by Cohen, Garcia, Purdie-Vaughns, Apfel, and Brzustoski (2009).

In a 2-year follow-up study to a previously reported experiment, where the intervention – which began with students in 7th grade – had students reflect on and write about a personal value. This subtle intervention aimed at lessening stereotype threat. The experiment was conducted three times with three independent cohorts (N = 133, 149, and 134). The intervention reduced the racial achievement gap. African American students' GPAs on average, increased 0.24 points. “Low-achieving African Americans were particularly benefited. Their GPA improved, on average, 0.41 points, and their rate of remediation or grade repetition was less (5% versus 18%). Additionally, treated students' self-perceptions showed long-term benefits” (Cohen Garcia, Purdie-Vaughns, Apfel, & Brzustoski, 2009, p. 400). Well-timed affirmation of values can help interrupt the recursive cycle of poor performance in African American students (Cohen, et al., 2009).

Effective teaching methods: group-work and active learning. Hodara (2011) conducts an extensive literature review and finds that organized student collaboration is especially effective for low-achieving math students. All students seem to benefit from group work especially when it involves critical thinking and problem solving.

Many instructors may use cooperative learning in informal ways, but research suggests that cooperative learning may not be effective unless it is systematically integrated into a course. Rigorous studies of student collaboration found that students benefited from cooperative learning methods in which all students played a role in working toward a shared goal. Applications of structured student collaboration in developmental math include collaborative problem-solving activities that have a group grade tied to them. (Hodara, 2011, p. 3)

Hooker (2011) conducted a study with pre-algebra developmental math students enrolled in a two-year tribal college. In this study, instead of traditional lecture style the students in the treatment group were taught using peer-led team learning. The students placed themselves in groups of four to eight students. The classroom was arranged so the desks were grouped facing each other and a group leader was assigned. For three of the four class days each week, students worked on problems and assignments together in their small groups. Solving problems in multiple ways was encouraged. The treatment group of students had improved (nearly double) successful completion rates (grade of C or higher) and the number of students who completed the course (did not withdraw) also improved. Peer-learning, accountability, and reduced absence are other positive effects of small group-work.

The teamwork, which began quite inefficiently, eventually became a key force, and students began to use peer pressure to keep each other on task and promote the idea of learning instead of copying.... The leaders were surprised at how many different methods there were for solving problems.... The results of the study showed that the use of small peer-led collaborative group learning workshops in developmental mathematics courses had an impact on completion, perseverance, and the demonstrated use of mathematical procedures for Native American students enrolled at a two-year tribal community college. (Hooker, 2011, p. 225)

Freeman, Eddy, McDonough, Smith, Okoroafor, Jordt and Wenderroth (2014) note the need for an annual increase in the number of students earning science, technology, engineering and mathematics (STEM) bachelor's degrees. "Adoption of

empirically validated teaching practices [is seen] as critical to achieving that goal” (Freeman et al., 2014, p. 1). Freeman et al. (2014) looked at classroom teaching by meta-analyzing 225 studies with the hypothesis that lecturing maximizes learning, and what they found was the opposite. They define “active learning [as] engag[ing] students in the process of learning through activities and/or discussion in class, as opposed to passively listening to an expert. It emphasizes higher-order thinking and often involves group work” (Freeman et al., 2004, pp. 4-5). In the studies reviewed, active learning “interventions varied widely in intensity and implementation, and included approaches as diverse as occasional group problem-solving, worksheets or tutorials completed during class, use of personal response systems with or without peer instruction, and studio or workshop course designs” (Freeman et al., 2004, p. 1). The results of the study indicated that active learning leads to test scores that would amount to an increase of a half a letter grade. Failure rates were higher with traditional lecturing by 55% over the rates with active learning. The results support the idea that the need for more STEM graduates could be improved with active learning classrooms (Freeman, et al., 2014).

Hodara (2011) noted that in addition to active learning and group-work, students benefitted from seeing multiple representations of solving problems. Calculus students in sections with concept based instruction – in which students were taught to solve problems using numerical, graphical and algebraic methods and connected the new ideas to past concepts – did significantly better than students taught through textbook teaching using a linear approach to definitions and formulas. Also, application-oriented instruction, teaching math concepts through real-world problems, is consistently seen as positively

affecting students test score and conceptual understanding of the math concepts (Hodara, 2011, p. 2).

Teacher mindset. The value-affirmation and brain malleability studies speak to improving the student mindset. Teacher's mindset and the teacher's implicit biases and explicit biases are also important to the success of the students in the classroom.

When we educators look out at a classroom of black faces, we must understand that we are looking at children at least as brilliant as those from any well-to-do white community. If we do not recognize the brilliance before us, we cannot help but carry on the stereotypic societal views that these children are somehow damaged goods and that they cannot be expected to succeed. (Delpit, 2012, p. 5)

Dweck (2006) writes about a researcher of teacher mindset:

Falko Rheinberg, a researcher in Germany, studied schoolteachers with different mindsets. Some of the teachers had the fixed mindset. They believed that students entering their class with different achievement levels were deeply and permanently different [teacher quotes]: 'According to my experience students' achievement mostly remains constant in the course of a year.' 'If I know a students' intelligence I can predict their school career as well.' 'As a teacher I have no influence on the students' intellectual ability'. (Dweck, 2006, pg. 66)

The Kirwan Institute for the Study of Race and Ethnicity at Ohio State University publishes an annual implicit bias review of literature (Staats, 2014). Keeping the original references in place, implicit bias is defined as follows.

Implicit bias refers to the attitudes or stereotypes that affect our understanding, actions, and decisions in an unconscious manner. These biases, which encompass

both favorable and unfavorable assessments, are activated involuntarily and without an individual's awareness or intentional control (Blair, 2002; Rudman, 2004a). Residing deep in the subconscious, these biases are different from known biases that individuals may choose to conceal for the purposes of social and/or political correctness. Rather, implicit biases are not accessible through introspection (Beattie, 2013; Kang, et al., 2012). Internationally acclaimed social scientist David R. Williams grounds the conceptual in real world realities when he states, 'This is the frightening point: Because [implicit bias is] an automatic and unconscious process, people who engage in this unthinking discrimination are not aware of the fact that they do it' (Wilkerson, 2013, p. 134). (Staats, 2014, p.16)

The education section of this review (Staats, 2014, p. 30) basically notes the lack of research on teacher implicit biases. There is a call for research in this area, and the effect of teacher's implicit biases in the classroom.

A study by Moss-Racusin, Dovidio, Brescoll, Graham, and Handlesmann (2012) is an example of the damaging effects of implicit or unintended gender biases. In this randomized double-blind study (n=127) science faculty at research universities received and rated application materials for a laboratory manager position. The materials had been randomly assigned either a male name or a female name. The faculty (both male and female faculty) rated the male candidates significantly more competent and hireable than the *identical* female candidates. The faculty also assigned higher salaries to the male applicants than to the female candidates. Males had a 14% increase in mean salary over the females. (Moss-Racusin, et al., 2012).

Project Implicit (2011a) is a collaboration of researchers at Harvard University, the University of Virginia, the University of Washington, Ben-Gurion University, and the University of Florida. The website has, in addition to considerable information, implicit associations tests for a number of topics including race, age, weight, religion, sexuality, gender-science, and so on. The implicit association tests can be taken to measure the strength of associations (race, gender, age, etc.) and evaluations (good or bad). These tests can be used to indicate potential implicit biases.

Summary of literature review. Nationally, students entering community college are often not sufficiently prepared for college-level courses and few students who start in developmental education courses actually go on to complete a degree. This is a complicated problem without a single, straightforward solution.

To support the success of community college students, we need qualified, caring teachers who can provide challenging, well-planned curriculum with critical thinking content, with expectations and standards that are high and clearly communicated. It must be obvious to all students what is required to successfully complete the course. We also need to provide an environment that supports the student and creates positive relationships with other students.

Fixed mindset and stereotype threat are barriers to student achievement. Students must believe they can succeed. Value affirmation and/or brain malleability exercises have been shown to help ease stereotype threat and fixed mindset. Students benefitted from effective teaching methods that include active learning, group-work, multiple representations of problem solving, and application-oriented instruction. In both developmental math and STEM coursework, active learning and particularly well-

structured group-work have been shown to be effective for student learning and for providing the social support piece in the classroom. The social support piece builds student trust, increases the student's willingness to ask questions, to put forth effort, and to learn from failures or setbacks, qualities necessary for higher-level learning.

The importance of the qualified teacher in the classroom is reiterated repeatedly in the literature. Teacher mindset and implicit biases can stand in the way of student success without the teacher even realizing it. The teacher is imperative to the success of the students in the classroom. This begins by teachers truly believing that each student can succeed. To get to this point it seems essential that teachers address their own mindset and their own implicit and explicit biases.

Outline of Full Literature Review

A complete annotated bibliography is found in Appendix B.

Chapter 3: Method

Quantitative Study Method

Student success and completion. Student learning outcome data and key indicator survey results from CC1 are available and will be included in this report for context. Only data and results from CC1 are available. These data are taken from a report created by CC1's office of institutional research which covers first-semester Statway[®] students. Additionally, CC1's math department used both semesters Statway[®] to create an institutional assessment report. This report compares student mindset and key risk indicator data taken at the beginning of first-semester Statway[®] with approximately the same questions at the end of second-semester Statway[®].

Student key indicators. At the beginning of the term and then again about three weeks later the students are asked questions by Carnegie for the six key indicators of productive persistence.

A 26 item student survey was created that takes roughly three minutes to answer. This survey is embedded in the Pathway's online platform [MyStatway]. In this way, drivers of students' motivation and engagement can be assessed efficiently and practically on a regular basis. Initial results suggest this brief set of items are highly predictive of increased student success outcomes, such as successful course completion, increased academic performance and higher rates of retention and persistence. (Carnegie Foundation, n.d. b)

At the end of the semester, after the final exam, second-semester Statway[®] students at CC1 were asked approximately the same questions for four of the six indicators. These four indicators are fixed mindset, uncertainty about belonging, comfort

asking questions, and stereotype threat. The following descriptions are taken from the Carnegie generated document Statway® Student Follow-Up Report.

The fixed mindset question asks students to indicate how much they agree or disagree with a statement about math ability as a set characteristic – you are either good at math or you are not. Student responses fell into categories of *very fixed* (strongly agree), *somewhat fixed* (mostly agree), or *not fixed* (mostly and strongly disagree).

The uncertainty about belonging question asks student how often they think that perhaps they do not belong in college. Student responses fell into categories of *always*, *sometimes* or *never*.

The comfort asking questions question asks student the level of comfort felt in asking a math teacher a question about a difficult concept. Student responses fell into categories of *comfortable*, *neither* or *uncomfortable*.

The stereotype threat question asks students the level of surprise they expect others at the school would feel if people – like the student – succeeded in school. Student responses fell into categories of *high* (extremely or very surprised), *medium* (moderately or slightly surprised), or *low* (not surprised).

These reports will be included in the results to provide context to this report's qualitative study.

Qualitative Study Method

Procedure overview. The methods used to conduct this qualitative research project were adapted from the book *Focus Groups, A Practical Guide for Applied Research* by Krueger and Casey, (2009). Focus group research is scientific research designed so the process of disciplined inquiry is systematic and verifiable.

Keep in mind that the intent of focus groups is not to infer but to understand, not to generalize but to determine the range, and not to make statements about the population but to provide insights about how people in groups perceive a situation. (Krueger & Casey, 2009, p. 66)

This study uses accepted systematic procedures for data collection, data handling and data analysis. The findings – what is said in the focus group – are distinguished from interpretations and recommendations. The study sought to obtain perceptions of people with varied experiences on complex topics. As people are included in this study, and it will be presented publically, this research must be submitted to the Bemidji State University Human Subjects Committee for an Institutional Review Board (IRB) process. The reader is referred to Appendix A for the informed consent form and for outlines of questions for both the survey and the focus group.

Participants. Teacher recruitment began by using the publically available course search engine. A search of the entire statewide system in spring 2014 was conducted using the criteria of College/University: *Systemwide (all colleges and university)* and Keyword search: *Statway*. This returned ten teacher names at a total of three institutions. Using campus directories, emails and phone numbers for the ten teachers were obtained. The teachers were contacted initially by email and then followed-up by phone calls or conversations. The ten teachers were asked to respond to a survey conducted using a Google form. They were additionally asked to participate in a focus group discussion.

Of the ten teachers, eight responded to the survey. The only required question in the survey asked the respondent to indicate if he or she received and understood the informed consent and was willing to participate. The group was gender balanced with

four women and four men responding. All eight attended the Carnegie Foundation Pathways Forum in Santa Cruz, CA and the Winter Institute in Palo Alto, CA. All eight were finishing teaching the second semester of the Statway[®] progression.

Of the ten teachers, four agreed to participate in the focus group. All four of the focus group teachers responded to the survey. These four represented the three institutions. This group was gender balanced with two women and two men participating. All have advanced math degrees. Overall math teaching experience varied from 12 years to 25 years. One of the participants held an advanced degree in statistics and had taught statistics courses perhaps 50 times. The other three teachers had taken one or two statistic courses. Of these three, one participant had taught statistics roughly 14 times. The two remaining teachers had previously taught statistics two or three times. They represented a demographically diverse group. The participant's demographic characteristics are not listed because they could be used to identify the participant.

All four focus group participants, used group-work as a teaching method prior to Statway[®] but in varying degrees. All agreed that the Statway[®] group-work method is different than their previous experience. Two participants' group-work experience was limited, not done regularly, and students could choose to be in groups or to work alone. Another participant organized the groups and required the students to participate. All three of these participants mainly gave the students calculation problem sets to work on as a group and then to discuss as a class. The remaining participant has been using and requiring group-work for at least the past five years.

