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UNIVERSITY OF CALIFORNIA, SAN DIEGO

Navigating the Transition to College:
First-generation undergraduates negotiate identities and
search for success in STEM and non-STEM fields

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

in

Teaching and Learning

by

Season Shelly Mussey

Committee in charge:

Hugh Mehan, Chair
Barbara Sawrey
Alison Wishard Guerra

2009

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microfilm and electronically:

Chair

University of California, San Diego

2009

DEDICATION

To Mom and Dad

For teaching me to believe

in myself

and others.

I love you.

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VITA

SEASON SHELLY MUSSEY

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- Coordinated school-wide science fair curriculum and events with 100% student participation
- Conducted interviews and collaborated with the school search committee to hire the school's senior academic adviser, and middle school counselor
- Collaborated monthly as a member of the Preuss School Education Committee to review current school curriculum and instruction: including course sequencing, and scaffolds used to support all students in the rigorous academic program offered at the school
- Participated in Scripps Research Institute as teacher intern; collaborated with graduate students in biology and chemistry to design curriculum for high school science students
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Cohen, D., **Mussey, S.**, & White, D. (2007). Criteria for Analysis of Math and/or Science Texts. Unpublished paper written under supervision of G. Harel. University of California, San Diego.

Mussey, S. (2007, March 30) *Evaluating Evolution: On concept v. belief*. Presented at National Science Teachers' Association Annual Conference. St. Louis, MO.

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- Served as teacher ambassador for Sally Ride Science 2007-present
- Started Middle School Science Club at the Preuss School UCSD 2007-2008 to increase underrepresented girls' and boys' interest in science
- Volunteer and Mentor for the Leukemia and Lymphoma Society's (LLS) Team in Training program, raised money for LLS, volunteered from 300-500 hours per year 2005-present

ABSTRACT OF THE DISSERTATION

Navigating the Transition to College:
First-generation undergraduates negotiate identities and
search for success in STEM and non-STEM fields

by

Season Shelly Mussey

Doctor of Education in Teaching and Learning

University of California, San Diego, 2009

Hugh Mehan, Chair

Historically, racial and ethnic minority students from low income backgrounds have faced unequal access to colleges and universities. Recently, both K-12 and higher education institutions, specifically the University of California, in response to Proposition 209, have made efforts to increase access and opportunities for all students. Similarly, female minority students are underrepresented in selected science, technology, engineering and math (STEM) majors and careers. Using a qualitative research design, this study investigates how first generation, low income, underrepresented minority students who graduated from an innovative college preparatory high school enact coping strategies that they were explicitly taught to achieve success within the context of university science and math courses. The

presence of a unique, college-prep high school on the campus of UC San Diego, which accepts exclusively low-income students through a randomized lottery system, creates an unusual opportunity to study the transition from high school to college for this population, a cohort of underrepresented students who were taught similar academic coping strategies for success in college.

This study aims to understand how students develop their college-going, academic identities within the context of their colleges and universities. Furthermore, this study intends to understand the phenomenon of “transition to college” as a lived experience of first-generation, low income, minority students, who all share a similar college preparatory, high school background. The main research questions are: 1) How do underrepresented students experience the transition from a college preparatory high school to college? 2) How are students developing their college-going, academic identities in the context of their educational institutions? and 3) What factors support or constrain student participation and success in college science courses?

Twenty-eight students participated in this study. Based on surveys and individual interviews with the participants, twenty student narratives were written and analyzed. The students’ narratives provide a picture of how these underrepresented students are experiencing the transition to college. In this sample, five factors impact the students’ college-going academic identity development, major choice, and career path:

- 1) college preparation in high school, 2) self-efficacy, 3) success in college academics,
- 4) affinity group participation, and 5) interaction with college faculty.

Chapter 1 – Introduction

Introduction: The Transition to College “It’s not all fun and games.”

At the 2009, National Science Bowl in Washington DC, the Secretary of the United States Department of Energy, Nobel Laureate, Dr. Steven Chu, addressed the nation’s brightest science and math students. Dr. Chu encouraged middle school and high school students who were competing in the Science Bowl to stay in the sciences. He revealed to the students the potential challenge that the transition from high school to college science may bring. “It is not all fun and games,” he told the students (Chu, 2009). He assured them, however, that the end result, the ability to conduct scientific research to the benefit society would make the “pain” of college worth it. Dr. Chu may be correct in his assessment of the difficulty involved in transitioning from high school to college science. In fact, many students decide to leave the sciences during this “painful” transition (Seymour & Hewitt, 1997). Using a qualitative research design, this study aims to help us further understand the high school to college transition period as well as the structural and cultural conditions at our nation’s colleges and universities that both support and constrain students’ success in college science, technology, engineering, and math (STEM) fields.

Advancements toward Equity and Excellence in Teaching and Learning

“We believe all students can learn.” This philosophy is touted in American schools and districts’ mission statements from California to the Carolinas, in public and private schools alike (San Diego City Schools, 2009; Greenville County Schools, 2009).

Due to the advancements made in understanding about human learning, fulfilling this espoused mission of teaching all students has become a reasonable goal. Today, we know how teachers and schools can both support and constrain student learning. Behind the *belief* that all students can learn is the *ability* to teach subjects such as science, mathematics, history, and literature in ways that make it possible for all learners to develop a deep understanding of any discipline (Bransford, 2000). By applying this new knowledge about human learning to teaching practices, schools can potentially teach all learners. In this type of teaching and learning utopia where any subject matter is accessible to all learners, it would truly be possible for students to major in and be successful in any discipline which inspired them to make contributions to the world. In this hypothetical learning context, a child, regardless of who they are or where they come from, could truly become anything that they wanted to be. American schools' dreams of achieving both equity and excellence would be realized.

Best Practices Unrealized: Unequal Outcomes for Students

Considering the advancements in our understandings about theories of learning and insights that have been provided by educational researchers as to how to apply this knowledge to develop best practices in schools, it is problematic that some students still have an advantage in terms of educational access and opportunity. Even though we have made strides in increasing college access and opportunity for all students, as evidenced by increased college enrollment rates for all groups (Bowen, Kurzweil, & Tobin, 2005), the achievement gap still exists.

The presence of both a class- and race- based gap in educational achievement is not news. The fact that this gap impacts college enrollment rates for low income and minority students does not come as a surprise. However, considering the advancements that we have made in understanding student learning, why aren't we seeing a dramatic decrease in the aforementioned gap? Given that research-based, best practices are being implemented in school reform efforts and being taught to the next teaching generation in teacher education programs at our colleges and universities, why aren't schools accomplishing their missions? It seems improbable that the gap should continue to exist and even widen, however, findings from the National Educational Longitudinal Study suggest that the role of family background in determining enrollment in college seems to have increased over time (Bowen, Kurzweil, & Tobin, 2005). The trend of unequal outcomes for students continues as minority children from lower socioeconomic backgrounds stay disadvantaged. The potential effects of our best practices remain unrealized.

College enrollment rates are not the only manifestation of a gap indicating unequal educational outcomes for students. Women and ethnic minority groups are also underrepresented in certain science, technology, engineering, and math (STEM) college majors (National Science Foundation, 2005) and careers.

For example, of the 409,326 undergraduates enrolled in STEM related majors in the United States in 2005, only 70,579, roughly 17 percent, were female. In 2005, 28,712 men earned STEM related degrees while only 19,587 women received the same (National Science Foundation, 2005).

According to the Bureau of Labor Statistics (2007), women in the United States fill only 11% of the total engineering occupations, 26% of mathematical and computer science occupations, and 41% of biological science related occupations. Similarly, traditionally female jobs, such as nursing and K-12 teaching positions are overwhelmingly occupied by females.

Overrepresentation of any group, in this case, white males, in a science field, may limit perspectives needed to solve the complex problems of our modern world. Underrepresentation of any group due to unequal educational outcomes seems contrary to the goals of 21st century schools.

Positionality: Best Practices in Action

Fortunately, my interest in this topic reaches beyond the mere vision of equity for students. I teach at a unique, college-preparatory charter school on the campus of UC San Diego, enacting the mission of preparing low income students to be the first in their families to enter college and major in the discipline of their choice. Everyday, my colleagues and I implement research-based, best practices in our classrooms. Approximately 83% of our students are admitted to four year colleges and universities, a testament to the effectiveness of best practices on student achievement. I work daily to increase access and opportunity for traditionally disadvantaged students by preparing them for college. This school, The Preuss School UCSD, offers a rigorous, college preparatory curriculum with the scaffolds in place to support all learners.

Teachers and administration at the school provide scaffolding to support learners' success. Some scaffolding involves explicitly teaching academic coping

strategies to students. Examples of these coping strategies include note-taking skills such as Cornell notes, time-management skills, including the use of a planner, and organized study groups including weekly structured practice of math skills and silent sustained reading. Departments work to vertically align the curriculum which supports students' preparation for the Advanced Placement (AP) courses that they are required to take in high school. Participation in the AP curriculum and the testing process helps to expose students to the rigorous work-load that they will encounter in college.

Beyond individual strategies, students are also engaged in an advisory class, a cohort of 25-30 students and one teacher. The advisory cohort of students and their teacher ideally work together yearly from 6th through 12th grade. The advisory teacher teaches a class called University Prep, yearly. During the class, students work collaboratively with the teacher and with other students for approximately 4 hours per week. During this class time, students are developing both literacy and numeracy skills. They are also studying the curriculum from their content courses. As part of the University Prep curriculum, students are required to form study groups during a structured tutorial time.

Beyond academics, advisory students, teachers, and parents work together through the process of preparing for and applying to college. For example, in the junior and senior year, students participate in formal and informal SAT and ACT preparation and practice. During the senior year, students spend some time in advisory writing personal statements for college applications, preparing for college interviews, and applying for financial aid, FAFSA, and scholarships.

The advisory program, a system of intensive academic and social networks, supports both the rigorous curriculum and the college going school culture. Advisory teachers work closely with families to ensure students' success. The above aspects of the advisory program provide what Oakes (1990) calls the critical conditions necessary to increase students' access to college. These conditions coupled with safe and adequate school facilities and highly qualified teachers are the conditions that all of the students at the UCSD charter school, The Preuss School UCSD, experience.

My participation as a science teacher at this institution, which was designed to address issues of equity and excellence in education, influenced my decision to conduct this study on the transition to college for underrepresented students. I hope to understand how students who learn in a best-practices rich, college-preparatory environment achieve at their colleges and universities. In this study, I critically examine post-secondary learning experiences and contexts from my students' perspectives. Beyond looking at the transition to college experience in general, I investigate students' science and math learning experiences at their institutions.

My review of current educational research will allow me to conduct this examination through the lens of current theories on teaching and learning. The results of my analysis will provide educational researchers and teachers with implications for both policy and practice at the K-12 and the college level. Findings from this study will also allow us to understand more about the nature of teaching and learning in college contexts for students and the various strategies that students are employing to

find success in the midst of the existing structural and cultural components of the institutions that educate them.

Study Overview: Transition to College for Students

Using a qualitative research design, this study aims to help us further understand the structural and cultural conditions at our nation's colleges and universities that both support and constrain students' college academic identity development and success in college academics and college life.

Combining a phenomenological approach with Gee's (2000) treatment of identity as an analytic lens in educational research, I can understand students' perceptions of their educational success as they transition from high school to college. By answering the following research questions, I will contribute to our understanding of factors that influence student decision-making in college. My specific inquiries into students' science and math experiences will inform us as to which factors lead to retention or attrition in science and math majors.

Research Questions

- 1) How do underrepresented students experience the transition from a college preparatory high school to college?
- 2) How are students developing their college-going, academic identities in the context of their educational institutions?
- 3) What factors support or constrain student participation and success in college science courses?

The purpose of this study is to understand how underrepresented students' participation in a rigorous college preparatory educational program influences their participation, and academic and social behaviors in college. My background as a science teacher and my interest in the problem of the underrepresentation of gendered and ethnic minorities in STEM fields has influenced my decision to use undergraduate science classes and cultures as a context for this study. Therefore, the specific aims of this project are to investigate and understand what strategies and behaviors first generation, low income, underrepresented minority females and males who graduated from a college preparatory high school use to achieve success within the context of the university science culture and to understand how they perceive their academic identity formation within the context of different types of colleges and universities – from small, private liberal arts colleges to large R-1 universities. I want to know what aspects of their cultures and historical experiences influence their participation in their current realities and how they make sense of the intersection of their ethnicities, genders, socioeconomic statuses, and cultures with the academic and social expectations at the university, specifically in their science classes.

Chapter 2 – Equity and Excellence in Education: What We Know

In order to place this study within the context of extant scholarship, I have reviewed literature on current best practices in providing equity and excellence in education. In the following sections, I will discuss how research about college preparation and transition to college, academic identity development, and science teaching and learning can provide a theoretical framework in which to embed this study. This research study was designed to fill a niche where these fields intersect, an area that has not been fully explored and understood. We know little about how preparing underrepresented populations for college directly influences their participation and success in their undergraduate institutions. The results of this study will inform how we can better prepare historically underrepresented groups for college, potentially increasing their access to and opportunities for participation in science and math majors and careers.

Theoretical Perspectives

I combine constructivist and feminist paradigms to inform my study. I look through these lenses at studies of students' identity and science learning.

Constructivist Theories of Teaching and Learning

Constructivism focuses on the analysis of how people construct social meaning and reality (LeCompte & Preissle, 1993). Major assumptions underlying this theoretical perspective include the following:

- 1) Meaning is constructed through social interaction.
- 2) Individuals act on the meaning that is perceived.

- 3) Meanings change in the course of interaction, therefore meaning and reality are not fixed.

Vygotsky (1978) provides the foundation for constructivist theories of learning and teaching which help me frame my research. Vygotsky claims that all learning is social.

Every function in the child's cultural development appears twice: first, on the social level, and later, on the individual level; first, between people (interpsychological) and then inside the child (intrapsychological). This applies equally to voluntary attention, to logical memory, and to the formation of concepts. All the higher functions originate as actual relationships between individuals (Vygotsky, 1978).

Learning is a complex social process affected by variables such as culture, society, and language (Vygotsky, 1978).

External experiences, such as making observations, interacting socially, or communicating, result in internal development (Wertsch & Stone, 1985). Because the external processes and internal processes are not identical, the link between them is complex. External processes transform and create internal processes like consciousness, internal dialogue, and thinking (Wertsch & Stone, 1985). Humans incorporate the knowledge into their schema once external processes are internalized. Learning occurs during this internalization process.

Social interactions and experiences are powerful variables to explore when attempting to determine how and when learning occurs. In order to understand the implications of social interactions in the learning environment, researchers can explore the roles of student participation in individual versus group learning activities, as well as student participation in communities of learning.

We often learn in social contexts where learners have opportunities to work collaboratively under the guidance of experts. Vygotsky (1978) called this principle of learning the Zone of Proximal Development. This principle describes the idea that with guidance, learners can reach potential levels of development. Therefore, social interaction enhances learning.

In order for social interaction to have positive effects on learning, the individuals engaged in the interaction must have developed some shared language and cultural understandings. This intersubjectivity, shared meaning, developed through language and cultural understanding, enables efficient learning to occur (Wertsch & Stone, 1985).

Tharp and Gallimore (1988) call for both a redefinition of teaching and schooling where we move beyond the traditional mode of teaching as mere recitation, and move towards teaching as *assisting performance*. In an assisted performance model of teaching, students will be experiencing learning at school as it occurs during informal socialization in social and cultural contexts at home, a strategy of learning that they have already *internalized*.

Vygotsky (1978) first talked about this process of internalization as a movement from the external plane to the internal plane. This is learning defined, the transfer of a concept or process introduced through social interaction from the social to the psychological plane (Tharp & Gallimore, 1988). The social process of learning can be facilitated through teaching by assisting performance.

The difference between students' assisted performance and their independent performance is a zone which Vygotsky (1978) referred to as the Zone of Proximal development (ZPD). Assistance through the ZPD by an adult or more capable peer is the optimal strategy for teaching according to Tharp and Gallimore (1988). The ZPD can be understood in four stages.

In Stage I, the performance is assisted by more capable others. The students may not even understand the task in the same way that the adult understands the task. However, through language, the student begins to understand the purpose of the task. The more capable "other" assists the learner through scaffolding the activity. As the learner moves through the zone, the responsibility for performing the tasks shifts from teacher to learner. In Stage II, the student carries out the activity without assistance, with the help of self. In Stage III, the performance has been automatized, it is no longer developing; it is developed. In Stage IV, the de-automatization of a performance leads the learner back to through the ZPD. This may occur when a performance is being improved or maintained.

There are six ways to assist performance: modeling, contingency management, feeding back, instructing, questioning, and cognitive structuring. If we are studying the ZPD, we must consider not just the student and the adult, but also the social context where the learning is occurring, activity settings.

Feminist Theory

Feminist theory focuses on how gender influences our perceptions and participation in society. Gender studies, including studies on feminist epistemology,

seek to understand how gender impacts knowing and knowledge construction, including understanding how gender inequalities are constructed and perpetuated in society.

Historically, feminist theorists have sought to understand how dominant culture disadvantages females by excluding them from inquiry, denying them authority as knowers, devaluing feminine cognitive styles, or ways of knowing (Belenky, Clinchy, Goldberger, & Tarule, 1990) and producing theories that represent them as invisible or inferior.

Critical Race Feminism

Critical frameworks including critical feminist and critical race theories are based on assumptions that reality is constructed through societies' cultural, political, social, economic, ethnic, and gender values (Wing, 1997). Although feminist theories have been criticized for excluding minority groups, in the case of science education, critical feminist research has been important in establishing the significance of attending to gender issues that may increase access to STEM fields for women (Keller, 1985). However, given the particularly low participation of minority women in STEM, perhaps a more complete framework must be used to understand identity development for these groups. Recently, scholars have begun to use critical race feminism as a lens through which to understand the intersection of class, race, and gender for individuals in contemporary society. For example, understanding the underrepresentation of minority women in science may be best understood by studying the experiences and identity development of low-income, minority females in science learning contexts

(Brickhouse & Potter, 2001). In this chapter, I will present some of this work in an attempt to delve more deeply into the intersection of gender-, class- and ethnicity-based minority status for students in science education.

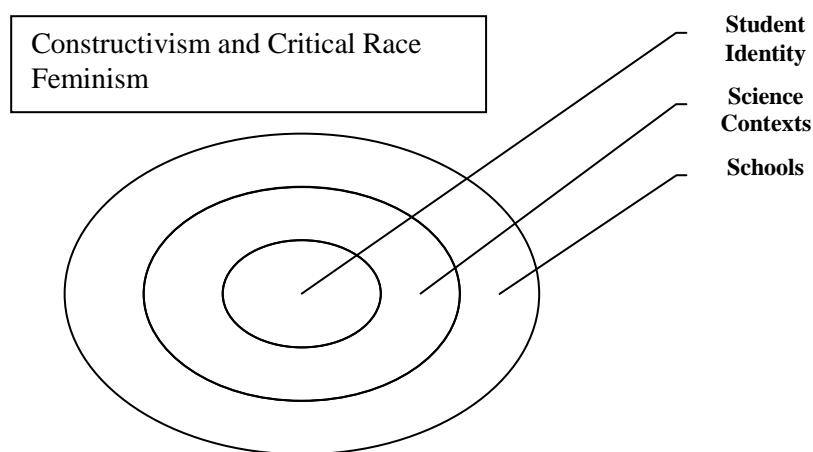


Figure 2.1: Theoretical Framework

Learning and Identity Development

Society is the context in which schools are embedded, and schools are the context in which individuals develop their identities. Therefore, it is heuristic to examine the literature on adolescent identity development in the context of science education. It is within this domain that female and male students attempt to construct academic, gendered, and ethnic identities while simultaneously trying to “become” scientists. Identity development through that process of becoming is central to learning (Lave & Wenger, 1991; Brickhouse, 2001). Integrative models can be used to understand adolescent identity development within school contexts (Belenky, Clinchy, Goldberger, & Tarule, 1990; García Coll, Lamberty, Jenkins, Pipes McAdoo, Crnie, Wasik, & Vazquez Garcia, 1996; Carolene & Johnson, 2007; Johnson, 2001, Gee, 2000).