Sampling procedure. All participants self-selected to participate both in the survey and the focus group. Although four teachers participating in the focus group is the minimum size suggested, for this study it was the right size.

If the study is to gain understanding of people's experiences, the researcher typically wants more in-depth insights. This is usually best accomplished with smaller groups. Also, smaller groups are preferable when the participants have a great deal to share about the topic or have had intense or lengthy experiences with the topic of discussion. (Krueger & Casey, 2009, p. 68)

Each focus group participant had considerable interest, knowledge, passion, and enthusiasm.

Research design procedure. The research question was developed. *Are the teachers who participated in the implementation of Statway® satisfied with their experience?* Because this research is qualitative it is purposefully open-ended. Survey questions were developed in an effort to ascertain some baseline information from the teachers. The survey was set-up and administered through a Google form. Appendix A has a listing of the actual survey questions. The research project was submitted to the instructional review board (IRB) process and the author received approval from the Human Subjects Committee at Bemidji State University on April 17, 2014. As agreed in the IRB process, the author is the only person with access to the survey results. The ten teachers teaching Statway® in the statewide system were asked to complete the survey and to participate in the focus group. Between April 22 and April 28, 2014, eight teachers responded to the survey. The results of the survey informed the focus group questions.

The teachers were generous in providing observations. The teachers' comments on the survey comprised six pages of single line spacing type.

The focus group was planned. Again, the researcher relied on the Krueger & Casey Focus Group book, specifically *Chapter 5 – Moderating Skills* for support in this planning process. This chapter includes guidance on setting expectations at the start, keeping the discussion going, recording the discussion, respecting and encouraging differing views, techniques, strategies for hearing each participant's thoughts, ending the focus group, and being ready for the unexpected (Krueger & Casey, 2009, pp. 85-111).

The focus group took place on Saturday, May 3, 2014 from approximately 8 to 10 am in Duluth, Minnesota. The focus group was conducted in a borrowed conference room of a local engineering firm. The author/researcher/moderator and the four teachers were the only people present. The focus group audio was recorded on a digital recorder and using an iPad app, it was also recorded using a video camera. Additionally, the moderator took notes. Each participant signed the informed consent form per IRB process and as required by the BSU Human Subjects Committee. Also, as agreed to in the IRB process, these recordings and notes are kept in the author's home office and will not be shared. Appendix A has a listing of questions that guided the discussion. The questions teachers were asked can be generalized into these categories: materials, technology, assessment, classroom, and training.

At the conclusion of the focus group the participants received \$50 each for their participation. This was an incentive for the participants. As outlined in the book *Focus Groups: A Practical Guide for Applied Research* "incentives are needed because it takes effort to participate in a focus group.... The incentive is not a reward and not really an

honorarium or salary. It is an incentive” (Krueger & Casey, 2009, p. 77). The researcher knew that all the participants had other places they could be.

Analysis procedure. “There are four critical qualities of focus group analysis: it is systematic, verifiable, sequential and continuous” (Krueger & Casey, 2009, p. 115). The process followed to analyze the focus group data was adapted from *A Classic Analysis Strategy and Analytic Frameworks* (Krueger & Casey, 2009, pp. 118-128). “This Classic Approach has been around a long time, but it is still effective. Quite a number of variations are possible, but the core elements are basically cutting, sorting, and arranging through comparing and contrasting” (Krueger & Casey, 2009, p. 122).

The decision was made to use the transcription-based method of capturing the data. “Transcript based analysis uses complete transcripts of the focus groups as a basis for analysis. These are often supplemented with field notes taken by researchers.... Transcript-based analysis is useful for studies being conducted in academic settings” (Krueger & Casey, 2009, p. 117). This is considered the highest-level of detail to ensure that everything is done with the utmost integrity. It quickly became clear that typing the focus group transcript was beyond the skillset of the researcher. A highly recommended, trusted medical transcriptionist was willing to type the transcript and to give her guarantee to delete everything once the job was completed while keeping the confidentiality of what was said. The focus group participants were asked for objections and the intention was passed on to the BSU graduate school and in turn to the Human Subjects Committee. Upon receipt of the transcript from the transcriber, the researcher watched the video and went through the transcript line-by-line, editing the document as necessary. Additionally, the researcher listened to the audio file completely twice. The

transcript of the two-hour session, using 10-point font and single line spacing is 24 pages long. As agreed in the IRB process, the researcher is the only one who has access to the transcript and original recordings.

Next the quotes and comments were sorted and categorized, looking for themes, important points, and patterns. In some cases, the question asked is answered. Other times a point emerges that is not specifically what was asked. To actually do the sorting, multiple Word documents were used and quotes and comments were virtually cut and pasted into these documents. In some cases, the comment or quote encapsulated more than one idea or concept.

During this process, several factors are considered to decide how much weight or emphasis is given to comments or themes. These include frequency, specificity, emotion, and extensiveness. The data is analyzed looking for themes, patterns, and also unique or rare events that are consequential. Comments that come up repeatedly especially by multiple people across multiple questions are given more weight. Comments that come up repeatedly by one person are given less weight. It is also important to look for the comment that, although only said once, is nonetheless impactful.

Next a descriptive summary of what was said is written. “At this point focus on the findings – just describe what was said in the groups. Later you may want to go further and offer an interpretation of what it means or a recommendation” (Krueger & Casey, 2009, p. 121).

The book suggests a break at this point. Taking a couple of days to regain the big picture focus. Then the results are written around the questions and themes. Once the

findings are reported, interpretations and recommendations are considered. The findings or results are separated from the interpretations and recommendations.

Time Line

- Conduct library research – Fall 2013/Spring 2014
- Learn about Statway® – Fall 2013/Spring 2014
- Write the research proposal – Fall 2013
- Seek comments and approval of proposal from Dr. Derek Webb (advisor) and other committee members – Winter 2013-2014
- Submit IRB paperwork for approval to CC1 – March/April 2014
- Submit IRB paperwork for approval to BSU – April 2014
- Observe Statway® class – Spring 2014
- Survey of teachers – April 2014
- Conduct focus group – May 2014
- Analyze the data – May/June 2014
- Consider CC1 Office of Institutional Research report *Statway® Student Outcomes*, from first semester – April 2014
- Consider the report from the CC1 Math department assessment – May/June 2014
- Speak with Joan Miller about formatting – May 2014
- Set-up defense – June 2014
- Submit Form 5 – June 2014
- Oral Defense of research to Committee at BSU – July 11, 2014
- Completed by end of – Summer 2014

Chapter 4: Results

Quantitative Results

Student success and completion. In the fall of 2013, CC1 enrolled a total of 73 students in three sections of first-semester Statway[®]. Table 1 gives the number of students at each semester juncture and the percentage of the original 73.

Table 1:

*CC1 Students Remaining at Each Juncture During 2013-2014 Academic Year****

| | Statway [®] Student Counts | | | | | |
|---|-------------------------------------|---------------------|----------------------|-------------------|---------------------|----------------------|
| | Term 1 Enrollment | Term 1 * Completion | Term 1 ** Successful | Term 2 Enrollment | Term 2 * Completion | Term 2 ** Successful |
| N | 73 | 62 | 50 | 47 | 37 | 32 |
| % | 100% | 85% | 68% | 64% | 51% | 44% |

*Completion is defined as persisting through the term and receiving any grade (did not withdraw).

**Successful completion is defined as receiving a grade of C or higher.

*** These numbers were provided by CC1 office of institutional research.

These numbers can be compared to the similar table in a Carnegie Community College Pathways: 2012-2013 Descriptive Report. A portion of this table is reprinted here in Table 2. It gives the quartile percentages at each juncture for all the participating Statway[®] colleges (Van Campen, Sowers & Strother, 2013, p. 8).

Table 2:

*Percentage of Students Remaining at Each Juncture During 2012-2013 Academic Year****

| Quartile | Term 1 Enrollment | Term 1 * Completion | Term 1 ** Successful | Term 2 Enrollment | Term 2 * Completion | Term 2 ** Successful |
|----------|-------------------|---------------------|----------------------|-------------------|---------------------|----------------------|
| Median | 100% | 92% | 72% | 63% | 57% | 52% |
| Bottom | 100% | 89% | 65% | 50% | 47% | 42% |

*Completion is defined as persisting through the term and receiving any grade (did not withdraw).

**Successful completion is defined as receiving a grade of C or higher.

***Taken from Carnegie Community College Pathways: 2012-2013 Descriptive Report (Van Campen, Sowers & Strother, 2013, p. 8).

From these data we see that CC1 falls slightly above the median for Term 2 enrollment, below the bottom quartile for Term 1 completion, and between the median and bottom quartile for the remaining junctures – Term 1 successful, Term 2 completion and Term 2 successful. Although CC1 numbers are mostly below the median, it is the first year compared to all participating schools – some of which would be in the second year. For CC1 this is a good trend.

The office of institutional research at CC1⁴ also provided information about the traditional path. At CC1 the traditional path is Introductory Algebra → Intermediate Algebra → College Algebra. Table 3 compares pass rates of the developmental portions of the two tracks. These are first-semester Statway[®] (one semester) and Introductory Algebra & Intermediate Algebra (two semesters).

Table 3:

Comparing Developmental Math Tracks at CC1

| Traditional Path: Introductory Algebra & Intermediate Algebra | | | | |
|---|---|---|--|-------------------------|
| Fall 2012 Introductory Algebra Enrollment | Fall 2012 Introductory Algebra Pass Count* | Spring 2013 Intermediate Algebra Enrollment** | Spring 2013 Intermediate Algebra Pass Count* | Pass rate % of Original |
| 439 | 268 | 117 | 78 | 18 % |
| Statway [®] Pathway: First-semester Statway [®] | | | | |
| Fall 2013 First-semester Statway [®] Enrollment | Fall 2013 First-semester Statway [®] Pass Count* | | | Pass rate % of Original |
| 73 | 58 | | | 79% |

*Pass is defined as receiving a grade of D or higher.

**The number of students who passed Introductory Algebra in fall 2012 and subsequently enrolled in Intermediate Algebra in spring 2013.

⁴ *Statway Student Outcomes – Fall 2013* (May 2014) from the Office of Institutional Research at CC1.

Using fall 2012 to spring 2013 retention and completion data: 61% of students enrolled in Introductory Algebra in fall 2012 passed, 44% of those students enrolled in Intermediate Algebra in spring 2013, and 67% of those students passed. As a percentage of the original only 18% of the students who enrolled in Introductory Algebra in fall 2012 passed Intermediate Algebra in spring 2013. It is important to consider that some students do not need to continue on to Intermediate Algebra. Several technical and nursing programs only require completion of Introductory Algebra. So while the pass rates of first-semester Statway[®] (79%) and traditional path (18%) cannot be compared directly, it is clear that Statway[®] results are hopeful and are a trend in the right direction.

The CC1 office of institutional research report⁴ also has interesting results from a binary logistic regression analysis. The impact of various factors and demographic characteristics on pass rates, success rates, retention, and math retention were tested. The following variables were tested as potential predictors: reading placement, math placement, gender, income status, student of color, first generation, age category, course load (full or part-time), and whether or not the student was in Statway[®]. It is interesting to note from this report that in the Statway[®] vs. Introductory Algebra regression model, students with an ESOL (English for speakers of other languages) reading placement were more likely to both pass and be successful than students with college or developmental reading placements. And in the Statway[®] vs. Intermediate Algebra model, students with a college reading placement were about twice as likely to succeed as students with a developmental reading placement. There is more information on reading in the qualitative results section of this report.

Student key indicators. At the end of the semester, after the final exam, second-semester Statway[®] students at CC1 were asked approximately the same questions for four key indicators. These four indicators are fixed mindset, uncertainty about belonging, comfort asking questions, and stereotype threat. The reader is reminded that more complete descriptions are in the method section of this report. These results were presented in a CC1 math department institutional assessment report.

Figure 1: Fixed Mindset of CC1 Statway[®] Students, Figure 2: Uncertainty about Belonging of CC1 Statway[®] Students, Figure 3: Comfort Asking Questions of CC1 Statway[®] Students and Figure 4: Stereotype Threat of CC1 Statway[®] Students, all show improvement over the course of the academic year, in students key risk indicators and all were positive results for the majority of the students.

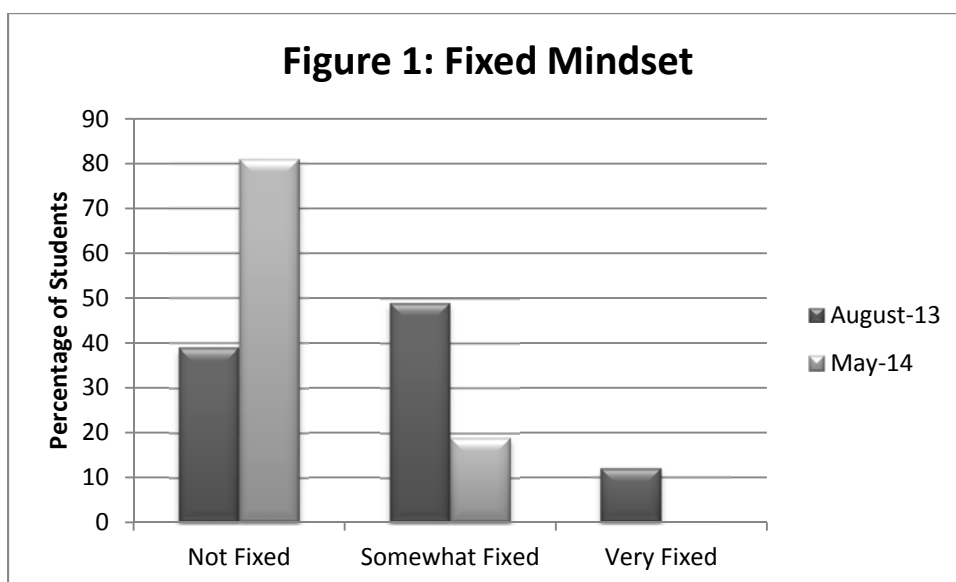


Figure 1. Fixed Mindset of CC1 Statway[®] Students. The fixed mindset question asks students to indicate how much they agree or disagree with a statement about math ability as a set characteristic – you are either good at math or you are not.

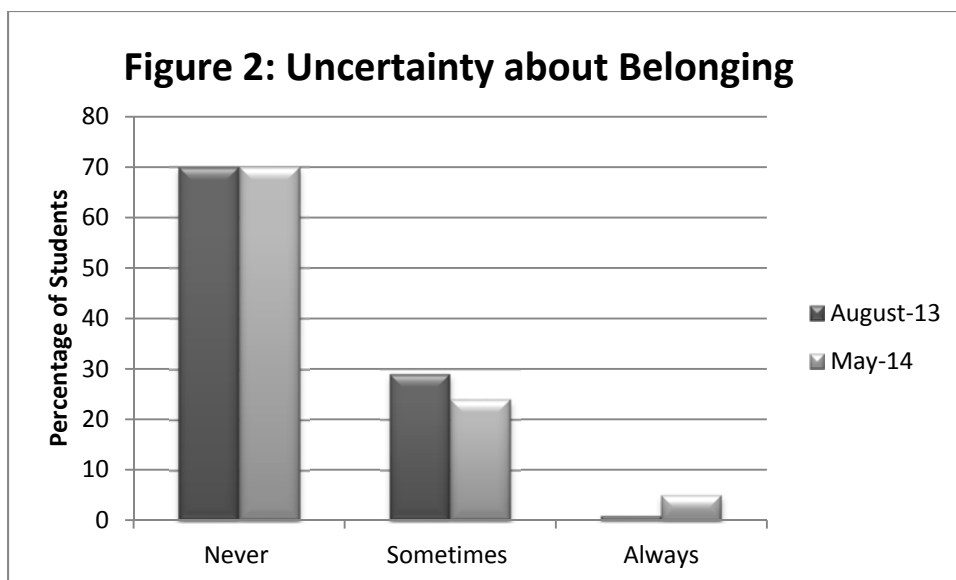


Figure 2. Uncertainty about Belonging of CC1 Statway[®] Students. Uncertainty about belonging question asks student how often they think that perhaps they do not belong in college.

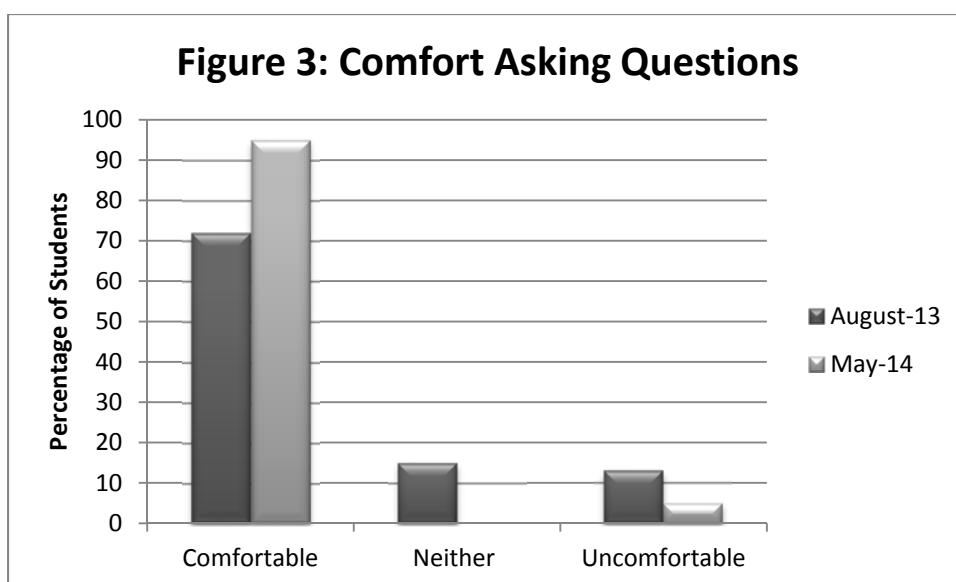


Figure 3. Comfort Asking Questions of CC1 Statway[®] Students. Comfort asking questions asks student the level of comfort felt in asking a math teacher a question about a difficult concept.

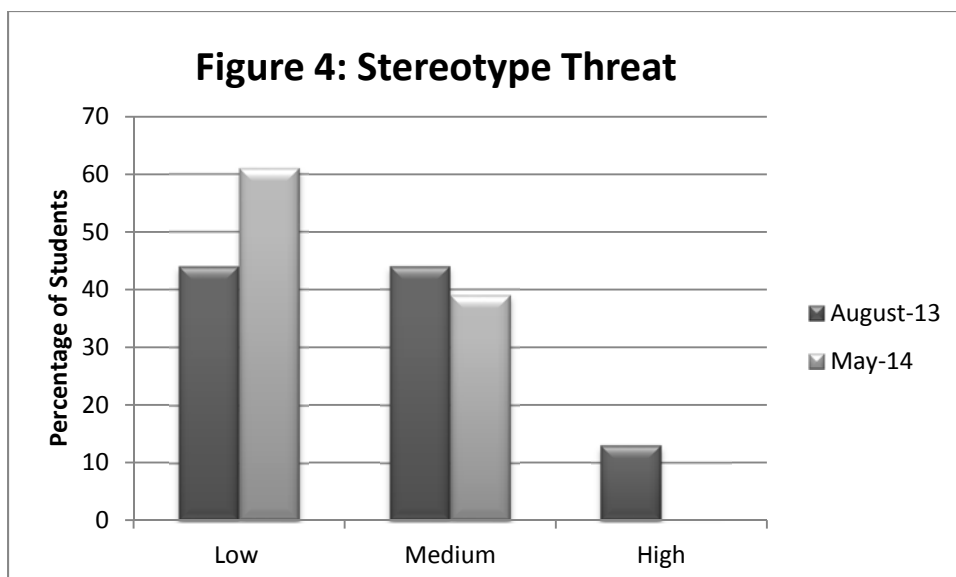


Figure 4. Stereotype Threat of CC1 Statway® Students. Stereotype threat question asks students the level of surprise they expect others at the school would feel if people – like the student – succeeded in school.

Qualitative Results

Authors note: This section mixes teacher quotes from the focus group and from the survey. Identifying information has been eliminated to preserve teacher anonymity and no credit is given to any quote. Although quotes are not always kept in the original context – effort was made to respect the integrity of the comment and to keep it within the context it was intended. Many quotes stand independently. The reader is reminded that during the analysis process several factors are considered to decide how much weight or emphasis is given to comments or themes. These include frequency, specificity, emotion, and extensiveness. The themes noted in the analysis of the qualitative data fell into these categories: reading, mindset, classroom and group-work, change in teaching – lessons learned, materials, technology, assessment, training, student learning objectives and rigor. The reader is referred to Chapter 5 for interpretations and recommendations.

Reading. During the analysis process it became clear that, based on all factors considered, reading was the theme that should be given the most weight. Reading came up more often than any other noted theme and every participant talked about reading – each bringing up a different aspect. Yet in general, the entire group seemed to agree on the points made. The comments about reading fell into categories of required reading level, amount of reading, and consistency in the Carnegie provided materials.

Required Reading Level: Materials require a sophisticated level of reading. Currently, none of the three schools have a reading prerequisite or a minimum achieved reading level. “We don’t have that yet. We talked about trying to put something in, but there are complications to putting it in.” “The audience this is meant for is not mature enough to read and understand the materials fully.” “Students who have low reading skills will have difficulty in Statway®.” It was noted that the difficulty understanding the material seemed worse for immigrants (non-native English speakers). Although the office of institutional research at CC1 results found that placing into ESOL – English for speakers of other languages, was predictive of passing and successful completion (see Student success and completion section of this chapter), specific examples to the contrary were noted. “[A student from Ethiopia] was in the lowest ESOL reading class and we ended up switching her to another class, but I just find it hard to believe that someone whose reading skills are really low would do well.” “[The reading level] is an important point and we talk about that at our school quite a bit too. We talked about trying to have a prerequisite...simply because there is so much reading.”

A dichotomy exists – the desire for rigorous, real-world statistical problems, contrasted with simplifying the wording enough so students are capable of reading and

comprehending the material. “I think there are sort of two competing things here. I think on one hand you really want to simplify the language for all students, but especially those lower level students...all of the terminology and all of that stuff is really challenging, I think even for instructors, some of us. It’s like ‘what are they saying in this sentence’.” And yet there is an understanding that rigor is needed. There is acknowledgement that statistics has difficult language associated with it. “I am not sure that I blame Statway[®], necessarily. I just think it is an inherent challenge of statistics and that the problems do involve a lot of reading, but I said that before Statway[®]. I know that they do have that whole language and literacy piece and they are aware of that and thinking about that. Again, I think that the phrasing on some of the questions [could be better].” “You want the problems to be realistic and I think that is one of the strong recommendations – is that you should not need certain made-up simple problems to simplify the stats.” The teachers felt it is important to keep the rigor, and to have realistic problems.

Extraneous or unnecessary information can be distracting for students, especially when the unfamiliar language is not pertinent to the concept they are learning. For example describing a bass and where the bass lives when ‘fish’ or even just ‘bass’ would suffice. “We don’t have enough time in the class to explain, in some way, to those who do not understand, because of the class structure”. “I sense that they [Carnegie] are sort of caught between those two things. They want the problems to be realistic, but then you end up reading a full paragraph all about the research and poll on this date and that date and then the students can’t wade their way through that, so I am not sure what the solution is there, but it is a challenge, for sure.”

And yet the students' reading levels seemed to have improved. "Having said all of that about the reading level and how it is challenging for the students, ... I have noticed that my students are actually reading better now, so they have learned, just by struggling, ... So, just by making them read and forcing them [requiring them] to do it, I think they have gotten better, but that's just a feeling. I don't have any data or anything to back that up, but I notice that when they are working in their groups and I listen to them reading, their reading is better."

Amount of Reading: "The classroom materials... require too much reading while in class. Since we all read at different rates, it made it very difficult to keep all of the students in the same place. I felt a lot of students felt rushed and didn't fully understand what they were being asked." "I think it would be better if [the Statway® workbook] was just as a regular textbook, assign the reading and then you come back and discuss the things....[Statway® workbook] is not designed as our typical textbook."

Consistency in the materials: The way the material is presented is different between the in-class and on-line materials. "The overall structure of [MyStatway] is good, but it doesn't line up with the workbook very well." This can be confusing for the students, particularly the developmental math students, "for students it's a bad thing because they are written in two different voices." As the lessons go on (second-semester Statway®), the teachers noted the material becomes more consistent.

The teachers did receive some training to help students with reading and some of the teachers received instructor materials this spring on working with students on reading skills. "They taught us in CA, how we read ourselves.... Everyone complained after that. We didn't understand what she was saying. We did not apply it to our students." "I think

that is a refinement. I mean you teach it once, and you're trying to get through [the curriculum].” After the focus group, the CC1 office of institutional research provided the descriptive statistics in Table 4: Fall 2013 CC1 Statway® Student Reading Placements.⁵

Table 4:

Fall 2013 CC1 Statway® Student Reading Placements^{1,2}

| Read Place | Success ³ | Count | Percent |
|------------|----------------------|-------|---------|
| ESOL | No | 1 | 33% |
| ESOL | Yes | 2 | 67% |
| READ D1 | No | 4 | 80% |
| READ D1 | Yes | 1 | 20% |
| READ D2 | No | 5 | 38% |
| READ D2 | Yes | 8 | 62% |
| College | No | 12 | 24% |
| College | Yes | 37 | 76% |
| Unknown | No | 1 | 33% |
| Unknown | Yes | 2 | 67% |
| Total | No | 23 | 32% |
| Total | Yes | 50 | 68% |
| Total | | 73 | 100% |

¹Data are from SCU Operational Data on June 5, 2014.

²Students who enrolled in first-semester Statway® in fall 2013. Most recent reading placement prior to the start of term.

³Success is a grade of C or higher.

Although there were not enough data to run the regression analysis to see if reading was predictive of success, data in Table 4 itself provides information that is interesting to consider. As a rate (80%) Read D1 – first course of developmental reading, seems indicative of not succeeding. However, the numbers are very small. Read D2 –

⁵ Table data from the Office of Institutional Research at CC1.

second course in developmental reading, ESOL – English for speakers of other languages, and college level reading seem indicative of success. It is also interesting to note, of the known placements, the number of students placing at college level reading (49 of the 73 or 70%) and all other reading levels (21 of the 73 or 30%).

Mindset. The reader is referred to Chapter 2 for general information on mindset. In this section, when talking about ‘surveys’ and ‘survey results’ the teachers are referring to the Carnegie provided report which compares students six key indicators assessed at about weeks one and three. The reader is referred to the Student success and completion section of Chapter 3 for more information.