Identity is crucial to learning. In fact, according to Lave and Wenger (1991), learning is a process of becoming. Therefore, as students transfer identities or aspire towards a certain identity, they will decisively learn the skills and knowledge required by that identity. Students enter into science class with multiple social identities based on race, ethnicity, class, gender, and age. Whether or not these identities are compatible with science identities will partially determine students' success in science classes. What and how people learn is task driven and socially situated. For instance, technology workers with no college education can perform at high levels comparable to an engineer when they are task driven and socially oriented into the task.

Theories of Identity Development

Erikson (1968) describes the stages of human development from infancy through adolescence and into late adulthood. For adolescent development he describes the process of identity development and role confusion as well as the struggles adolescents face while simultaneously dealing with the social stress of peer pressure. Perry's work (1968) builds on the pioneering efforts of Erikson by describing both intellectual and ethical development for college students in the 1950's and 1960's. After interviewing students at Harvard throughout their college careers, he developed a scheme of nine stages of intellectual and ethical development describing students' ways of knowing and learning in their college contexts. Perry begins by describing how students in the early stages of intellectual development accept knowledge from authority figures, rarely questioning teachers or leaders. This form of knowing is dualistic in nature. Students receive knowledge and accept absolute truths. In these

stages, the world is viewed in black and white. Most students reach the next stages in development when they are confronted by multiple “rights” or conflicting views of the world received from different authorities. This can be an exciting time for learning as students begin to accept or understand knowledge as subjective. Unfortunately, some students get stuck in these stages, adopting a view that there are no absolute truths and the only thinking that matters is their own. When students move beyond this stage, they enter a stage of relativism in which they start to understand their thinking as taking a certain point of view in a given context. The final stages mark a shift into ethical developmental stages where students commit to certain viewpoints or stances in the world. These commitments influence students’ conceptions of their identity. In these stages, students start to understand knowledge as constructed.

Perry’s study has endured much criticism, namely the lack of inclusion of women and minorities. In 1990, Belenky, Clinchy, Goldberger, and Tarule complicated the Perry scheme with a contribution to understanding intellectual identity development for women. By conducting 135 interviews with women, the authors wrote about five ways of knowing through which women perceive themselves and the world. These stages are similar to the Perry scheme with some notable differences. In the first stage, called “silence,” women receive knowledge from authority and struggle to develop their own identities outside of perceived stereotypes. In the next stage, called received knowledge, women receive and reproduce knowledge, but still have difficulty conceiving of their own identity outside of an identity given by an authority. In the third stage, called subjective knowledge, women

start to understand that truth and knowledge are conceived in a personal, private, and intuitive way. In the fourth stage, called procedural knowledge, women rely on objective procedures for obtaining and communicating knowledge, and finally in the fifth stage called constructed knowledge, women view all knowledge as contextual. In this final stage women can conceive of themselves in relation to their world contexts. The Belenky et al study has been criticized because of the case study methodology.

Both the Perry and the Belenky et al work focuses on intellectual and identity development for college students without much attention to the issues at the intersection of social class, race, ethnicity, and gender for students in these learning contexts. In 1996, Garcia Coll, Lamberty, Jenkins, Crnie, Wasik, and Vazquez Garcia proposed an integrative model for the study of developmental competencies in minority children. The authors argue in favor of this model because of the absence of research that focuses on normative development of minority adolescents. They also criticize mainstream research for focusing on outcomes rather than processes of development for minority children. With their model, they hope that researchers can move away from mainstream notions of studying difference and deficiencies in minority children and move towards studying eight constructs which they believe influence developmental processes for minority groups. The model begins with understanding the social position variables such as race, class, ethnicity, and gender which stratify individuals in our society. The assumption that individuals are placed in a particular position due to these defining characteristics is a foundation of this model. The authors propose that individuals, based on their social position variables,

experience racism, oppression and segregation which influence promoting or inhibiting environments in schools. Students' experiences in social institutions such as schools help them to define their adaptive culture which then influences their family relationships. Those relationships along with the child's characteristics, such as age, ultimately determine a child's social and cognitive developmental competencies and identity. In order to accept this model and use this model in educational research, one assumes that the developmental process begins with the original social position variables, variables that are associated with degrees of segregation in society. This model may become less useful when individuals experience forces which work against oppression, such as innovative reform efforts in education. Another assumption and a source of criticism of this model is the notion that individuals place themselves in a hierarchical position in society based on these social position variables. This negates the individual's experience and perspective of their own self-efficacy or natural identity. Both of these criticisms can be addressed by a modified model of understanding multicultural identity development in unique school contexts, one which incorporates an individual's understanding of their own natural (social position) and institutional positions.

Gee (2000) provides us with such a model for understanding identity in educational contexts. Gee (2000) describes identity as being recognized as a "kind of person" in a given context. He discusses four ways to view identities: as a natural state, as a position, as an individual trait, or as a collection of experiences. Each of the four identities can develop from different processes. Table 1.1 depicts both the identities

and processes from which these identities develop. Gee suggests that identity can be used as an analytic lens in educational research. Using Gee's categories of identity, we may begin to understand the intersection of race, ethnicity, gender, and class for students in learning contexts. Gee's model also allows us to understand students' conceptions of their own academic identity development.

Table 2.1: Categories of Identity

Ways to View Identity	Gee's Categories	Process
1. As a natural state	Natural Identity	Developed from forces in nature
2. As a position	Institution Identity	Authorized by authorities in institutions
3. As an individual trait	Discourse identity	Recognized in the discourse of rational individuals
4. As a collection of your experiences	Affinity identity	Shared in the practice of affinity groups

Adapted from Gee (2000).

In this study, I use Gee's description of identity development as a construct in which to understand college students' academic, college-going identity development as they interact with affinity groups across and within their natural and institutional identities.

Identity formation is a complex process during which the individual engages in a variety of mental functioning involving reflection and observation. An individual's identity is in part a reflection of how one perceives others' observations of him or her (Erikson, 1968). Erikson (1968) says that identity is embedded within social, cultural and historical contexts. The concept of identity encompasses one's past, present and future, as well as one's race, class, gender, and many other aspects of self. In fact,

people usually have multiple identities. One thing to note is that when asked to describe oneself, an individual often does not include aspects of self which are consistent with the dominant culture. For instance, a white person may not identify ethnicity as part of their identity (Tatum, 1997). A white person may not even be conscious of his or her own whiteness. Erikson says that this phenomenon can be explained by the fact that there is no dissonance between one's self and the dominant culture. When harmony exists, consciousness does not. Identity can be a reflection of what the dominant culture sees in us. We often highlight differences between ourselves and the dominant group as aspects of our identity. Unfortunately, these differences can often make us feel isolated and subordinate when working with members of the dominant groups, members who do not reflect our own identity (Tatum, 1997). One such example may include minority females' feelings of isolation in a male dominated science context.

In cases such as these, individuals may resist interaction with members of the "other" group. In classrooms, this resistance can lead to what Tatum calls "not learning". Identities can enhance, interfere with, or remain neutral in the act of learning. When the student feels as though their identity is not valued or that they are subordinate to the dominant group, they may rebel by purposefully "not learning" (Tatum, 1997).

When students feel disconnected from the teacher, content, or coursework because of conflicting identities, it can be disastrous for the learner. This disconnect often happens in science classes. Take into consideration an African American female

from a lower socioeconomic status who perceives scientists as a white, middle class, and male. This particular student may resist interactions with scientists and science in general if she feels too much difference between scientists' identities and her own. Science may become a foreign culture to her, and scientists and possibly even science teachers can be seen as foreigners. Unfortunately, this is not merely a hypothetical case. Many students do feel as though science class and science in general is a foreign culture to them (Aikenhead, 1996; Costa, 1995). Existing in the science class as a foreigner may disable learning opportunities. Occasionally, though, a student such as the African American girl mentioned above navigates through the foreign land and cultural distinctions between herself and her perception of scientists and crosses over to a culture different than her own.

Aikenhead (1996) calls this movement cultural border crossing. Brickhouse, Lowrey, and Schultz (2000) have documented successful cases of border crossing among low income, African American females and attribute their success to the students' own perceptions of their identity. In order for students to successfully perform academically in a different culture, they must become a part of that culture. In other words, they will be successful if they do not perceive a difference between their own culture and the classroom culture. They may also become successful if they possess the skills and abilities that enable them to resolve conflicts between the new culture and their own. As anthropologists have noted, not all members of our society and certainly not all students in our schools possess the necessary conflict resolution skills to negotiate this cultural border crossing.

Costa (1995) describes four categories of students in science classes. The success of these science learners depends on the congruence of their identities with scientific culture. The "potential scientists" are students whose identities of self do not conflict with the identity of a scientist (Costa, 1995). In a study of science identity development among middle school girls, Brickhouse and Potter (2001) provides an example of the 'potential scientist' by describing a good student with an interest in science. Costa's other categories include: the outsiders, the impossible category, and the 'I don't know' group. If a student's identity does not match with the science identity, as in the case of the impossible group, a student may not be able to cross the border into science success. Border crossing becomes easier as the degree of cultural separation decreases. Students' ability to transition from one culture to another is also dependent on the institutional support that they receive, and their own sense of self-efficacy.

Self-Efficacy and Identity Development

Self efficacy, or how people perceive their own capabilities, can impact student achievement, emotional outcomes, and identity development for students. Studies by Bandura (1982) indicate that the higher the perception of self-efficacy, the greater the achievement outcome for individuals in various contexts. Perceived self-efficacy is a person's belief about their ability to react appropriately and even be successful in certain situations. Percepts of self-efficacy include people's beliefs in their ability to integrate their cognitive, social, and behavior capabilities in order to orchestrate a desired outcome. For students in college, perceived self-efficacy can impact students'

academic, social, and behavior outcomes. Bandura (1977) tells us that people will avoid activities that they believe exceed their capabilities and perform well in activities that they believe they can handle. When people believe that they do not possess the coping capabilities which would allow them to handle a given situation, they may choose to leave that situation. Conversely, when students feel that their coping capabilities can manage a particular event, they will persist through the event, even overcoming initial obstacles that they faced. Understanding the importance of self-efficacy can help us understand retention and attrition rates for college students.