Mindset was the aspect of Statway® that was most positively regarded. Productive persistence and productive struggle were what convinced many teachers to teach Statway®. “I thought the Mindset stuff was really good – I mean especially in the first semester when you are trying to get them to think a certain way....The survey results and things for me were not,...I didn’t find them particularly interesting to me. I mean, the activities, to work on those things, I think those are important things to think about. I think the surveys are more the Statway® goal, which is a good goal, but [Carnegie is interested in] getting all the information and finding what works for everybody and I think, maybe just teaching it the first time, I was just more interested in what worked for me. So, for me, I liked activities. [The] surveys didn’t really mean much to me.”

“You give them time to ask questions and they are not afraid anymore, it’s like a family, nobody’s shy or something, when you have a family, they can ask questions, both stupid and good ones, you know nobody cares.”

“What I thought was interesting was the sense of belonging as a predictor. That was, to me, eye opening, because I never really thought about that, I thought that if they were all in college together, they belonged, but some of the students don’t really feel like they belong and that is a contributing factor. That makes them shy in class.”

“I like that mindset *activity*, but I didn’t see mindset *activities*, I only saw one. The first semester, the first and second week, and then no more. I would like to see them, sprinkle it in a little bit more, not a lot, because we don’t have time, but maybe somehow make it part of an activity that they are already doing in the workbook or something like that, give them a chance to see how their mindset is changing.” “Or even, one of the problems could be a study about mindset or belonging.”

The Cohort Contract was seen as an important mindset activity. “One thing that kind of stands out in my mind, one of my favorite students from last semester had kind of a buddy in the class and before class I overheard them, one of her buddies was kind of struggling and I overheard her say ‘well we have to stick to it, we signed a contract’, [laughter] so signing that contract really made it serious.”

“They don’t do [any mindset activities] in the second semester.... They have three or four little activities, syllabus activity, the contract, and online stuff. That is what the survey is testing, because they give them it before that and then they do these things and then they want to see if those things moved any of those survey points. To me, that is why I was kind of disinterested in the surveys, because it seems more of a test [or assessment of the mindset activity] to see if these things work for [Carnegie], almost, whereas I think a lot of those things just happen over the course, some of those things just happen with the way the course is set up, by working in groups they have to talk with

each other and they learn that everyone has the same kind of problems and they feel they belong more or at lot of those things, but I do think they are important things. I don't want to discount.”

“It's almost sort of more like data collection for them versus actually trying to fix [the students], right? Sometimes that's what it feels like. I don't just want to do data collection. I want to teach the class. I want the class to go well.”

“The Productive Persistence and the Productive Struggle, those were kind of the things that sort of sold us on doing Statway®.” “Because a lot of times we talked about what makes a successful student and it's not really the math skills, it's the other stuff, and those things that matter...so, let's focus on those [key risk indicators].”

Classroom and group-work. “Students who have not had good experiences with math previously can be engaged by this curriculum.”

The Statway® teachers describe their class period as starting with classroom business – handing back papers, announcements, and so on. Next there is a launch of the day's topic – it is a brief introduction not a traditional lecture. The students then work in groups on the lesson for the rest of the class time. Several teachers noted group-work as a change in the way they will teach in the future – see the next section. Half of the teachers noted group-work when asked, *what aspects of the program work best for students?* “The students, working in teams, become completely engaged in the learning.” The intention is that the students read the lesson aloud. And “then it's noisy. They are just working in their groups and I'm just walking around, checking in with them, making sure they are okay, that sort of thing. When ... it is a good point, we stop and we discuss what they have just been doing, whole class, and then they get back to work. They work, we talk

with the whole class for a while, they work, we talk as a class...” Teachers use variations and make adjustments to fit the needs of the class. “It’s hard for me to think with a lot of noise, so all of the noise was bothering me. Some of the noise was bothering some of the students, because [the Statway® model is] to read out loud and all that. So, one day I just decided to tell them to read things silently and then discuss and then when we started doing that, students said they really like it because some of the students said that the noise was bothering them.”

The teachers agreed that it worked better in a longer block of time, two hours twice a week. The 50 min sessions are difficult to get everything done and can break-up the momentum. Desks arranged to face each other in groups also was noted as helpful to the student’s team/group-work. The students learn the routine and the system and come in ready to begin. “It was four days a week for a 50-minute class, but I would force them to put two tables together and sit facing each other and I thought this was also pretty effective and they started doing that again on their own and after a bit they didn’t ask questions about that. Otherwise,...you would get four people and one of them would be off at the edge and three of them facing one way, and that mattered to me. I think that that made a difference. If I were doing it again, I would try to get a classroom that was set up as groups, bigger tables.... One day I got stuck late and I came in and I wasn’t needed. [laughter] They were already in there working ... so it’s nice that way, the momentum of the group-work.”

The forming and maintaining of the groups seemed to be the most fluid aspect. The teachers’ observations and ingenuity went into the forming and maintaining of the groups. All teachers started out randomly forming groups of three or four students.

Strategies for forming groups included having students draw a slip of paper “giving them some group names”, drawing a playing card, using D2L (Desire 2 Learn – course management platform) to assign groups, or just randomly choosing. Attendance has an impact on the groups. “The first semester I had a lot of trouble – the attendance was not very good...and it was hard, because you have a group, this group of four, and I tried to do something they did at the conference, setting up roles, you are the note-taker and you are this and you are that, but the group – when you are missing two people and then it is hard to work with that. Sort of frustrating for me, just because the balance is all off. But, the second semester went much better. Attendance was much better. Mostly, I was able to have four groups of four, sometimes groups of three, which was okay.”

The methods used to change groups varied by teacher and circumstances. Some groups were kept the same throughout the term, some were changed periodically and some changed with each module. “I started off random. I switched them in every module. No questions. And I mixed them up. I did it myself. I tried to scatter them a little bit.” Creative adjustments, “they stayed in those groups for the first module until after the first test. During that time, as I would walk around, I would try to figure out peoples’ personalities and figure out who would work well together and so after the first exam, I reformed the groups based on personality... – someone in our department talked about putting similar people together. So, I put all the quiet people in one group and figured out who had a tendency to not be in class...to be absent, so I put them in groups together so then maybe they would all be absent at once,... and then people who talk a lot, I put them together.... So, the quiet ones, it worked... they were actually one of the best groups, I think, and they were always in class too.” Another approach to adjusting at “the second

module, by that time I sort of had an idea of who the stars were and I tried to make sure that there was not more than one star in each group, because I needed to spread those guys out. Every group needed to have at least one person who I thought was a star. You know what I mean by a star?" Asked for clarification, "the star student is the one who reads well and gets the material, but mostly it's for reading. I had to make sure there was at least one person in the group who was a strong reader." "So, I formed the groups. I did not let them form the groups. In the first semester, I changed the groups every module. They didn't like that, for the most part. ... Second semester, they pretty much stayed in the same groups...and if anyone came to me and said that they didn't like their group and they needed a change, which happened about halfway through the semester, I rebalanced the groups for that person, but I didn't tell the other students that was what I was doing."

Forming groups works better in larger classes (~20 students) and is more difficult with small groups (<10). Small classes of students reported forming a class group. "The people [started] withdrawing or to be absent...and then after that, it kind of deteriorated into one big group of individuals." And "I have six now so I have a very giant, one group."

Teacher levels of commitment to the format varied. "Some of [the students] don't have an idea what the concept is all about. They cannot answer some of those questions. So I have to come in and then sort of teach it, as if I was teaching it [with traditional lecture style], for us to move ahead, it's 15 minutes if you let them struggle throughout and they aren't coming up with any reasonable, something, the class will end without [students arriving at a solution], in the reading, the answers are there, what they need to figure out, but they cannot [see it without help]." "Yeah, it is tricky. One of [the other

teachers at my school], I don't think [this teacher] really does a lot of group-work, necessarily. I think it is mostly [this teacher] lectures...but they still mostly talk through it.... There is a very wide variety of how it is delivered at our school, as well.”

“When I help people in groups, I am much less likely to give them the answer than I was before, because they need to fight with [understanding the material], so that's kind of my mindset.”

Change in teaching and lessons learned. How has your teaching changed? What lessons can be learned from this experience that could be transferred to teaching math in general?

Teachers noted learning to guide student learning, allowing productive struggle, encouraging productive persistence, “my classroom is more student-focused”. “I'm more willing to let students struggle with ideas, and I'm more willing to challenge them.” “I have always believed in the concepts of productive struggle and Statway[®] has given me more tools to incorporate that into other classes.” “The ideas of productive struggle, persistence, and changing our mindset. Students will get more out of the class they are in and college in general if they struggle and put in the necessary effort instead of looking at it as a means to an end. Educators are here not to just disseminate information but to guide students in developing better strategies for learning.” “The ideas of productive struggle are powerful in any class, and I think students appreciate the challenge. I also think that using group-work extensively helps students talk about these ideas which is especially important for a topic like statistics.” “I love group-work, much better than lectures.”

“A lot. Take students seriously. Stop teaching irrelevant curricula. Students are not empty vessels but are, rather, intelligent beings waiting to be engaged by serious work that is relevant to their reality.” “Let students work in groups; spend less time talking to the whole class in lecture format; let students struggle with new concepts.”

“[Teaching Statway® is] very different. For the most part, I lecture in my other classes, but I want to try to do more activities, but not necessarily like the way it’s done in Statway®. [I would] just have them working on problems themselves more and not necessarily in groups, but sharing what they do with the rest of the class. I am going to try to do something with intermediate algebra. It looks like I am going to have a really small class. So, I wouldn’t say it has changed yet, but I think it’s going to change or grow.”

“I changed the way I taught ... our regular statistics class ...the biggest change I made was it was group-work all the time. I mean, I still lectured at them, but not as much as I had in the past, so it has really cut down on the amount of lecturing that I do, ... I don’t tell them everything. I just tell them what they are going to learn. ... This is what you are going to know when you are done and then they do it and then summarize what they did. So anyway, yes, it has changed the way I teach and so it’s not going to be different, because I am going to do all of my classes that way. I really like the group-work. I have always liked group-work, I have just never done it as much, but now I have done it with Statway® and I see it is not that hard to do.” “[In a non-Statway® statistic course,] I use group-work all the time, even group quizzes.”

“I also like group-work. I often feel better after a group-work class than a lecture class because I can sort of hear a little more what they say and I get a better sense of where they are at. I do think that seeing the end result of Statway® it’s like wow, [my

Statway® students] were exclusively in groups and they can really learn a lot working in groups. Sometimes there is a reluctance. I don't know that they are really learning anything. But in the end they did, so I think they can. I don't know that it is going to be a huge change in how I structure things, but it will build more confidence maybe in how group-work can work."

"My own changed more on the testing side. I used to do the group-work. Now I have multiple-choice questions in Statistics. I used to just give them open-ended, but now, more than about half will be multiple choice, because I have now multiple choice questions. I could make changes to reflect how we did it in the class." "Actually, when we talked about stuff going to our other classes, I had down belonging and some of those other [indicators,] thinking of what makes a student successful. I think those things do go to my other classes."

Materials. The materials provided by Carnegie are considerable. These include a student workbook used for in-class work; take-it-home (written homework) assignments; and MyStatway the on-line platform; there is a testbank; mid-pathway test; and end-of-pathway test. There is also instructor notes and faculty submitted materials.

"The material is excellent. It is very well prepared. There are some bugs and some things that could be fixed, but generally it is well fashioned for the audience it is meant for and the way it is meant to be taught, so the content is very good." "The materials are supposed to be under continuous improvement but there are way too many typos and errors." "When students were first learning about quartiles using temperature examples. At first it seemed like the materials were well put together but there were little details missing from the explanation that confused the students. For example, the materials don't

point out the difference in the procedure with an even data set versus an odd data set.”

“Some modules are more fully developed than others; that is why we have the Networked Improvement Communities. We are all working constantly to make the materials as perfect as possible.” “In the first semester we did the classroom activity that made the point that survey results are heavily influenced by the working of survey questions. That was the bomb.”

The classroom instructional materials received from Carnegie were rated by the eight teachers responding to the survey an average of 4.25 on a 5-point Likert-type scale, where 5 is very effective. The training materials were rated an average of 3.75 on the same scale. “The teacher support version of the book is actually counter-productive.” And “I find the instructor/student handouts to be very valuable. The sequence and design of the course is excellent in how the topics are presented and in the types of questions asked of the students.”

The workbook is used for in-class group-work. “All the questions in the workbook are related to the real world problem and also data from the students (either it is collected by observation studies or experiment). Students struggle through the class (which is intended) and at the end of the class, they understand the materials and able to do their homework.”

Technology. MyStatway is an on-line program that has modules that relate to but do not always align with the workbook chapters. “I also feel, and it may be just me, but the online part seems very separated from the class. It’s the same, but it is not matched up perfectly. I think the online stuff is actually pretty good, but I think if there was some way to connect the two a little more, it would be helpful.” “I found the online text,

MyStatway [to be] the most useful for the students and me. I like the embedded applets and videos provided that help students see why the subject is developing as it is.

MyStatway also has short problems embedded in the reading to make them stop and think instead of having to take it all in at once then answer a bunch of questions.”

As is the current state of technology, things could be better. “Applets - often did not work.” “I know that is hard to do, but people do it, so I think [Carnegie] should [make sure the technology works], because you have to use Firefox and even then it does not always work.” “They require some plug-ins for students to use the applets and this is not working in many computers.... The students enjoy using it.... [They can] change things and ...[get a] visual understanding of the content.” “I suspect that the students, once they found out that the applets and plug-ins might be troublesome, they started to use that as an excuse and they would just say, well, ‘I couldn’t get the applet to work, so I didn’t do the homework.’ I [said] ‘there are a thousand computers to use on campus and they work, so what are you talking about’, but once they found out that the applets can be troublesome, that was it, that was their excuse. That’s my biggest thing about why I really want them to fix [MyStatway platform], because they are using that as an excuse not to do the work.” “Yeah, any kind of tiny barrier that comes up, the smallest hurdle will throw a number of them off.”

Assessments. All teachers give points for in-class group-work, homework (take-it-homes) and MyStatway checkpoints (topic and module). The teachers from one school give credit for all the work done in MyStatway beyond the checkpoints. It is displayed in the gradebook as a percentage of completion. These teachers said they turn this into a

score out of ten and give that to the students as a MyStatway participation grade. Other teachers mentioned they are considering something similar.

“I am very rigorous with requirements on the MyStatway because I figured out after the first semester that if they do not get points for something, they are not going to do it. I want them to do that stuff, so I actually count all participation points in the MyStatway as part of their grade. I give a participation grade for that. ... The section checkpoints count as little quizzes and the module checkpoint at the end counts as a bigger quiz and then they have an exam with pencil and paper, but that all counts for points and I give them multiple attempts on those [checkpoints], but I do not let them see the feedback [immediately]. They have to come and see me to get the feedback before they can get their second attempt, so I have a lot of students in my office all day. It’s fun. I love it. I have taught statistics a lot and I can dig into their head and find out what they really understand, because I am actually having a conversation with them, one-on-one, so that is cool. So, I use it extensively. It is a big part of their grade.”

“The Carnegie-supplied assessment materials are quite poor--this is likely due to the crowd-sourced fashion in which they were assembled. When I started making my own assessment materials, life improved for my students.” “The testbanks are ok, there are clunker questions but there are some okay questions. We did a test every module, which works fairly well because they are not huge chunks of material and we would use testbank questions as a template. The final and mid-term exams are all multiple-choice questions and don’t involve any calculations. That is how the Statway® [tests] are set up. You can write your own final if you want to.”

Carnegie provides a mid-term and a final test. The instructors agree to give these tests and to share the results. The instructors must assign a value to the provided tests, to make them worth something so the students will work hard. It is possible to make changes to the provided tests as long as the people at Carnegie are informed what changes were made. It is also possible to create and give a separate exam. However, due to time constraints it is difficult to give two tests – the Carnegie provided exam and the personally created exam. So all teachers used the Carnegie supplied mid-term and final only. “You don’t have to put anything on there that you didn’t cover and you can keep those questions off and add to them.” “You just have to let the Statway® people know you did that.”

“My students did not do very well on the midterm exam, actually...it was all multiple choice and no calculations and we had a lot of calculations normally, so I think they were a little unprepared for that. The multiple-choice questions – I think they are good questions – but the reading thing, it is hard. I [recently] took the final, just to check, because we give ours this week.... There were a couple of questions [that made me think] ‘I’m pretty sure this is the right answer, but maybe I’m missing something’ and I had to check the answer. [The test questions] are not easy. I don’t think that’s a bad thing. But at least with the final exam, I feel it is not totally reflective of the tests [and materials] that we have been working on, just because there is zero calculations.”

“All the tests in the testbank look to me like the MyStatway stuff. It is written in the same way as the learning, the multiple choice type questions in MyStatway and also the checkpoints and end of module checkpoints. It’s very similar. So it became obvious to me that if they wanted to do well on those tests they had to do the MyStatway portion,

because it's not like the workbook, not at all." "[For] the module exams, which are in the test bank, ...the three of us get together and go through them with as fine of a tooth comb as we can to find all of the typos, all of the things that are like unnecessarily confusing, don't apply to the section.... We do some editing and some fixing, because there are lots of typos in those. We pretty much use those tests. We use the multiple-choice. [We use some] of the open-ended questions, so we select a few from those, because we want to have them do calculations, but it is true that on the mid-pathway assessment and the final-pathway assessment, there are no calculations."

"We have some multiple choice and some open-ended and then once in a while, [one of the teachers] will add something from another [statistics] class. Those problems that have the different steps where they wouldn't have them in the problem, we actually just went ahead and added those, since that is what the students were accustomed to."

Training. All eight teachers who responded to the survey attended and participated in one or two Pathways Forum/Fora in Santa Cruz, CA and all but one attended the Winter Institute in Palo Alto, CA. The overall effectiveness of the support and training received from the Carnegie Foundation was rated an average of 3.75 on a 5-point Likert-type scale, where 5 is very effective. Teachers from two of the three schools participated in conferences calls with a Statway[®] mentor. Those who participated in the mentor phone calls rated the effectiveness of these calls, an average of 4.6 on a 5-point Likert-type scale, where 5 is very effective. "Our mentor ... is wonderful. She always gives us valuable information and we learn from her experience teaching Statway[®] since it started. She answers our questions via email in between the phone calls."

The comments about training related to the amount of previous experience teaching statistics and group-work experience. Asked about their training experience, the quality of training, and the usefulness and effectiveness of the training they received, some teachers were very satisfied with the experience. Generally, the satisfied teachers had more experience teaching statistics and with group-work. “The trainings were effective.” “The forums are valuable.” “We also picked up a lot of good information at all the Statway[®] conferences.” “There are peers to talk to at the Summer Institutes, which is very helpful.” “They let us know what to expect and informed us of pitfalls and troubling areas of the curriculum for students. They also gave us good training on how to effect a change in mindset for our students.”

Other teachers had a different view. “It was less than stellar. Good ideas with little thoughtful implementation. At the Pathways fora, we’re told to do group-work by being lectured at.” “I think we should have had more intense and consistent training, more than just three conferences. For someone not accustomed to leading in collaborative learning, it wasn’t quite enough.” “I think we need maybe a summer class to go through, because they just threw us into this 5-day conference and all of these sessions that we had – it’s just kind of hard to absorb all that stuff at once and it’s not very organized. It was followed up with a Palo Alto trip, but that was only two or three days, so I feel there should be something a little bit like a class.” “Or even online or something.... The conferences are equal parts propaganda – it’s like they are selling it to you – and half of it, the other part, is they are very into the NIC [Networked Improvement Community], that’s my sense, they want you to get into these different groups and so you are collecting data and doing all this other stuff, but I think when you haven’t taught it before, the

whole time [at the forum] I'm [thinking] *How am I going to teach it? How is it going to work in the class?* So all the other stuff was – I don't want any of that.... I want to know...how [teaching Statway® is] going to go. [It] would be great if they had something online where you worked through some lessons to get a sense of how it goes and then maybe I would have been more receptive to some of the other stuff they were saying.”

“I would agree with some of my colleagues...the whole business about them selling it to us versus training us. The winter forum was better. If we had just a little bit more opportunities to actually be in a group, we worked through a lesson – if they could do more of that – have us practice being in a group so we know what that feels like and then being the teacher so we know what that feels like and they could do that, by actually having us do that, they could show us more. I liked watching the video of the classes, once in a while they would show us clips.” Also show us “how they analyze it.” “I want more of that.”

All teachers agreed that the mindset training was effective and helpful. “[Mindset] type of training was very helpful, the need to feel like belonging, what are the factors that make the students feel like they belong to a group – all those drivers so, we are put through that, and then how you let students struggle, persistent struggle, let students struggle to get to the answer, and then the content of the material, which is part of the training.”

As noted in the reading section of these results, the teachers felt the training they received to help students with their reading was ineffective. Teaching Statway® for a second time the teachers agreed that they will make refinements and improvements in this area.

The training continues beyond Carnegie. The teams of teachers at the individual institutions help each other. “I feel like I am being trained by [my teammate], because [this teacher] is our expert ... I am always going to [my teammate], asking her something about statistics or how should I do this, so it’s really helpful having [my teammate].... I think that’s really useful, having [my teammate].”

Student learning objectives and rigor. Is Statway[®] as rigorous as other College Statistics classes? “I feel it is a really strong class, actually. Personally, I think my statistics students in Statway[®] would beat up on my other statistics students, in terms of the way they can talk about the material and their understanding. We cover more statistics and slightly different, but really more statistics in Statway[®] than we do in our normal statistics course.”

“I feel that my Statway[®] statistics students who had a C would have an A in the regular statistics class here, because they are learning a lot they are going to use in the field.” “Statway[®] [student] versus [student who learned the] regular way, they are able to speak more intelligently about statistics and results and interpreting results. They do go into a lot more depth.”

“One of my students told me,... that she knows someone from [a 4-year college] who is taking statistics, just a regular stats class, and her instructor makes them write out, do everything by hand and she said that her friend doesn’t know why she is doing – she can explain the mechanics of it, but she doesn’t know why she is doing anything, whereas [my student] can’t do any of the mechanics, but she can explain what things mean.” “If you have to choose one you’d choose [understanding – ability to explain the concept].”

Teachers were asked about Statway[®] statistics without algebra and College-level math without algebra – are we adequately preparing our students? Does this limit their future options? Do you see a pathway to STEM?

To successfully complete Statway[®] “I figured out that really the only amount of algebra that they need is...[to] be able to follow the linear equation with one variable. They should be able to grasp an equation with two variables, and they have to have an understanding of proportions.” Having algebraic skills can be helpful. “I had a few students who did have introductory algebra and it seems like it was a lot easier for them. I think when they have a little bit more algebra it helps with their confidence. Some of the other students...haven’t had enough of it, they didn’t know what a square root was or how to do long division and that really hurt their confidence.”

“For us, at least, a lot of the algebra that we cover as a prerequisite for the [regular] statistics course is just unnecessary for statistics and so they may have seen it, but they will have forgotten it by the time they get to the end of statistics – things like solving radical equations or rational expressions, it is just not really part of it. And I think that is something our school is moving towards – we have introductory and intermediate algebra, which I think most schools have a similar breakdown, but we are trying to not have to teach radicals and rational expressions and things like that to people who are not going on to college algebra and calculus, so we have finite math that is college level but they only have to take our introductory algebra to get to it, so this is the same kind of thing. We are also creating, trying to come up with an online bridge [to STEM] course, because we have a number of students now, for various reasons, who [say] ‘now I need college algebra’ - who are [currently] taking Statway[®]. I had one student say ‘well, math

is actually not so bad so I am going to try this field' – which that's kind of the dream – a little bit. We need a way to give them some of those algebra skills to move on. One more thing, we talked about it with the Statway[®] people [is] being successful in some of those high level math classes or even college algebra is only partly based on your algebra skills. A lot of it is mathematical sophistication, being able to look at a problem and analyze it and think about all of the parts, and so my sense is that the Statway[®] [students] are so much better at thinking analytically and they are sophisticated mathematically, even though they do not have some of the basic manipulative skills, I think those are going to come pretty easily for them. So I think sometimes, and actually this came up in some of the sessions I went to yesterday [at a math conference], sometimes we focus too much on the manipulative skill for students, at the algebra level and forget it is almost more a mental sophistication, [sophistication] is the word I like to use for it. So someone who gets to calculus is sophisticated enough that it doesn't matter that they never would have seen – working with radicals, for some reason. They would be able to figure [working with radicals] out because they have a structure and a system. So that is my sense of not having algebra. That doesn't concern me because that's just one component. It is really about thinking [sophistication]. I think that Statway[®] does a pretty good job of it, considering that the students we had were weak students. I mean they had a lot of deficiencies in algebra, yet a lot of them have been successful and I think have a pretty good knowledge of statistics. So that is my assessment. That's a good question." "If you are going to do Chemistry for instance.....They are not prepared." "They need something extra. I am hoping, it will come fairly easily, but they definitely do need something."

Chapter 5: Discussion

In this chapter the findings of the literature review, the quantitative study, and the qualitative study – both the survey and the focus group, will be synthesized into interpretations and recommendations.

Conclusion

Are the teachers who participated in the implementation of Statway[®] satisfied with their experience? The four people who participated in the focus group were enthusiastic, forth coming, astute, generous, and cooperative. Although I had no control over choosing the participants, I could not have imagined a better group on every conceivable criterion. As seen in the results section, the insights provided by the teachers in the focus group and those who took the time to complete my survey are substantial. In sum, the experience has been positive for the teachers. “I think my students are mostly really knowledgeable about statistics, and they can converse effectively about statistical ideas. They get along well, and look out for each other, and I enjoy teaching the class.”⁶

From reviewing literature, quantitative student outcomes results, and analyzing the qualitative data from the survey and focus group, it is clear that the practices used in Statway[®] including: mindset activities, in-class group-work, homework, and an on-line component; are beneficial. This integrated approach is applicable to teaching math and other STEM courses. Using this holistic approach is positive for student learning. Applying practices similar to these to other STEM coursework, at least in part, could be the answer to increasing the number of students, particularly underrepresented minorities and women, earning STEM degrees.

⁶ Statway[®] Teacher at Focus Group on May 3, 2014.

Interpretations and Recommendations

Nationally, students entering community college are often not sufficiently prepared for college-level courses and few students who start in developmental education courses actually go on to complete a degree. The developmental math student arrived at this juncture due to a myriad of circumstances. This is a complicated problem, without a single, straightforward solution. It takes a holistic approach to overcome the obstacles. To support the success of our students, we need qualified, caring teachers who can provide challenging, well-planned curriculum with critical thinking content. Expectations and standards need to be rigorous and clearly communicated. The course framework needs to be in place, it must be obvious to all students what is required to successfully complete the course. Teachers also need to create an environment that supports the student and creates positive relationships with other students. Teachers must truly believe that each student can succeed. To get to this point it seems essential that we – the teachers – address our own implicit and explicit biases.