Students with a strong sense of self-efficacy approach difficult tasks such as graduating from college as a goal to be attained rather than as an intimidating threat or unattainable challenge. Students with a strong sense of self-efficacy respond to setbacks with resilience, changing their course of action, and overcoming obstacles. Self-efficacy results from experiences overcoming obstacles, observing social models of success, being socially persuaded, and experiencing reduced levels of stress (Bandura, 1994).

For college students in STEM fields, the sense of self-efficacy becomes increasingly important as they encounter their first challenging academic courses, often in the first semester of their freshman year. When students believe that they can succeed, they will persist through the challenging courses. Students who believe that they will fail may withdraw from a course, and even change their major, switching into a new major, one that seems more manageable. In this way, perceived self-efficacy can influence career choice. Women especially may be affected by low self

efficacy beliefs as they attempt to penetrate fields formally designated or dominated as ‘male domains.’ (Hackett & Betz, 1997). As low-income and minority groups gain more access to education and career opportunities once dominated by more affluent and dominant groups, self-efficacy is an important determiner in success. For this reason, promoting self-efficacy beliefs may be an important and strategic intervention (Brown, 1999) for women, low-income and minority populations if we hope to increase diversity in the STEM fields (Brown, 1999).

Seymour and Hewitt (1997) have observed the effects of low self-efficacy on retention in science, math, and engineering majors in college. Their findings show us that students who leave science, math, and engineering majors often talk about their own lack of academic abilities as the cause for leaving. They feel that they are not successful due to their own innate abilities. Students who persist in science, math, and engineering majors often perceive external causes as the reasons that they are struggling.

In learning contexts, the notion of self-efficacy becomes complicated as it relates to both motivation and effort. Learners who perceive they have high capabilities may become unmotivated in contexts they consider to be “easy.” In these cases, they may stop putting forth the effort needed to learn (Bandura, 1982). On the other hand, in challenging learning contexts highly self-efficacious individuals feel motivated and therefore will put forth the effort needed to learn. Academic achievement outcomes generally reflect effort, so there are occasions when even people with high self-efficacy percepts may achieve poor academic outcomes.

Conversely, learners who perceive themselves to have less self-efficacy may give up in challenging environments, reducing the amount of effort that they are putting forth. These students may put forth more effort in less challenging learning contexts where they believe they can be successful (Bandura, 1982).

Findings about self-efficacy in learning contexts have strong implications for classroom teachers, and make a strong case for differentiating instruction at all levels, including higher education. In large lecture halls, such as those prevalent on both R-1 and other large public university campuses, it seems unrealistic to find many examples of differentiated instruction. There are cases of differentiated instruction present in other institutional support programs, including some undergraduate apprenticeship programs.

Undergraduate students participate in research apprenticeship programs that help socialize them into the professional community of science researchers. The major benefit of this affinity group affiliation is the students' science identity development. According to Hunter, Laursen, and Seymour (2006), students involved in undergraduate research apprenticeship programs see themselves as engaged in the process of "becoming a scientist." In an ethnographic study of a summer undergraduate research program at four liberal arts colleges, Hunter et al found that students who engaged in collaborative work with scientists and other students have positive perceptions of their personal and social development, as well as development of their professional identity. Faculty involved with these same projects see the importance of students' participation as a way to socialize them into the sciences. This

study exemplifies situated-learning (Lave & Wenger, 1991) and communities of practice being developed at the university level. Results of this study indicate that students who engage in major-related affinity groups through apprenticeships or by developing personal relationships with professors at their undergraduate institutions form more positive academic identities related to STEM, and will be more likely to participate in STEM fields in the future.

Hunter et al (2006) large scale study included over 300 interviews which translated into over 13,000 pages of transcribed text. From the student perspective, benefits of an apprenticeship program included being able to: think and work like a scientist, become a scientist, clarify professional goals, and gain other skills. From a faculty perspective, benefits of the program were similar to what the students perceived. The only difference was the faculty's emphasis on the program as a socializing agent. The apprenticeship model, according to the faculty, also helped students understand how the process of science occurs.

Unfortunately, this study sought to compare student and faculty perspectives only. The results showed, overwhelmingly, that engaging in undergraduate research using a cognitive apprenticeship model is a positive step in helping students become scientists. Unfortunately, the authors do not discuss the kinds of students who were so easily socialized into the role of the scientist. The authors do not report on an analysis of differential outcomes by gender or ethnicity, nor do they address the socially constructed nature of science.

In another study of the science experiences of 15 successful women of color, Carolene and Johnson (2007) develop a model of science identity that can be used to understand how participants make meaning of their science experiences. According to researchers in science education, three arguments exist for using science identity as an analytic lens (Carolene & Johnson, 2007). First, using sociocultural theories of learning and the identity lens helps us to understand teaching and learning in the science environment (Vygotsky, 1978; Lave & Wenger, 1991) as well as the people marginalized by science teaching and learning practices. A second argument for using identity as the analytic lens involves viewing the learning process as the socialization into the norms and discourses of science (Hunter et al, 2006). Finally, using identity as a lens helps us increase equity in science education by enabling us to broaden the traditional, narrow definition of science identity, a definition that does not appeal to all students (Eisenhart & Finkel, 1998). According to Carolene and Johnson (2007), three main factors influence the development of science identities: performance, competence, and recognition. They find that recognition by others is the most important determinant of science identity pathways. Students recognized positively by “scientific” others develop research scientist identities. Students recognized negatively by “scientific” may develop altruistic science identities or disrupted science identities, depending on their ability to adapt their own conception of a science identity. These findings illuminate the importance of context, participation, and recognition by professors and more capable peers for women interested in science majors and careers.

Feminist studies and science identities

Feminist studies tell us that girls are socialized into certain role expectations and behaviors. Socially constructed expectations may interfere with girls' attitudes, beliefs, perceptions, and achievement in science class. For example, young girls often focus on pleasing the teacher, which implies that girls follow the rules. On the contrary, boys, stereotypically try to stretch the rules, bend the rules, and even break the rules. Eventually boys may even invent new rules of their own. Inventing rules, ideas, and even procedures become central aspects of scientific thinking and progress. Boys may come into the science class with more practice at scientific thinking than girls. Girls may be reluctant to exercise their inventing muscles at all. While socially accepted roles adopted by boys and girls before they even enter a science classroom can affect how they engage in the class, a problem generated from social norms can be fixed. Norms can be adjusted, and society can change, grow and adopt different expectations.

Perhaps crucial to the progress of removing limitations for individuals based on society's gender expectations is a glimpse at the trailblazers, girls and women who have paved a way into the once completely male dominated fields and disciplines. We could look at the famous trailblazers of yesterday, Marie Curie, Elizabeth Blackwell, Barbara McClintok, and Margaret Mead. How did they contribute? What obstacles did they face? We could also look at the modern greats, such as Jane Goodall and Sally Ride. What is it like to pave the way today?

Brickhouse, Lowrey and Schultz (2000) opted to look even deeper by creating detailed personal profiles of four minority female students who have been successful at the “cultural border crossing” (Aikenhead, 1996) mentioned earlier. Brickhouse et al (2000) selected four African American girls in middle school for their study. Their research participants did not fill the culturally-created mold of a scientist, yet were still interested in science. These young students followed a path towards becoming a scientist, deviating from more traditional paths taken by African American women (Brickhouse, Lowrey and Schultz, 2000). The authors of this study wanted to know how the girls’ self constructed identities intersect with standard science identities. Findings from this study suggest that how students engage in science depends on whether or not they think they are the kind of person who engages in science.

In an earlier study, Brickhouse, Lowrey, and Schultz (2000) tested the hypothesis that in order for students to learn science, they must develop identities compatible with scientific identities. Brickhouse et al (2000) focused on the socially situated construction of individual identity formation. In order to understand the participants’ identity, the researchers made observations and collected journals and interviews, since describing someone’s identity requires indirect interpretations of data.

The results of this study are interesting, particularly because the students’ in the study possess similar social position variables but experience differential educational outcomes. The participants include African-American girls from similar backgrounds who formed different academic identities. One of the students took on the role of a high-achieving student. She was very quiet and industrious in class and

never disobeyed the teacher. She earned an “A” average and entered the honors track in high school. The other student, while interested in science outside of school, only engaged in school science when she considered the instruction to be good. At school, she took on the identity of an athlete and social leader. A third student had significant experiences with hands-on science outside of school working with her dad, a mechanic. This student liked doing labs in science. Her identity was in constant flux depending on the audience. The final student, a loud and social African American girl, did not like science. She was more interested in peer relationships and being a “people-person” than engaging in science. Results of this study tells us that students who take on the “good-girl” role in school or the “social-butterfly” role, easily identifiable, traditionally “female” roles, are responded to most positively by teachers. Girls who like science outside of school, and prefer hands-on science activities, more commonly associated with male roles, are less positively responded to by teachers. This study speaks to the importance of “promoting” social environments as suggested by Garcia Coll et al’s model of competency development in minority youth.

In a second study on young women’s identity formation in urban contexts, Brickhouse & Potter (2001) selected two young African American females as case studies. Brickhouse and Potter found that the students’ identities helped them respond to their experiences in science contexts. Both young women experienced marginalization during participation in school communities of science practice. For example, one African American student felt isolated in her predominantly white honors class. She was a minority in the college prep track at her high school. In

response, she changed programs and joined a vocational track, where she found herself unsuccessful in a computer program. Ultimately, even though she was a model science student in middle school, she entered into the business program where she felt more comfortable. The other case study illustrates a student who was a mediocre science student in high school. As an African American student from an urban environment, she was in the majority at the vocational school where she excelled in the computer program. Results of this study suggest the importance of students feeling that their personal, gendered, and ethnic identities are compatible with their academic identities. When these identities are not aligned, conflict occurs. In the one case, where identities conflicted, a student switched out of the college preparatory track and stopped studying science. In the other case, where identities were aligned, the student excelled in the science context. These results are important to keep in mind as I examine young women's science identity formation in the context of science culture at large public universities. Perhaps students with different self-efficacies or different affinity group participation may have different outcomes.

In both of the above studies, a critical race feminist theory could have been used to more clearly examine minority female students' identity development in science learning contexts. Perhaps applying the Garcia Coll et al (1996) model of identity competency development would provide a clearer picture of the social constructs that act on students' identity development and educational outcomes. Using Gee's (2000) categories of identity to understand students' own perceptions of their identity may also be useful to understand educational outcomes as well as how

students are perceiving the intersection of their ethnic, gendered, and academic identities.