Fixed mindset and stereotype threat are barriers to a student's achievement. Students must believe they can succeed. Value affirmation and/or brain malleability exercises have been shown to help ease stereotype threat and fixed mindset. These can be included in our classes, additionally giving our students need writing practice.

Active learning, and especially group-work, is seen throughout this report to be very effective for student learning and for providing the social support piece in the classroom. The social support piece builds student's trust, which increases the student's willingness to ask questions, to put forth effort, and to learn from failures or setbacks, qualities necessary for higher-level learning. Group-work to be effective needs to be

systematically incorporated into the course, to be structured, and it needs to have value. If it is important make it mandatory and have an associated grade or value. Group-work may initially be ineffective. Students resist and it is up to the teacher to not give in to pushback.

The teacher must see the big-picture. It is important that we resist giving-in and rescuing the students, that we embrace discomfort. This should be done with empathy and acknowledgement of difficulty or frustration. Students will build resilience and begin to see the positive, recursive results. Eventually, if we are consistent, group-work gains momentum and the benefits are academic and social. Student collaboration has a positive impact on math learning; other benefits include peer learning, accountability, and reduced absences.

The Carnegie Foundation for the Advancement of Teaching, in creating Statway[®] has developed a comprehensive, holistic, much-needed pathway for under-prepared students. Statway[®] gives teachers the tools to implement productive persistence and productive struggle in their classroom. The teachers were supported in their efforts both by Carnegie and by the individual institution. Statway[®] has promising results for improving college math completion rates. The themes noted in the analysis of the qualitative data fell into these categories: reading, mindset, classroom and group-work, change in teaching – lessons learned, materials, technology, assessment, training, student learning objectives and rigor.

Reading was the theme, from the analysis of the qualitative study that should be given the most weight. The comments of both the focus group and survey fell into the three related categories: reading level needed; amount of reading required; and

consistency across the provided materials. The materials provided by Carnegie require a sophisticated level of reading. None of the schools in this study currently have a reading prerequisite. The dichotomy exists – the desire for rigorous, real-world statistical problems, contrasted with simplifying the wording enough so students are capable of reading and comprehending the material. Extraneous or unnecessary information, typos and missing information all add to ineffective, unproductive struggle for the students. The amount of reading coupled with the variations in students' reading ability also makes in-class group-work difficult. Consistency across materials (in-class workbook, homework, and on-line component) is also important for student clarity.

Mindset was the aspect of Statway[®] that was most positively regarded. Productive persistence and productive struggle were what convinced many teachers to teach Statway[®]. Although some teachers already believed in these concepts, it was felt that Statway[®] gave them additional tools to practice these concepts. The teachers would like to see more activities throughout both semesters of Statway[®]. Additionally, it was noted that throughout the duration of the course, aspects of the course design – for instance group-work – naturally affect change in mindset, comfort asking questions, and belonging. When asked about the student survey reports, it was generally felt that this was not useful information for the classroom teacher. The teachers felt this fulfilled a Carnegie assessment goal more than it helped in the classroom.

Classroom and group-work had variations and differing levels of commitment. It was generally agreed that a longer block of time works better and having desks that students could arrange in groups was helpful. Several teachers seem to follow the Statway[®] framework closely: launch not-lecture[®]; structured, consistent group-work;

allowing struggle; and requiring on-line work and homework. Others used variations of group-work and some fell back to more traditional lecturing and giving students the answer. Group-work is affected by absences and withdrawals and sometimes it seemed ineffective. However, teachers who consistently required group-work reported that it was the most effective aspect for the student.

Change in teaching and lesson-learned included the repeated themes of mindset and group-work. Several teachers will add these practices to other courses. Also, a few teachers mentioned using limited lecture in the future classes. Several teachers noted a shift in their perspective of the student. The teacher comment, “students are not empty vessels but are, rather, intelligent beings waiting to be engaged by serious work that is relevant to their reality,”⁷ sums this up.

Materials were generally positively regarded. Typos, missing information and inconsistency, as already noted in the reading summary, are difficult for the student.

Technology primarily focused on MyStatway. As with the materials, consistency is important for students. The on-line component would be better if it consistently aligned with the workbook. Not all students have the wherewithal to effectively install and use the applets, plug-ins, proper browsers, and so on. These become an obstacle.

Assessments include points given for in-class group-work, homework, and on-line work, as well as quizzes and tests. If it is important it needs to be mandatory. Giving points for all the components will encourage students to put effort into the work. The multiple-choice tests provided by Carnegie do not reflect the work the students have been doing. The students are used to doing calculations and the tests focus on interpretation.

⁷ Statway® teacher response on the research survey.

The tests require a sophisticated level of reading and this also can be confusing for the student.

Training satisfaction fell along the lines of experience. Those with more statistics coursework and/or more statistics teaching experience were more satisfied with the training they received from Carnegie. Those with less statistic coursework and/or less statistics teaching experience were less satisfied with the training. It was felt that the training focused on selling the teachers on concepts rather than training them how to teach it. The first time you teach something it is always more difficult. You are concerned with how it will go. Your focus is on how you will teach the course. The mentor was very highly regarded as a valuable resource. The teams of three teachers at each institution is seen as helpful and the source of continual training.

Student learning objectives and rigor for Statway[®] were seen as positive by all teachers. Students who successfully completed the two semester of Statway[®] pathway, understand the material and have the ability to explain the concepts. The topics covered are on par with college-level statistics. In fact, the teachers agree that Statway[®] is a stronger class than the regular college statistics course at their colleges. It did not concern the teachers that students do not take algebra while fulfilling the college math requirement. The sophistication of the students who have completed the pathway was also noted. It is agreed that a bridge to STEM coursework is needed should students decide to pursue a STEM path. It was postulated that, although the student would require additional coursework if this change was made, the level of mathematical sophistication gained through the Statway[®] coursework would make the transition to a STEM path less difficult than it would have been pre-Statway[®].

Statway® suggestions to consider. Continue to work on improving materials to eliminate typos, inconsistencies, and missing information. Work on consistency across various components, the in-class workbook, take-it-homes, and MyStatway. Keep the material rigorous, not tedious, by eliminating superfluous, redundant, or extraneous words.

Carnegie should consider including additional mindset activities later in first-semester Statway® and in second-semester Statway®. A recommendation from the focus group is to add a lesson that analyzes or compares mindset survey data, or a problem set incorporating another study about mindset and belonging, or simply another brain malleability exercise. For the second-semester activities, I would recommend adding value-affirmation exercises (Miyake et al., 2010), or perhaps have second-semester students write to first-semester students as encouragement. Although there are positive results from the initial activity, the Statway® brain activity exercise is based on the work of Dweck (2006), which is generally conducted with younger students – thus catching the students before recursive cycles have long-term effects. The developmental math student arrived at this point due to complicated circumstances and that may take some additional work to uncouple. Dweck (2006) writes about her own continual complicated process to move from the fixed mindset.

Consider teacher-training modules that are geared toward different levels of statistics teaching experience and group-work experience. These could be on-line modules or different offerings at the forums. Teacher-training modules on assisting students with reading skills would also be helpful for the teachers. Model group work, have participants assume the role of teacher, and then switch to be a student. Teachers

need to be encouraged to stand firm and require group-work. It would be helpful for teachers to know that group-work may initially be ineffective and students will complain. Teachers need to be willing to be uncomfortable. Eventually, the momentum of group-work takes hold and the benefits are great. It takes struggle to get there.

Consider adding more teacher mindset training. Also, encourage teachers to explore Project Implicit (Project Implicit, 2011a) to gauge implicit biases.

Consider adding computational problems to the tests. Perhaps there is a way to do this and still have multiple-choice questions. The need to have consistency and not variations in grading is understandable. However, it would benefit the students to be assessed in a way that is consistent with the work they have done in class.

Statway[®] schools should consider a reading prerequisite and a longer class time block. It is important that the classroom set-up allows for desks or tables to be put in groups. Students should be advised to work on reading before taking Statway[®], especially students testing into the first course of developmental reading.

Statway[®] teachers should consider giving points for all work done in MyStatway, and for in-class work and take-it-homes assignments. If it is important it needs to be required and given points.

While a Statway[®] teacher must have free will to make adjustments, to use creativity, ingenuity and variation to fit the needs of the class, teachers should commit to limiting lecture, allowing productive struggle and requiring group-work.

Final Commentary

We need to find a better path for students, especially for our under-represented minority, first generation, and low-income students. They are counting on us for the

chance to prepare for a future workforce that has not yet been envisioned – a better future. To do this, we as teachers need to be brave enough to address our own implicit and explicit biases. We need to be qualified, caring teachers with growth mindsets who embrace learning and understand that it is a journey. We must provide critical thinking content in a well-planned curriculum, with expectations that are rigorous and clearly communicated. We need to systematically incorporate active learning and group-work in our classes and work with students on their mindset to encourage resilience and persistence. Acknowledging that this is a challenge, not easily faced. If we embrace discomfort and act with empathy, we will build a community of learners in our classrooms, then the students will leave our classrooms prepared with the skills needed to adapt to the ever-changing future.

Appendix A

Informed Consent, Survey and Focus Group Questions

Informed Consent Form Statway® Teachers' Experience

April 13, 2014

Dear Statway® Teacher:

You are invited to participate in a qualitative study that will include survey and a focus group (if you are available). My main research question is “Are the teachers participating in the implementation and teaching of Statway® satisfied with their experience?” It is a somewhat vague question, as is the nature of qualitative research. This research report is in fulfillment of a requirement for my Master’s of Science in Mathematics degree program at Bemidji State University

You will be asked to answer questions in a Google Survey. You will not be required to provide identifying characteristics, unless you wish to do so (giving your name will be optional). You are also invited to participate in a focus group, on the morning of Saturday, May 3, in Duluth, MN. The survey results will help inform the focus group questions. I will not be sharing information about you with anyone. The information I collect from this research project will be kept private. I will not use your name in my final paper or in any presentation I may give. Focus groups provide a particular challenge to confidentiality because once something is said in the group it becomes common knowledge. I will encourage group participants to respect confidentiality, but I cannot guarantee it. I ask each of you to respect each other during this process. I anticipate minimal risk to you.

You are free to decline to participate or to withdraw your consent and discontinue participation at any time. There are no penalties for withdrawing. You may talk to anyone about the research and you may take time to reflect on whether you want to participate or not. If you have any questions about this study, you may ask them before, during, or after participation. Your participation is truly appreciated.

If you agree to participate, click the “I agree to participate” box on the survey or please sign here (focus group participants)

Name (please print) Signature Date

If you have questions, please do not hesitate to ask. You may contact me: Joan Carter at joan.carter@minneapolis.edu or my Bemidji State University research adviser: Dr. Derek Webb at 218-755-2846 or dwebb@bemidjistate.edu

Survey Questions

April 19, 2014

Statway® Teacher's Experience Survey

The current working title of my research report is "IMPLEMENTATION OF STATWAY® FOR NON-STEM MAJORS AT TWO-YEAR COMMUNITY COLLEGES, FOCUSING ON THE TEACHERS' EXPERIENCE."

Thank you for participating in my research project. This research project is the final requirement of a Master of Science degree in Mathematics from Bemidji State University. You are being asked to participate because you are teaching or have taught Statway® in the 2013-14 school year. I would like you to answer all of the questions. Your answers will be kept confidential. You may choose to skip any question, except the Informed Consent question. Your full participation is truly appreciated. If you have any questions please contact Joan Carter at joan.carter@minneapolis.edu

Thank you for your time and input. Please answer the following to the best of your abilities:

Google Survey Questions:

(This is the only required question.) I (the participant) have received and I understand the Informed Consent Form for this research project. By clicking here and filling out this survey, you agree to participate in this research. You understand that you may decide to discontinue participating at any time. If you have any questions you may ask them at any time. The Informed Consent Form can be accessed at this link. Informed Consent

Your name

Your email

I have taught or I am currently teaching (check all that apply): Statway® I or Statway® II

This is my ____ semester teaching Statway®: 1 or 2 or More than 2

Training

I participated in the Pathways Forum in Santa Cruz, CA Yes/No

I participated in the Winter Institute in Palo Alto, CA Yes/No

I participated in the Phone calls with Statway® Mentor (3rd timer). Yes/No

Please rate the effectiveness of the Mentor calls. Scale 0-5

Please note any other training you received from the Carnegie Foundation. Short answer

Please rate the effectiveness of the support and training you received from the Carnegie foundation (where 0 is "not at all effective" to 5 "very effective")

Please comment on the usefulness and effectiveness of the training you received from the Carnegie Foundation. Text box

The length of time, from when you first agreed to participate in the implementation or teaching of Statway® until you were in the classroom is closest to: Less than 1 month or 1-6months or 7-12months or More than 12 months

Please rate the training materials you received from the Carnegie foundation (where 0 is "not at all effective" to 5 "very effective")

Please rate the classroom instructional materials you received from the Carnegie foundation (where 0 is "not at all effective" to 5 "very effective")

Time spent outside of classroom:

How many hours on average do you spend prepping for a 4 or 5 credit Statway[®] class?
Please include the time spent preparing before the term in the weekly average. Short answer

How many hours on average do you spend grading for a 4 or 5 credit Statway[®] class?
Short answer

Do you spend more or less time prepping to teach for Statway[®] I when compare to teaching other developmental MATH courses? Statway[®] is more time or Statway[®] is less time

Do you spend more or less time grading for Statway[®] I when compare to teaching other developmental MATH courses? Statway[®] is more time or Statway[®] is less time

Do you spend more or less time prepping to teach for Statway[®] II when compare to teaching other entry College level MATH courses? Statway[®] is more time or Statway[®] is less time

Do you spend more or less time grading for Statway[®] II when compare to teaching other entry College level MATH courses? Statway[®] is more time or Statway[®] is less time

Short answer

What materials did you find the most effective?