Gender and Science Education

For the past 30 years, debates in the field of gender and science education have centered around the treatment of boys and girls based on their gendered differences. As more research is done in the area of equity in science teaching and learning, assumptions that girls and boys have identical experiences in schools are dispelled. Using a critical feminist perspective as a lens through which to look at this scholarship allows us to understand the different obstacles faced by girls in the classroom and the role of schools in perpetuating or eliminating those obstacles. Thinking about science learning from a constructivist perspective allows us to understand the impact of gendered identities on meaning making in science classrooms. With these perspectives in mind, we realize that engaging in the girl vs. boy debate takes energy away from the issue, equity and excellence in science teaching and learning in order to provide equal opportunity and access to STEM fields in the future. Similarly, a focus on gender differences alone ignores the other aspects of identity that require attention if we want to understand issues of underrepresentation of minority groups in STEM fields as well.

Kristina Johnson, dean of Duke University's Pratt school of engineering, posed the following question, "If the cure for cancer is in the mind of a woman, will we ever find it?" (Society of Women Engineers, 2005) Unless we learn more about women's unequal access to educational and career opportunities in STEM areas, then I am inclined to say "no." Despite legislation to ensure equity and excellence in education,

many gender-based inequities exist in our schools today. These inequities, enacted down gender lines, (Sadker & Sadker, 1994, American Association of University of Women, 1992, National Science Foundation, 2005) may lead to differential educational opportunity and career access for our nation's girls and boys.

Byrnes (2001) points to innate differences in cognitive abilities as a possible explanation of the gender gap in STEM fields. Gurian (1996) goes so far as to attribute these differences to different brain structures in boys and girls. However, before utilizing these biologically-based theories as explanations for the small number of women in STEM fields, I would call attention to the fact that the number of women and men in STEM related careers is inconsistent with the performance of girls and boys in primary grades (NAEP, 2006, Byrnes, 2001). Girls and boys display similarities in cognitive functioning at young ages. In a meta-analysis of research on gender differences, Linn and Hyde (1989) find virtually no cognitive ability differences in boys and girls. In another study, Zohar (2006) found that girls actually receive higher teacher given grades than boys in AP physics classes. As students progress from elementary school towards college, evidence reveals a widening gender gap. Girls and boys start off equal in ability (Byrnes, 2001), interest (Eccles, 1987), and scientific reasoning (Spelke, 2005). But, a longitudinal study by Lee, Burkham, and Smerdon (1998) tell us that between 8th and 10th grade, the gender gap increases and girls' interest in science wanes. What causes decreased levels of interest (Eccles, 1987) and achievement (NAEP, 2006)? Attention has been focused on schools as primary socializing agents and the historical construction of science by white, middle-

class men, which influences the perception of science as masculine and thus exclusionary to young female students (Keller, 1985).

Before I examine schools as potential sources of systematic inequities for girls in science and the relationships between schools and lack of diversity in STEM fields, I will provide an overview of the historical relationship between women and science as viewed through a critical feminist perspective.

Critical Feminist Perspectives of Science

In her pivotal work, *Reflections on Gender and Science*, Evelyn Fox Keller (1995) explores the question, “How much of the nature of science is bound up with the idea of masculinity, and what would it mean for science if it were otherwise?” She tells us:

My endeavor has been to call attention to the ways in which the social construction of a binary opposition between "masculine" and "feminine" has influenced the social construction of science. I argue that it is only by recognizing the social character of the construction of both gender and science that we can realize the emancipatory value--for men, for women, and for science--of transcending that opposition. The first step, of course, is to abandon the myth that the opposition between "masculine" and "feminine" is somehow "natural," and therefore fixed.

In this work, Keller examines the history, practices, discourses, and consequences of the interactions in what she calls the “science-gender” system which leads her to conclude that both science and gender are socially constructed categories. Keller (1985) gives examples of language, events, and ideas that link science to masculinity including metaphors and discourses used in science that exclude the feminine and celebrate the masculine. For example, Keller discusses how the mode of

scientific inquiry was influenced by Francis Bacon, and how modern science accepts and assumes that control and domination are innately part of the nature of science. Bacon's early writings taught that science was power and it is the ultimate right of man to exercise that power to tame nature and make "her" his slave. Thanks to Bacon, modern scientific discourse continues to characterize the pursuit of science as a masculine force seeking to control the femininity of "Mother Nature." Ultimately, Keller suggests that the study of science has become the study of all things masculine. She says, "of course, to focus on the personal, emotional, and sexual dimensions of the construction and acceptance of claims to scientific knowledge is, precisely because of the male-centeredness of this tradition to focus on the personal, emotional, and sexual dimensions of male experience" (Keller, 1985). It is within this context and this domain that female students attempt to construct both academic, gendered, and ethnic identities while simultaneously trying to "become" scientists. We cannot ignore the possibility that the historical roots and celebration of the masculine nature of science and scientific pursuits may be related to the problem of underrepresentation of females in STEM.

Keller's explanation of science and gender as socially constructed categories and her discussion of the gender-science system that influences modern scientific theory, practice and ideology provides us with insight into the epistemology that continues to inform science teaching and learning today. Understanding these epistemologies can help us make sense of some of the systematic inequities experienced by females in science education today, as well as some of the overt and

subtle exclusionary practices which lead to low representation of women in STEM. Exclusion and underrepresentation of any group is unacceptable as Keller argues that “a healthy science is one that allows for the productive survival of diverse conceptions of mind and nature and of correspondingly diverse strategies.”

Harding (1998) echoes Keller’s sentiments regarding the importance of promoting and including cognitive diversity in the sciences. She reports on how women’s involvement in science benefits both the women and science. She also comments on the socially constructed nature of science and notes that gender-based knowledge develops when men and women are assigned different roles. Clearly, there is evidence of this assignment of male and female roles in STEM careers (National Science Foundation, 2005) which has historical roots in the early conception of modern scientific processes.

In the article, *Women, Science, and Society* (1998), Harding provides insight about the human intellectual repertoire, claiming that it consists of many styles, ways of thinking, ways of understanding, and ways of knowing. Harding refers to the totality of the repertoire as “cognitive diversity,” a diversity that, like biodiversity, benefits the human condition. Women in science add to this cognitive diversity in scientific research and application, and the result has been beneficial to both science and modern culture. For instance, allowing women to participate in all aspects of science, including scientific careers has added to the pool of well trained, motivated intellectuals who we need to solve some of the health-related and environmental problems of our modern world. Harding’s commentary on the intellectual loss

associated with excluding any group from a project illuminates the many benefits of including women in scientific endeavors. Benefits include: tapping into the resources that can advance everyone's health, enhancing the quality of decision making in policy, and allowing different viewpoints that can add to our understanding of science and technology. Women's participation in science improves the care and sensitivity in which design of scientific projects are practiced. Specifically, participation of women in science has increased our understanding of women health care issues, issues which were at one time ignored or undifferentiated from men's health care issues.

Ultimately, Harding (1991) calls for a new science, science for all women, including every race, class, and culture. She discusses challenges that face feminism and other countercultures of science and advocates improving science and math education emphasizing the need to create learning environments that encourage both men and women to enter and stay in STEM fields.

Brickhouse (2001) comments on the advancements that have been made in recent years regarding our understanding of science teaching, curriculum, assessment, and the social context of science classrooms. She builds on the work of Keller and Harding acknowledging the impact that feminist research has had on establishing the significance of attending to gender issues in science education, and understanding the culturally situated and socially constructed nature of science. She criticizes earlier work however, noting that it does not address epistemological issues and therefore does not question what counts as knowledge (Brickhouse, 2001). She concludes that *situated cognition* is a powerful learning theory which feminist researchers can use to

understand science education. Situated cognition epistemology is compatible with feminist epistemologies in that both have worked to move away from a binary understanding of how the world works. Feminists have worked to complicate the objectivity/subjectivity and masculine/feminine dualisms while situated cognition theorists, coming from anthropological traditions have attempted to move beyond comparing the “participants” of the study, often “natives” to the “rationale Western Man.”

Lave & Wenger (1991) talk about learning as more than what happens in classrooms when good teachers plan good lessons; learning is actually happening all of the time and leaning is a process of becoming who you are. By combining feminist and situated-cognition frameworks, it becomes obvious that understanding identity development formation can facilitate understanding learning. Brickhouse (2001) concludes that to understand learning in science, it is necessary to understand how the learner engages in science and how this engagement relates to who they are and who they want to be.

Brickhouse’s delicate merging of feminist epistemologies, situated cognition, identity formation, and science learning helps to inform my research study as I aim to understand the strategies and behaviors that undergraduate students use to achieve success within the context of university science cultures. This study examines the ideas suggested by Brickhouse (2001) in hopes of providing further insight into how underrepresented students develop college-going academic identities within the

context of university science classes, and how these identities support or constrain their participation in STEM majors and careers.

By looking through the critical gender lens provided by Keller, Harding, and Brickhouse, we can now examine how gender and science intersects in schools and science classrooms. In the next section, I discuss some empirical studies on gender and science education and what we know about how gender may impact science teaching, learning, and identity formation in science contexts.

Empirical studies - gender in science education

The historical relationship between science and masculinity may help us to understand the current systematic inequities enacted upon gender lines which may influence the lack of gender equity in STEM fields. The Society of Women Engineers conducted a review of research on the importance of diversity in STEM fields (Frehill, 2006). Frehill (2006) adds a “business case” to an educational and moral case for increasing diversity in STEM fields. Attention to diversity, he asserts, may bring about a better economic future for America and continue to ensure innovation in math, science, and technologies. In order to maintain our place in the global economy, the United States needs to expand the inclusion of women in STEM fields. should continue to contribute to the ever expanding use of technology.

Providing equitable educational opportunities to all students is a compelling reason to investigate the field of gender equity in science teaching and learning. Moreover, understanding how inequality works in concrete social situations will

inform our understanding of how school contexts influence students' attitudes, interests, behaviors, and achievement in science.

College preparedness begins in Pre K-12 education, therefore, much of the research reviewed in this section focuses on gender-based differences that influence students' early participation in science during elementary and secondary school. Understanding these differences will help us understand and study how participants may have been prepared for the college science culture, and how these historical experiences may influence their current participation in University science courses.