What materials did you find the least effective?

Can you name some ways in which your teaching has improved?

What lessons can be learned from this experience that could be transferred to teaching of Math in general?

What aspects of the program work best for the students?

Can you tell me about one particularly good lesson experience?

Can you tell me about one lesson experience that did not go as planned?

Is there anything else you would like me to know? Please provide any further thoughts, comments or input.

Thank you for your time and input. Your response has been recorded. Your participation is appreciated.

Focus Group Questions**May 3, 2014****Statway® Teachers Focus Group Outline of Set-up and Questions**

Introduction & Welcome & Thank you

Qualitative research methods adapted from Focus Groups: A Practical Guide for Applied Research, R.A> Krueger & M.A Casey – 4th ed.

Informed Consent form & Institutional Review Board. I will collect this data and use it for the purposes of my report. In my report, I will make sure that you are not identified in any way and to keep your anonymity. The report will be available, but the data from today will not be available to anybody. Do you have any questions about the IRB process?

Questions (outline of questions & topics asked):

General

How does teaching Statway® differ from the way you teach your other courses?

How has your teaching changed in your other classes? How do the Student Learning Outcomes (SLOs) for Statway® differ from the SLOs of your other courses?

Training

Tell me about:

1. The training you received.

Were you new to/how did you learn:

- to effect change in student mindset
- Productive struggle and Productive persistence.
- Group-work
- Guide on the side rather than sage on the stage

2. Forums

3. Institutes

4. Mentor Calls

5. Website training

Materials

What is your evaluation of the Statway® materials?

Required level of reading.

Tell me about:

What technology do you use with Statway®?

1. Technology used

- MyStatway - Applets and videos
- on-line student resources; on-line reading; on-line workbooks
- Forums and blogs

2. Assessment materials. Language used.

3. Workbook (student)

4. Teacher support book

5. Take it homes

6. Instructor sheets/student handouts

7. Mindset activities

8. Supplemental materials provided by other instructors in the Network Improvement Community (NIC)

9. Surveys

What would you change about the materials?

Classroom tell me about your classroom – describe it.

Tell me about group-work?

How do you form the groups?

Do they ever get new partners?

Your thoughts on that.

Quality of the learning experience. Do you feel that Statway[®] II is college level?

What are your thoughts on College Level math not including Algebra?

Statway[®] fills a need for non-STEM majors.

Do you think there is a path to STEM math?

What are your thoughts on not requiring Algebra?

Assessment

How would you change the assessment materials?

Online work:

Can you tell if the student is doing the online reading and submitting the Learn by Doing and the Did I get this? “My Participation score” that the students see? Or just the checkpoints?

How do you score this work? Do the students do these? How do you use this? Do you give them some sort of credit?

Additional Questions on the units: Do the students submit these? Do you use them in class?

In-class work:

How do you assess their progress on the in-class work?

How do you make sure everyone participated?

Take-it-home

Do you grade these? Give them points?

Testing Materials:

Tell me about the quality of the testing materials.

How well do the testing materials relate to the class work and MyStatway?

How would you change these materials?

Do you make up your own tests?

Appendix B

Annotated Bibliography

Aronson, J., Fried, C. B., & Good, C. (2002). Reducing the effects of stereotype threat on African American college students by shaping theories of intelligence. *Journal of Experimental Social Psychology*. 38, 113-125. doi:10.1006/jesp.2001.1491.

The phenomenon of stereotype threat, plays a role in African American student underperformance. Stanford University students were the subjects of this experiment to test a method of helping students resist these responses to stereotype threat. Specifically, students in the treatment group were encouraged to see intelligence—the object of the stereotype—as a malleable rather than fixed capacity. The African American students (and, to some degree, the European American students) who viewed intelligence as malleable reported greater enjoyment of the academic process, greater academic engagement, and got higher grades than students in two control groups. The treatment consisted of three repetitions, included information about the brain’s malleability and potential to grow and writing this information in the student’s own words. Although it helped and seemed to reduce stereotype threat, it did not close the gap between GPAs of European American and African American students. The authors suggest combining strategies, including collaborative learning.

Asmussen, J. (2013). *Longitudinal study of developmental education at four metropolitan area MnSCU colleges – Final report*. Asmussen Research & Consulting LLC, Mendota Heights, MN. August 9, 2013.

This report details a study of developmental education (reading and math) at four MnSCU schools over two years. Systemic trends or patterns are noted. Similar to national trends in developmental education are seen. They recommend: using a variety of methods to place students (HS coursework and placement test scores), to combat students being placed below their ability level. Suggest eliminating or greatly reducing students referred to adult basic education. Also noted is the need to find a way to improve “non-starters” rates, graduation rates, and male success rates.

Bissell, A. (2012). Architecture and impact of an open, online, remixable, and multimedia-rich algebra 1 course. *Journal of Asynchronous Learning Networks*, 16(5), 49-59. EJ1000090

Article notes that less than half of the students in the United States graduate from high school ready to take college-level math courses and remedial math programs have not appreciably improve outcomes. The author of this article describes the work of the Monterey Institute for Technology and Education, and specifically the design and early evidence of impact of their multimedia algebra and developmental math resources. He believes that the structure and function of these open educational resources can effectively meet the diverse needs of the nation's math teachers and learners, perhaps offer personalized teaching and learning practices. Good quality resources alone are not enough to “fix” the math educational outcomes. But they do play a role in effective learning.

Boylan, H. (2011). Improving success in developmental mathematics: An interview with Paul Nolting. *Journal of Developmental Education*, 34(3), 20-27. EJ986275

This article is an interview with Dr. Paul Nolting, a national expert in assessing individual math learning problems, developing effective student learning strategies, and assessing institutional variables that affect math success. In this interview, Dr. Nolting shares his views on why so many incoming students place into developmental math and why so many fail to complete developmental math. He offers strategies recommended for students who fail a developmental math course.

Bryk, A., Gomez, L., & Grunow, A. (2011, July). Getting ideas into action: Building networked improvement communities in education. *Frontiers in Sociology of Education*. Retrieved from http://www.carnegiefoundation.org/sites/default/files/bryk-gomez_building-nics-education.pdf

The authors propose a networked improvement community to continuously improve materials.

Carnegie Foundation for the Advancement of Teaching. (n.d. c). Statway[®]. Retrieved from <http://www.carnegiefoundation.org/statway>

Carnegie’s website for Statway is a tremendous resource for information, research, and specifics about this course.

Cohen, G. L., Garcia, J., Purdie-Vaughns, V., Apfel, N., & Brzustoski, P. (2009). Recursive processes in self-affirmation: Intervening to close the minority achievement gap. *Science*. 324(5925), 400-403. doi: 10.1126/science.1170769

This is a 2-year follow-up to a previously reported experiment. The intervention – began with students in 7th grade – had students reflect on and write about a personal value, something that is important to the student. It could be a relationship with friends, family or other interest. This subtle intervention is aimed at lessening stereotype threat related to being negatively stereotyped in school. The experiment was conducted three times with three independent cohorts (N = 133, 149, and 134). The intervention reduced the racial achievement gap. African American students GPA on average increased about ¼ of a grade. Well-timed affirmation of values can help interrupt the recursive cycle of poor performance in African American students.

Delpit, L. D. (2012). *“Multiplication is for white people” : Raising expectations for other people’s children*. New York City, NY: The New Press.

This book studies the achievement gap between the African Americans and European Americans. Historic and academic reasons as well as implicit and explicit biases are explored. Teachers need to believe in the potential of ALL students. We need to provide critical-thinking work (**not** fill-in-the-blank worksheets) and collaborative learning opportunities. “Your work does matter more than you can imagine. Your students, particularly if they are low-income children of color, cannot succeed without you. You are their lifeline to a better future. If you put your energy and expertise into your teaching, learn from those who know your students best, make strong demands, express care and concern, engage your students, and constantly ensure that your charges are capable of achieving, then you are creating for your students,...“a future [they] could not even imagine for [them]selves.”” (p.88)

Dweck, C. (2006). *Mindset: The new psychology of success*. New York, NY: Ballantine Books.

There are essentially two mindsets, the fixed mindset and the growth mindset. The **fixed mindset** is characterized by the need to be thought of as smart. It leads people to avoid challenges and failure, to take the sure path and to give up easily. Effort is seen as a bad thing. Criticism and feedback is ignored and other people’s success is threatening to the fixed mindset. Everything has a cause and is predetermined; ‘I am not to blame’. All this leads to generally achieving less than full potential, it limits achievement. We put students in this mindset by praising their intelligence. The **growth mindset** is characterized by the belief that intelligence can grow and abilities can be learned. Challenges are embraced as learning opportunities. Effort is fundamental, necessary to gain expertise. Failures

are setbacks and hurt but failures are surmountable, another opportunity to learn. The growth mindset learns from criticism and finds lessons and inspiration in other people's success. This leads to a greater sense of freewill and ever-higher levels of achievement. We put students in a growth mindset by praising their effort.

Edgecombe, N., Smith Jaggars, S., DeLott Baker, E. & Bailey, T. (2013). *Acceleration through a holistic support model: An implementation and outcomes analysis of FastStart@CCD*. Community College Research Center, Teachers' College, Columbia University.

This report outlines the fast track (accelerated) program at Community College of Denver. This program combines multiple semester-length course sequence into one intensive semester. The students although finishing in an accelerated pace seem to be as prepared as those students completing the traditional path sequence. Relationships that the cohort formed due to the extended time together were seen as beneficial. Coursework, study groups and computer based homework system (MyMathLab) are all used. Students received academic, career and personal advising.

Fike, D. & Fike, R. (2012). The consequences of delayed enrollment in developmental mathematics. *Journal of Developmental Education*, 35(3), 2-5, 8, 10. EJ998802

Though a large percentage of U.S. students enter higher education with mathematics deficiencies, many institutions allow these students to decide the timing of their enrollment in developmental mathematics courses. This study of 3476 first-time-in-college students entailed the review of student outcomes (Fall GPA, Fall-to-Spring retention, Fall-to-Fall retention) for those who enrolled in developmental math during their first semester compared to those who delayed enrollment. The findings suggest that policy requiring mandatory enrollment during the first semester for developmental math students may be in the best interest of students and their institutions.

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences of the United States of America*, USA. doi/10.1073/pnas.1319030111

“Active learning engages students in the process of learning through activities and/or discussion in class, as opposed to passively listening to an expert. It

emphasizes higher-order thinking and often involves group work” (pp. 4-5). The active learning interventions in this meta-analysis study varied widely in intensity and implementation. Results indicate that active learning leads to increases in examination performance that would raise average grades by a half a letter, and that failure rates under traditional lecturing increase by 55% over the rates observed under active learning.

Hern, K. (2012). Acceleration across California: Shorter pathways in developmental english and math. *Change: The Magazine of Higher Learning*, 44(3), 60-68. EJ968493

Developmental courses in English, math, and reading have an important purpose in higher education, especially in community colleges. These classes are intended to give less-prepared students a chance to catch up and meet the challenges of college-level coursework. However, nationwide studies have shown that the more semesters of remediation a student is required to take, the less likely that student is to ever complete a college-level math or English course. This has led to the California Acceleration Project, an initiative of the state-funded California Community Colleges' Success Network (3CSN) that supports colleges in offering new accelerated math and English courses.

Hodara, M. (2011). Improving pedagogy in the developmental mathematics classroom. *Community College Research Center*, 51, 1-4. ISSN 1526-2049

Community colleges typically offer extensive developmental education programs to prepare students for college-level coursework. Yet rates of completion are particularly low. This report summarizes a meta-analysis of literature. Research suggests that group-work, problem representation, application-oriented problems, understanding student thinking, and computer based learning support student learning. These approaches are not typically used in isolation but instead are often used in combination. **Group-work:** Overall, the literature on math pedagogy indicates that student collaboration has a positive impact on math learning. Everyone seems to benefit from group-work – applications of *structured* student collaboration in developmental math that include collaborative problem-solving activities that have a group grade tied to them. **Problem representation:** Students benefitted from seeing multiple representation of solving problems. **Application-oriented** instruction teaching math concepts through real-world problems is consistently seen as positively affecting students test score and conceptual understanding of the math concepts. **Understanding student thinking:** It is generally accepted that teachers assessing and adapting to meet the needs of their

students is a positive impact of student performance, the research did not include comparison groups to confirm the results. **Computer based learning:** Students work at their own pace and the instructor provides individual attention. Research is limited and cannot be compared directly.

Hooker, D. (2011). Small peer-led collaborative learning groups in developmental math classes at a tribal community college. *Multicultural Perspectives*, 13(4), 220-226. doi: 10.1080/15210960.2011.616841

In this study the author examines the use of small peer-led collaborative learning (group-work) groups to change students' perceptions of mathematics and their success in developmental mathematics classes at a small tribal community college. "There is great variation among Native American tribal populations and what may work well for one group does not always work well with others. There is some agreement that Native American students learn best with hands-on, inquiry-based, and cooperative-learning methods" (pp. 221-222). Group-work allows students to be seen as contributors. "Native American children are taught to cooperate and help everyone to succeed. They have worked together for the good of everyone.... Collaborative learning has been suggested as an excellent method for helping American Indian students learn" (pp. 221-222). It instills teamwork and pride. Peer-learning, accountability and reduced absence are other positive affects of small group-work. "The results of the study showed that the use of small peer-led collaborative group learning workshops in developmental mathematics courses had an impact on completion, perseverance, and the demonstrated use of mathematical procedures for Native American students enrolled at a two-year tribal community college" (Hooker, 2011, p. 225).

Krueger, R. A. & Casey, M. A. (2009). *Focus groups a practical guide for applied research* (4th ed.) Thousand Oaks, CA: SAGE Publications, Inc.

This book is a guide for conducting and analyzing data from focus groups for research or evaluation.

Lee, V. E., Smith, J. B., Perry, T. E., & Smylie, M. A., (1999). *Social support, academic press and student achievement: A view from the middle grades in Chicago*. Retrieved from <http://ccsr.uchicago.edu/sites/default/files/publications/p0e01.pdf>

The report focuses on student social support – relationships the student has in and out of school, and school 'academic press' – involves both the teachers and the students, the content is clear, the expectations are high and students are supported

while being held accountable. It challenges the academic focus versus social support models in favor of a model that includes both academic rigor and social support. In the schools studied, those with high levels of academic press and high level of social support saw average math gains of a 2.39 grade equivalency in one-year. Compared to average gain of 0.63 grade equivalency for low levels of academic press and low level of social support and average gain of 1.34 grade equivalency for high levels of academic press coupled with low level of social support. “Social support also provides a sense of trust, confidence, and psychological safety that allows students to take risks, admit errors, ask for help, and experience failure along the way to higher levels of learning” (p.9).

Merseth, K. (2011). Update: Report on innovations in developmental mathematics – moving mathematical graveyards. *Journal of Developmental Education*, 34(3), 32-33 & 36-38. EJ986277

The purpose of this article is to outline the issues in community college developmental math and to highlight solutions developed by the Carnegie Foundation. Carnegie Foundation as developed to programs for non-STEM majors, Statistics Pathways or Statway™ and Quantway™. The author outlines the barriers to student’s success in traditional math courses; the collaborators that added to the development; the teacher preparation and support; and the materials available. These programs have elements of productive struggle, explicit connections, and deliberate practice.

Miyake, A., Kost-Smith, L. E., Finkelstein, N. D., Pollock, S. J., Cohen, G. L., & Ito, T. A. (2010). Reducing the gender achievement gap in college science: A classroom study of values affirmation. *Science*, 330(6008) 1234-1237. doi: 10.1126/science.1195996

Women are underrepresented, in many science, technology, engineering, and mathematics disciplines and professions. Stereotype threat, is seen as a factor here. These authors conducted a randomized double-blind study with 399 introductory physics students at the University of Colorado to test the effectiveness of a psychological intervention, called values affirmation, to counteract stereotype threat and reduce the gender achievement gap. The treatment group wrote about their most important values, like family or friends, twice at the beginning of the 15-week course. The women in the values affirmation condition had a modal grade increase from the C to B range. Scores on an end of the semester, standardized test were also compared. The women with the value affirmation condition actually had a slightly higher mean score than the

men. The values affirmation exercise seems a hopeful way help to address the gender gap. The cumulative recursive effect of success (or failure) is noted. Breaking the cycle early is especially important in math and science courses where later material generally builds on earlier material. It should be noted that the course has a good curriculum and qualified teachers without those in place the benefits of any psychological intervention would be limited.

Moss-Racusin, C. A., Dovidio, J. F., Brescoll, V. L., Graham, M. J., & Handelsmann, J. (2012). Science faculty's subtle gender biases favor female students. *Proceedings of the National Academy of Sciences of the United States of America*, USA. www.pnas.org/cgi/doi/10.1073/pnas.1211286109

This study is an example of the damaging effects of implicit or unintended gender biases. In this randomized double-blind study (n=127) science faculty at research universities received and rated application materials for a laboratory manager position. The materials had been randomly assigned either a male name or a female name. The faculty (both male and female faculty) rated the male candidates significantly more competent and hireable than the *identical* female candidates. The faculty also assigned higher salaries to the male applicants than to the female candidates (males had a 14% increase in mean salary over the females).

Project Implicit® (2011a). *Main webpage*. Retrieved from <https://implicit.harvard.edu/implicit/>

A collaboration of researchers at Harvard University, the University of Virginia, the University of Washington, Ben-Gurion University, and the University of Florida. The website has, in addition to considerable information, implicit associations tests for a number of topics including race, age, weight, religion, sexuality, gender-science, and so on. The implicit association tests can be taken to measure the strength of associations (race, gender, age, etc.) and evaluations (good or bad). These tests can be used to indicate potential implicit biases.

Staats, C. (2014). *State of the science: Implicit bias review 2014*. Ohio State University Kirwan Institute for the Study of Race and Ethnicity. Columbus, OH. Retrieved from <http://kirwaninstitute.osu.edu/wp-content/uploads/2014/03/2014-implicit-bias.pdf>

This report looks at research studies regarding implicit biases in many areas such as law enforcement, medicine and education. “Implicit biases are attitudes or

stereotypes that we carry around with us unconsciously. These mental associations influence our perceptions, actions, and decisions, yet because implicit biases are unconscious and involuntarily activated, we are not even aware that they exist” (Staats, 2014, p. 70). “Everyone has implicit biases. The implicit associations we harbor in our subconscious cause us to have feelings and attitudes about other people based on characteristics such as race, ethnicity, age, and appearance. Research suggests that these associations begin to develop very early in life as we’re exposed to both direct and indirect messages. Some studies have documented implicit biases in children as young as six years old. Beyond early life experiences, the media and news programming are often regarded as influencing individuals’ implicit biases. Keep in mind, though that not all of the messages we’re talking about are blatant; many are quite subtle” (Staats, 2014, pp. 70-71).

United States Government Accountability Office (2013). *Community colleges: New federal research center may enhance current understanding of developmental education*. By M.H. Emrey-Arras. September 2013. (GAO-13-656 Developmental Education) retrieved from <http://www.gao.gov/assets/660/657683.pdf>

In this report to Congress, examines current community college developmental education improvement efforts. They visited 11 colleges. The recommendation is made for a federal research center to conduct scientific studies to determine the efficacy of the efforts.

Van Campen, J., Sowers, N., & Strother, S. (2013). *Community college pathways: 2012-2013 descriptive report*. Stanford, CA: Carnegie Foundation for the Advancement of Teaching.

In the 2012-2013 academic year, the Community College Pathways program sustained the positive outcomes realized in 2011-2012. Fifty-two percent of Statway community college students and 75 percent of Statway CSU students successfully completed the course, earning college credit within one year. Quantway 1 results were similarly encouraging, with 52 percent of students successfully completing the course and fulfilling their developmental math requirements. These rates are consistent with Year 1 results and dramatically higher than the typical completion rates of other developmental math students. Year 2 data add to the evidence that Pathways can help large numbers of students in a variety of contexts gain essential mathematics skills and achieve their academic goals.

Vasquez, S. (2004). A Report on the effectiveness of the developmental mathematics program M.Y. math project - Making your mathematics: Knowing when and how to use it. *Mathematics and Computer Education*, 38(2), 90-199. EJ720423

M.Y. Math Project is a developmental mathematics program that is aimed at: fostering fundamental and problem-solving skills in developmental mathematics students by helping students learn when and how to create and use algorithms; and providing on-the-job training for developmental mathematics instructors through an instructional framework that requires them to develop and incorporate non-traditional instructional techniques. All the developmental mathematics instructors are full-time graduate students. The data supported the success of the program.

Waycaster, P. (2011). Tracking developmental students into their first college level mathematics course. *Inquiry*, 16(1), 53-66. EJ952026

A recent SACS review at the author's institution prompted an assessment of the school's developmental mathematics program. The author needed to examine the effectiveness of the developmental mathematics courses in preparing students for their first college level mathematics course. The author tracked developmental students from their last prerequisite developmental mathematics course into their first college level mathematics course. The author reports the results of the comparison of the success rates of developmental math students to the success rates of non-developmental students in their first college level math courses

Williams, J. & Bryan, J. (2013). Overcoming adversity: High-achieving African American youth's perspectives on educational resilience. *Journal of Counseling & Development*, 91, 291-299. doi: 10.1002/j.1556-6676.2013.00097.x

The purpose of this qualitative multi-case research study was to identify characteristics and factors that contributed to the success of 8 urban, African American high school graduates from low-income, single-parent families. Ten main themes emerged: 1) school-related parenting practices (8 of 8), 2) personal stories of hardship (7 of 8), 3) positive mother-child relationship (5 of 8), 4) extended family networks (7 of 8), 5) supportive school-based relationships (8 of 8), 6) school-oriented peer culture (6 of 8), 7) good teaching (6 of 8), 8) extracurricular school activities (6 of 8), 9) social support networks (3 of 8), 10) out-of-school time activities (4 of 8). These 10 can be clumped into 3 main categories, A) Home Factors includes items 1-4; B) School Factors includes items 5-8; C) Community Factors includes items 9-10. The results suggest the

importance of family, school and community networks playing a role in the success of African American students from low-income, single-parent families. All 8 participants identified school related parenting practices as essential to their academic success. This included verbal praise for good grades, setting high but realistic expectations, monitoring grades, and use of physical discipline in response to bad grades. It seemed to the researchers that this parental involvement acted as a buffer to the external environmental issues. In addition to the family characteristics, all students also had at least one positive relationship with a school official. The students identified these school characteristics: high standards and expectation, challenging curriculum and instruction; extended after school learning opportunities and activities; positive relationships with other resilient students, and well-qualified teachers. Most students also had a strong church or other positive community/social relationship. The combination of effects is interesting in this study. All too often broad generalizations are made and the responsibility for success or failure of a student is laid at the feet of family, school or community. This study would indicate (as common-sense dictates) that responsibility for success is clearly multifaceted and three pronged (family, school and community), not to mention dependent on the fortitude of the student. The weakness of this study is the small number of students included. I certainly hope they try to replicate and refine the results. Also a longitudinal study with this group would be interesting.

Woodard, T. (2004). The effects of math anxiety on post-secondary developmental students as related to achievement, gender, and age. *Inquiry*, 9(1). EJ876845

Math-anxious students complain of such things as nervousness, inability to concentrate, a blank mind, and a feeling of sickness when they are confronted with taking a math test. Educators need to recognize the causes of math anxiety – such as poor math instruction, negative attitudes about math, negative math experiences, and low self-esteem – and work to help students cope with these factors. In this article, the author examines the nature of math anxiety in developmental students and proposes ways to alleviate their worries. Recommendations include implementing prevention and reduction techniques, teachers grading procedures, alternate methods of assessment (oral exams, observations, discussions, journal writing, and allowing for retesting), use of manipulative and other alternate methods of instruction.

Woodard, T. & Burkett, S. (2005). Comparing success rates of developmental math students. *Inquiry*, 10(1), 54-63. EJ876858

Developmental mathematics students are generally students who are at risk of dropping out of school because of various factors. Many are nontraditional students who have jobs and families; others are traditional students who lack the skills needed to succeed in the college environment. Math anxiety, fear, and intimidation often affect developmental math students, who tend to be afraid of technology, math, and college in general. The authors conducted a study on the success rates of developmental math students and examined the effects of the change from three to five credit math courses and of implementing an exit exam. There was no significant difference found in the success rates of any of the developmental courses after they were offered for five credits. This indicates that three-credit courses are just as effective as five-credit courses for developmental math students. When comparing the success rates of all three courses for all students before and after the exit exam, results showed no significant difference in success although success did increase modestly after the exit exam was in place.

Woodard, T. & Burkett, S. (2010). A Follow-up study to compare success rates of developmental math students. *Inquiry*, 15(1), 21-27. EJ876858

This article presents a study that compared the success rates of students in developmental math when they were offered at Southwest Virginia Community College (SWCC) for three credits versus five credits. The authors' findings showed no significant differences in the success rates of students who were enrolled in the three-credit classes and the five-credit classes. As a result of both studies, they recommend that developmental courses be offered for three credits instead of five. Advantages include lower costs to students, fewer scheduling problems, and possibly less burnout for students and teachers. They also recommend that other colleges that offer a variety of credits for developmental courses replicate this study. As a result of the study, SWCC returned to offering the development math courses for three credits in Spring 2005

Zavarella, C. & Ignash, J. (2009). Instructional delivery in developmental mathematics: Impact on retention. *Journal of Developmental Education*, 32(3), 2-4, 6, 8, 10, 12-13. EJ868668

Studies of students enrolled in computer-based instruction have yielded mixed results, with some reporting a high dropout rate. This article describes a quantitative study examining the probability of students' withdrawal from a computer- versus lecture-based developmental math course based on learning style, reasons for selecting the instructional format, and entry test scores. Students in the computer-based format were more (twice) likely to withdraw from the

course compared to those in the lecture-based format, and personal reasons for choosing a specific format appeared to influence completion rates. Students who chose this type of delivery for personal reasons were more likely to succeed compared to those enrolled based on perceived need. Learning styles did not seem to matter. Implications for practice include suggestions for providing appropriate information to students prior to their enrollment in online developmental education courses.

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Woodard, T. & Burkett, S. (2010). A Follow-up study to compare success rates of developmental math students. *Inquiry*, 15(1), 21-27. EJ876858

Zavarella, C. & Ignash, J. (2009). Instructional delivery in developmental mathematics: Impact on retention. *Journal of Developmental Education*, 32(3), 2-4, 6, 8, 10, 12-13. EJ868668