Mehan (1992) criticizes early sociologists of education for ignoring the internal life of schools. We can learn much about inequity in schools by looking beyond the distinction between macro and micro systems in education. The empirical studies reviewed in this section show a more interpretive approach to studying culture, social actors, and meaning making in schools. Mehan (1992) suggests that an interpretive approach can contribute to earlier theories that attempt to explain the social inequalities which contribute to unequal educational outcomes for students.

The Current State of Research: A Focus on Differences

Much of the research done on gender in classrooms has been focused on differences between boys and girls. Several theories employed to explain those differences include: biological theories, socialization theories, differential experience theories, and cognitive processing theories (Byrnes, 2001). Major limitations to the above theories exist which may explain why theory-based attempts to eliminate gender differences in classrooms often fail. One such limitation is the absence of critical

feminist theory and the understanding of science as socially constructed. Another limitation is the absence of a critical race feminism which studies the intersection of ethnicity and gender for students in classrooms. Rather than attempt to identify the origin of the differences, in this section, I focus on research studies which highlight various differences that exist between boys and girls in the classroom.

Du, Wegmouth, and Dragseth (2003) tried to determine how differences between girls and boys influence student learning. They discuss the different, but equally 'painful' problems faced by girls and boys in their school context. For example, girls performed better in lower grades and in verbal subjects, whereas boys outperformed girls in mathematics and computer science in high school. Overall, girls seemed to be more engaged in and recognized for learning achievements. Boys, on the other hand were often recognized for behavioral disruptions, and were suspended more often. Boys were overrepresented in special education programs. Boys and girls both faced obstacles in the classroom, albeit different obstacles. They do not discuss the role of the dominant culture or gender socialization in the creation of the obstacles.

A report by the American Association of University Women (AAUW, 1992) suggests that these obstacles may appear as early as pre-school. By the time students reach pre-school age, boys and girls have acquired different skills and thus have different needs, and therefore different obstacles. Taking students who are different and treating them the same is a form of discrimination in itself. (Lau v. Nichols) Therefore, it is necessary to understand the subtle differences between boys and girls in the classroom if we are to provide equitable teaching and learning environments.

Researchers have found that boys and girls are different in the science classroom in four main areas: behavior, perception, achievement, and interest.

Differential Behavior

Gender differences in aggressive behavior are subject to situational influences (Linn and Hyde, 1989). Teachers, for example, may pay more attention to students who aggressively seek information which may encourage, in the form of a self-fulfilling prophesy, that very aggressive behavior. This aggressive behavior most often displayed in males may also influence female confidence and perceived ability in math and science. Unfortunately for girls in college science contexts, lack of aggressive behavior may be viewed as apathy or lost interest which may translate into lost opportunities.

Jovanovic and King (1998) were interested in the behavior of students when working in collaborative groups on performance-based science activities and assessments. They conducted a study of six “performance based” middle school science classrooms, grade 6 – 8, in order to test the hypothesis that boys and girls have equal access to performing hands-on behaviors during science activities in the classroom. They hoped to learn whether behaviors were related to students’ perceived science ability. Jovanovic and King suggest that “doing science” results in positive attitudes that predict high science achievement for boys and girls. Therefore, the gender differences in science and math attitudes could be attributed to lack of exposure to “doing science.” In their study, they visited six science classrooms. During group activities, researchers used a checklist to observe behaviors of male and

female students. Students also filled out a questionnaire at the beginning and the end of the year in order to determine science ability perception.

Student behaviors were grouped into three categories: active-leading, passive-assisting, and active-manipulating. Analyses of data show that regardless of gender, active-leading behaviors emerged as predictors of ability perceptions and indicated higher science achievement on standardized tests. Findings showed that girls and boys exhibited active-leading behaviors almost equally in all classrooms. Findings also showed that boys handled the equipment more frequently than girls leaving girls to read directions or record data. Despite behavior outcomes, there was a decrease in girls' ability perceptions over the year which led the researchers to believe that girls and boys may be participating equally in active-leading behaviors, but may be experiencing the classroom differently. Limitations of this study lie in the researchers' decision to rely on mainly quantitative data. Student interviews could have provided information confirming or denying the conclusion that girls' "experience" the classroom differently. There is no mention of identity formation and little discussion of the content or context from a feminist perspective. Another limitation is the absence of data informing us of the other aspects of students' identity which may influence behavior such as social class, race, or ethnicity.

There is no denying that boys and girls exhibit different behaviors at school, but some authors think that we should move away from the emphasis on differences. For example, Thorne (1993) conducted studies in order to test the hypothesis that boys and girls actually have different cultures. We learn from her observations that boys do

talk more than girls in classes and when given a choice, boys and girls voluntarily segregate themselves in classrooms and during lunch. Regardless of some behavioral differences between boys and girls, Thorne suggests that researchers move away from studying the dualism of male vs. female culture and look at the context that may be influencing these behaviors in classrooms.

Pollack (1998) might agree with Thorne as he attempts to expose three myths of 'boyhood', strongly illuminating the importance of socialization on development of gender roles and stereotypes. As previously discussed, socialization and the social construction of both gender and science are guiding frameworks in this study.

Other researchers emphasize differences in behavior of boys and girls and the implications for learning. Kindlon and Thompson (1999) address the 'different-ness' of boys and describe how the energy level, maturity, and activity evidenced from boys behaviors may cause challenges for the boys in the classrooms. The authors site a specific example of a pre-school class where girls sit quietly on the carpet waiting for story time, a task that appears difficult for boys. They question the compatibility of boys' innate behaviors with school culture.

Brown (1998) reminds us that girls' behaviors do not always align with the 'good girl' stereotype, the girl who quietly sits in the front of the class, raising her hand. She describes two groups of girls who challenge that stereotype, one group from middle class society and one group from a lower socioeconomic class. Both groups of girls find ways to express their anger and have their voices heard, outside of 'good girl' norms. Cohen (1996) describes this same type of 'speaking out' behavior as one

way that successful girls learn to ‘negotiate school.’ Girls adopting this method of school negotiation do so because of the pressure they feel to conform to society’s expectations of feminism. Other girls negotiate school by taking on the role of the ‘good girl’ or by becoming a ‘translator.’ Translators are girls who successfully adapt to any context and can easily ‘cross borders’ between societal, school, and peer group expectations. Behavioral differences may be influenced by both the girls’ and boys’ identities and the perceptions of classroom experiences.

This literature is important as it helps to understand how students who are socialized into certain gendered behaviors may have advantages in certain contexts.

Differential Perceptions

According to Kahle (1989), Mead and Métraux developed a ‘draw a scientist’ test in 1957 in order to elicit students’ perceptions of scientists. Thirty-two years later, Kahle (1989) was interested to know if students’ perceptions of scientists had changed. As of 1989, she found that they hadn’t. The predominant view of a scientist was an older white male in a lab coat and glasses, surrounded by lab equipment. Buldu (2007) conducted a similar study, and although the sample size was small, 30 students, findings indicate that students’ perceptions of scientists are slowly starting to change. Over 10% of the boy students drew female scientists, an increase from the results of Kahle’s (1989) study. The fact that some students realize that there is some diversity in science may be interpreted as positive progress.

Brok, Fisher, Rickards, and Bull (2005) conducted a large study of over 665 students in California in order to examine factors that influence students’ perceptions

of their learning environments. They found gender as the one variable that consistently influenced students' perceptions. Girls tended to perceive environments more positively than boys in four domains: student cohesiveness, teacher support, task orientation, and cooperation.

Goldstein and Putambekar (2004) conducted classroom observations and found that girls have a more positive perception and participate more actively than boys during technology-based group work. Students in this study completed questionnaires from which it was determined that regardless of perceptions and participation, girls attributed success in these technology-rich learning environments to luck, whereas boys attribute success to ability. These perceptions of success may lead to different anxieties about science and technology classes.

Udo, Ramsey, and Mallow (2004) posed the following question: Does physics teaching affect science anxiety for college non-science majors? After administering a science anxiety questionnaire to a cohort of students, they found two main causes of science anxiety in students: 1) non-science anxiety and 2) gender. Girls were consistently more anxious about taking physics courses than boys, even those courses designed for non-science majors.

Perceptions affect identity development and may increase or decrease students' perceptions of self as scientist.

Differential Achievement

Differences in academic achievement of males and females involve performance in school and on standardized exams. Mickleson (1989) reviewed several

studies which found that in schools, girls tend to perform better until junior high. Her reading of studies by Eccles (1987) indicated to her that it is the competitive aspect of junior high which ‘works against’ girls’ strengths. Girls do outperform boys in verbal tasks such as reading and writing (Byrnes, 2001) but boys excel in mathematics courses.

Mickleson (1989) describes an “anomaly of women’s achievement.” She found that women perform as well or better than men in some school subjects, yet do not have access to the same level of career opportunity or pay. She poses the question: if women know that stratification in opportunity structures exist in America, then what motivates them to achieve? When faced with inequality in the work place, “Why does Jane read and write so well?”

Mickelson offers four hypotheses to answer her question. The hypothesis most relevant to my review of research is the “sex-role socialization hypothesis.” This hypothesis suggests that girls do well in school because they are socialized to please and be ‘good girls.’ This need for approval begins at a young age and manifests itself in high school with the need for extrinsic awards, teacher approval, and good grades.

Perhaps this hypothesis could be extended into an explanation of why females do not remain in STEM fields. Perhaps “good girls” don’t become physicists, work late at the lab, or wear lab coats? Perhaps “good girls” have other roles to fill and identities to form. The goals of this research study are to find out.

Differential Interests

In this, the final section on gender differences in science education, I examine studies about differential interest in science. Gender does seem to influence the development of scientific interest (Feist, 2006) for students. However, similar to achievement, Linn and Hyde (1989) find that interest in science does not differ in males and females in elementary school, but emerges in high school. Eccles (1987) shows that girls are less likely than boys to view science positively and less likely to be interested in science as a career, especially as they get older. Perhaps this occurrence is mediated by experiences in science classes in junior high or high school. Also related to students' declining interest in math and science is the perceived usefulness, relevance, and connectedness to students' lives.

Weisgram and Biger (2006) studied girls' perception of traditionally masculine fields after girls attended an 'Expanding your Horizon's' conference, a Saturday program for girls interested in science. After conducting surveys of 617 middle school girls, they found that girls' interest in science was piqued when they realized the altruistic value of working in these fields. They also learned that for girls, self-efficacy and interest in science are related, whereas in boys, self-efficacy and interest in science are unrelated.

Some feminist epistemologists suggest that students who prefer "feminine cognitive styles" prefer to learn how content is connected and relevant to their lives and to greater contexts. Teaching science from a more feminist perspective may help to increase females' interest in science fields. According to Zohar (2006), this type of

learning is akin to learning for understanding, a goal of most science teachers and learners. The concept of ‘connected knowledge’ emerged from the work of Belenky et al (1990) and is explained in *Women’s Ways of Knowing*. This type of ‘knowing’ occurs when the learner makes connections between the object to be learned and prior knowledge. Zohar argues that the idea of connected knowledge can and must be applied to math and science disciplines.

In fact, in a study of 50 physics learners, Zohar found that what girls love about physics is the ability to understand and make connections to their lives. Boys also loved this aspect of physics, but girls experienced more frustration when the learning took the form of merely memorizing formulas and practicing problems. The need for understanding and making connections was greater in female learners. Unfortunately, I fear that science teaching and learning in college has not yet evolved to emphasize making connections to students’ lives.

In 1997, Boaler conducted a similar study in the United Kingdom in which she learned that 91% of the female learners think that understanding is the most important aspect of mathematics learning and that cooperative learning is the best way to learn. If ‘ways of knowing’ are gender related, and teaching using ‘connecting knowledge’ increases understanding and moves girls towards becoming experts in fields of mathematics and science, then methods of instruction may be factors in the continual inequity in educational opportunity and access for females in STEM arenas.

Differences in the Classroom

The literature provides evidence of boys' and girls' differences in terms of behavior, perceptions, achievement, and interest in science classrooms. How the differences are perceived by teachers and how boys and girls are treated in schools is the subject of much debate in the field.

Sadker and Sadker (1994) discuss the 'miseducation' of boys stating that while girls blend in, boys stand out, indicating that boys may suffer in a 'feminized' school. Sommers (1998) goes so far as to say that boys are now 'politically incorrect.' She argues that boys are often discriminated against in our classrooms and schools, and that African American males comprise the most disadvantaged group.

Sadker and Sadker (1994) also discuss how girls are shortchanged in schools, noting that boys get more positive attention in classrooms, including; teacher praise, acceptance, and remediation. The Sadkers' findings show that boys receive praise for interaction while girls are praised for quiet compliance. The Sadkers describe this as evidence of gender bias against girls in the classroom. The AAUW (1992) agree that girls are the 'shortchanged' gender.

Thorne (1993) suggests that schools are actually responsible for promoting gender separation. Each teacher does this differently and it may be conscious or unconscious. For example, when a teacher allowed students to choose their own seats, the classroom became segregated into girls' and boys' sides. When one teacher lined up students in the hall, girls and boys were on opposite sides of the hallway.

As more research is done in the area of equity in science teaching and learning, assumptions that girls and boys have identical experiences in schools are dispelled. Girls and boys enter school with similar ability levels, but over time differences emerge. Both girls and boys face obstacles in the classroom and it is up to teachers and schools to ensure equal opportunity towards overcoming those obstacles.

Engaging in the girl vs. boy debate ignores other aspects of identity and takes energy away from the issue, equity and excellence in science teaching and learning in order to provide equal opportunity and access to STEM fields in the future. It is not the intention of this study to engage in this debate, however, due to the historical construction of science as a gendered domain, gender remains an important variable in understanding how girls and boys participate in and are successful in various STEM contexts. Since minority females and males are both underrepresented in STEM, special attention must be paid to how identity formation intersects with the process of doing science or becoming a scientist in various academic contexts. Hyde's work (2006) on the gender similarities hypothesis supports this notion.

Most of the research in this field focuses on differences between boys and girls, but in 2006, Hyde proposed a 'gender similarities hypothesis'. After conducting research in areas of gender in education, she determined that there are more similarities than differences in boys and girls. She suggests that by focusing on the similarities, science educators may be able to reduce the impact of gender stereotypes on students and emphasize good science teaching and learning strategies.

Hydes's findings are consistent with what Thorne proposed in 1993. She questioned the assertion that boys and girls have different cultures. In her studies, she discovered similar ways of acting, knowing, and talking amongst boys and girls. Thorne suggests that subscribing to the ideology of boys' and girls' separate culture dichotomy ignores variation and complexities within the sexes. Thorne concludes that within-gender variation is greater than differences between boys and girls. This work is important because it indicates that we should not be looking at a dichotomy of male vs. female, but perhaps looking at academic and scientific identity formation boys and girls in context.

The research indicates that using deficiency theories to explain the differential educational access and career opportunities for females in STEM areas is no longer sufficient. Differences in gender are not universal, but are socially constructed and specific to context. Therefore, attention should be paid to situations that minimize gender differences, including attention to the gendered nature of science education and to the methods of teaching and learning that promote confidence in science abilities and success for all boys and girls.

Loss of Male and Female STEM students in College

For the past three decades, there has been a steady decline in freshman interest in undergraduate science majors (Seymour & Hewitt, 1997; National Science Foundation, 2005). According to Seymour & Hewitt (1997), the greatest loss occurs during the transition to college, when students abandon their intentions to major in science, mathematics, technology, or engineering and change their majors to non

STEM fields. There are very few students who switch into STEM majors.

Unfortunately, when we lose students from STEM majors, we are often losing the most able, well prepared students (White, 1992).

In 1990, Seymour & Hewitt (1997) began a three year study in an attempt to understand the factors that influence students to switch from science, math, and engineering (SME) majors to non-SME majors. In their study, they refer to students who remain in their intended SME related majors as “persisters” and to those that switch out of a SME major into a non-SME majors as “switchers.” In this study, I will borrow their nomenclature and refer to students as either STEM persisters or STEM switchers.

In the Seymour & Hewitt (1997) study, they conducted individual and focus group interviews with 335 undergraduate students at seven different universities in the United States. They attempted to understand the difference in educational experiences of SME majors at different types of institutions. They also hoped to compare and contrast aspects of the structure, culture, and pedagogy which may attract or deter students from completing their intended majors in SME.

They found that there does not seem to be a difference in the “kinds of people” who switch versus persist in SME. In fact, both groups of students had similar abilities, interests, and motivation. The main differences between switcher and persisters are the “coping strategies” that each student uses to survive the SME culture on their university campuses. Often, intervention of a faculty member at a strategic point in the undergraduate career played a role in the persisters decision to remain a SME major.

They also found a set of problems that may exist for both switcher and non switchers. These problems can contribute to students' decisions to switch majors. Problems include: 1) a loss of interest in science; 2) a belief that a non-SME major is more interesting; 3) poor teaching in SME; 4) a feeling of being overwhelmed by pace and curriculum demands; 5) inadequate counseling; and 6) inadequate high school preparation.

Seymour & Hewitt (1997) found only four issues that contributed to switching decisions that were not issues for persisters. These issues include both career concerns and dissatisfaction with low grades and curve-grading. Nearly all switchers (over 90%) and many non-switchers (over 73%) complained of poor teaching in SME courses. Specifically, students were dissatisfied with pedagogy, curriculum design, and assessment practices in SME courses at their higher learning institutions.

Activating the lever of change

Many gender inequalities in society exist as is evidenced by the underrepresentation of females in STEM related careers. Debates about equitable access and unequal treatment of boys and girls monopolize the time and energies of teachers and researchers. The focus needs to shift away from a problem-based approach toward a solution-based approach, with emphasis on reforming schools and building programs from the ground up that encourage all students, male and female, to develop their interests and skills in STEM areas.

While a wide body of literature exists hypothesizing the causes for the disparity of educational access and opportunity for women in science, little research

has been done to examine scientific and academic identity formation in various contexts and how students' identities influence their behavior, perceptions, achievement, and interest in sciences. Understanding how female students' identities are compatible or conflict with ways of doing science can help educators reform science education.

I am recommending further study be done in the area of gender inequity with particular focus on understanding the intersection of multi-cultural and academic identity formation in science learning contexts. This area deserves attention because it has been overlooked by other researchers in this field. This area also deserves attention because understanding how various science contexts positively or negatively impact students' science identities can inform how we modify those educational contexts and/or improve science teaching and learning within those contexts towards a more inclusive, equitable future. Examining the problem of underrepresentation of women & minorities in STEM from this perspective indicates that one solution would be to improve excellence and equity in education to increase access and opportunity to STEM college majors and careers.

Equity and Excellence in Education

Following the civil rights movements of the 1960's selective colleges and universities made efforts to increase diversity at their institutions. The college and beyond survey was analyzed by Bowen and Bok (1998) to determine the effects of those efforts. Overall, outcomes were positive. Unfortunately, in 1996, the University

of California decided to adopt a race-neutral admissions policy which would actually decrease the numbers of Black students at the University.

Today, according to the National Longitudinal Study of Freshman (Massey, Charles, & Lundy, 2003) Whites and Asians are outperforming Blacks and Latinos during the freshmen year of college. An achievement gap still exists. Universities advocate better college preparedness as one way to increase social and cultural capital in individual students and as one solution to continuing to increase diversity. In the next section, I will describe the types of capital important to achieving academic success, and the potential results of capital deficiency. I will also discuss the dangers of relying on these large deterministic theories to explain social inequality in schools without looking at the interactions at play between the individuals and their schooling contexts/culture as well as the role of human agency (Mehan, 1992). Identity development theories provide one framework through which to view these interactions and the complexity of meaning making within social contexts.

Mehan (1992) discusses the contributions of a form of constructivist studies called interpretive research. Interpretive research has a concern for meanings given by both the participants and the researcher. These studies emphasize the analysis of language and semantics.

Interpretive studies assume that people create and associate their own subjective and intersubjective meanings as they interact with the world around them. Interpretive researchers thus attempt to understand phenomena thought assessing the meaning participants assign to them (LeCompte & Preissle, 1993).

Mehan discusses how interpretive studies in schools, an area in the sociology of education, once thought to only address “micro” areas of education, really can add to our understanding of “macro” theories used to account for social inequality.

According to Mehan, interpretive studies such as MacLeod’s (1987) account of the “Brothers” and “Hallway Hangers” in his ethnography of teenagers in an American high school setting, can inform theories of inequality in three ways: 1) These studies can introduce cultural elements into the highly deterministic macrotheories 2) They introduce human agency into theories accounting for social inequality and 3) They open the “black box” of education and reveal relationships between schools as institutions and students’ experiences.

Therefore, it is important to learn from interpretive studies and how they complicate the cultural capital theories introduced by Bourdieu (1982) and the social capital theories described by Coleman & Hoffer (1987).

Despite obvious inequality in the school system such as tracking (Oakes, 1990) and ability grouping in classrooms (Sadker & Sadker, 1994), much emphasis has been put on attempting to explain or even blame the differential success of minority students (Byrnes, 2001) on their cultural differences. Other widely accepted explanations for inequalities include sociological theories that emphasize the exchange of cultural capital (Bourdieu, 1982) or social capital (Coleman and Hoffer, 1987). Until recently, little effort has been made to truly raise expectations and prepare all students for college and STEM careers (AAAS, 1990) or to understand how cultural elements,

human agency, and complex contexts within schools complicate these macro theories (Mehan, 1992).

Recently, however, there have been attempts to address these issues of inequity (Rosen & Mehan, 2003) with the development of charter schools that offer college-going cultures and whole school de-tracking, a “strategy for equity and excellence” (Alvarez & Mehan, 2006). Students who attend these schools and are better prepared for college and attend at higher rates (Massey et al, 2003; Bowen & Bok, 1998; Bowen, Kurzweil, & Tobin, 2006). We don’t yet know what is what is happening to these students who participate in this whole school detracking system when they transition to college.

Transition to College

Deil-Amen and Turley (2007) conducted a meta-analysis of the transition to college literature in sociology and discovered that it focuses on four main themes: college preparation, college access, college financing, and college retention. Much of this literature focuses on understanding transition to college for underrepresented populations using the status attainment model. Deil-Amen and Turley (2007) call for more work in the area of understanding the actual processes during which particular cultural and social resources become applied in educational contexts.

Summary

I have discussed literature on constructivist theories of teaching and learning, critical theories such as critical feminism and critical race feminism, and theories of identity development. I used these frameworks to view the literature on gender and

science education, equity and excellence in education, and transition to college. Using both constructivism and critical feminist perspectives as lenses through which to view the literature, I have developed three main frameworks that guide this study:

The first framework combines theories of multi-cultural, academic, and science identity development. The work in these areas calls our attention to the intersection of gender, ethnicity, culture, class, etc. and academic identity development in science contexts. I will use Gee's (2000) conceptualization of kinds of identity (natural, institutional, discursive, and affinity group) as an analytic lens and interpretive tool to understand the perceptions of identity development for my participants.

The second framework helps me to understand the construction of the university science learning contexts in which my participants engage. Using the constructivist and feminist perspectives as lenses, I understand the socially constructed nature of both gender and science, as well as the relationship between gender and science education. Also, I am able to understand the theories of teaching and learning espoused and enacted by both the student and the institution and how these theories may be congruent or inconsistent. This framework informs my understanding of the university science culture, and the experiences and educational outcomes of the female and male students within that context.

The third framework is a combination of the constructivist theories of teaching and learning which may inform the purpose of schools in preparing students for institutions of higher learning. Using this framework as a lens helps me to understand the construction of the high school learning environments with the critical conditions

(Oakes, 1990) for enhancing college opportunities in which all of my informants have participated (Rosen & Mehan, 2003; Alvarez & Mehan, 2006).

Integrating the three frameworks guides and informs the development of the research design, data collection, and data analysis methods used in this study. My research fills a niche where these theories intersect, an area, which, until now, has not been fully explored and understood. Therefore, my primary research questions are:

- 1) How do underrepresented students experience the transition from a college preparatory high school to college?
- 2) How are students developing their college-going, academic identities in the context of their educational institutions?
- 3) What factors support or constrain student participation and success in college science courses?

To answer these research questions, I conduct a qualitative research study. Please refer to the research design section in Chapter 3 for more details.

Chapter 3 - Methodology

This chapter provides an overview of the qualitative research design used to conduct this study including the general characteristics of qualitative research and a rationale for why employing this paradigm is best suited to answer the research questions. Furthermore, it also describes the phenomenological approach to inquiry used to frame the research design.

Phenomenology helps us bring to light that which presents itself as pedagogy in our lives with children. It is that kind of thinking which guides us back from theoretical abstractions to the reality of lived experiences – the lived experiences of a child's world, the lived experience of schools, curricula, etc (van Manen, 1982).

This chapter includes a discussion of the key constructs and the operationalization and integration of these terms and concepts into the overarching theoretical framework. The chapter also discusses sampling procedures along with the criteria for the selection of participants. As the author of this chapter, I briefly review my positionality discussing the interesting benefits and limitations that emerge during the study as a result of my past participation in the students' lives. The chapter also describes the particular methods used to both design and implement the data collection measures. Finally, it discusses the data reduction and analysis processes as they relate to the phenomenological approach.

The purpose of this study is to explore the transition to college for underrepresented students who have completed a rigorous college preparatory high school curriculum and participated in a college going culture in high school. It is rare to find a cohort of low income and minority students who have all shared a similar

high school experience and who are all currently attending colleges and universities. Findings from this study will help us to understand “transition to college” for underrepresented populations, a phenomenon that will ideally become more common in the future. We know little about this phenomenon given that K-12 schools in the United States have not been systematically preparing a pool of low-income, ethnically diverse students for the university.

We do strive for increased equity and excellence in education (Bowen, Kurzweil, & Tobin, 2005), therefore, we need to better understand how this population of students experiences the transition to college. One specific focus of this study is an exploration of students’ transition from high school science courses into undergraduate science courses. Findings from this study have multiple implications for practice and pedagogy, including re-thinking what it means to *prepare* students for college academics and college life. Using a qualitative research design, I determine students’ perspectives of how they are developing their academic and multi-cultural, college-going identities and what factors are influencing their current realities, including their shared high school experience. Using a phenomenological approach, I use survey and interview methods to answer the following research questions:

- 1) How do underrepresented students experience the transition from a college preparatory high school to college?
- 2) How are students developing their college-going, academic identities in the context of their educational institutions?

3) What factors support or constrain student participation and success in college science courses?

Qualitative Research Design

Sociologists, anthropologists, psychologists, and educational researchers alike commonly use qualitative research designs to explain phenomenon in their respective disciplines or fields. There are some approaches to inquiry which are traditionally linked to specific disciplines. For instance, sociologists have traditionally used narrative and phenomenological approaches while anthropologists have often used ethnographic approaches. In educational research, an applied field, scholars have had the opportunity to borrow methods from any and all of the other social science disciplines. This luxury of being uncommitted to a particular discipline may benefit educational researchers as we try to answer complicated, multi-faceted research questions and understand the interaction and relationships between complex issues in teaching, learning, schools, policy, etc. in the education arena. It is vital to our success to have a variety of methodological tools in our repertoire. However, with this opportunity, comes responsibility to choose appropriate methods related directly to our current research questions and interests.

As a novice educational-researcher, I have struggled with this opportunity, knowing that my ability to defend my methodological decisions is linked with my future reputation and credibility in the research world, a great responsibility indeed. It is because of this struggle and repeated reflection that I have included this section on general characteristics of qualitative research, and justification of my chosen approach.

According to Creswell (2007), qualitative research designs are most appropriate when the following characteristics are present:

1. Data is being collected in the natural setting where participants experience the issue under study.
2. The researcher is the key instrument for analysis.
3. There are multiple sources of data.
4. The researcher focuses on participants' meanings.
5. The design is emergent.
6. A particular theoretical lens is used.
7. Researchers make interpretations.
8. A holistic account of an issue is created.

My study possesses all 8 of these characteristics. For example:

1. Data is collected around students' experiences at their universities.
2. Other than minimal use of descriptive statistics to understand the population that I am looking at, I am the key instrument of analysis.
3. There are multiple sources of data in my experiment, including surveys and individual interviews.
4. Using a phenomenological approach I look for participants' meanings in the lived experience of their transition to college.
5. As I progress through the study, the research questions and methodology evolve. During the data analysis phase, I allow themes to emerge from the data corpus. Therefore, the design is emergent based on how the study unfolds.

6. Using a constructivist paradigm as a framework, I apply a feminist theoretical lens to the data analysis.
7. As part of my data analysis, I interpret participants' interviews and survey responses to understand the meaning they are applying to their lived experiences.
8. During data analysis, I simultaneously work using both a top-up and a bottom-down approach, selecting themes to search for in the data while at the same time, allowing other themes to emerge. I analyze data across all participants, as well as look at each participant individually. After interpreting all the data from these multiple points of view, I provide a holistic description of the transition to college for this sample population.

Phenomenology

In this study, I apply a phenomenological approach of inquiry to understand the lived experiences of these individuals as they transition from high school to college contexts. The intent of this type of research is to describe the experience from the students' point of views in order to understand the essence of this experience. Therefore, I collect data from the individual students in the form of surveys and individual interviews. I apply descriptions of the students' experiences to understanding the transition process as more than just a series of steps. Unlike much of the existing literature on this topic, I look beyond understanding students':

1) preparation, 2) application processes 3) financing issues 4) enrollment and

5) graduation rates (Deil-Amen & Turley, 2007). This limited, procedural view of the complex process of “transition” de-values the challenges and successes commonly experienced for individuals as they travel from high school graduation to freshman orientation through graduation day.

Unfortunately, due to the time constraints of my study, I am unable to conduct a longitudinal, or ethnographic exploration into individual cases. In order to work within the parameters set for me by my program, I have decided instead to glimpse into this experience for students at one point in their developmental process. Clearly, this approach limits my ability to observe the progression from high school student to college graduate in its entirety. However, I can see one point along the way and look for similarities and differences in students’ experiences.

Interpretation of these events will allow me to uncover new and forgotten meaning about this “in-between time” after childhood and before adulthood. Perhaps, I can describe some of the unseen structures and influences on these individuals as they negotiate the complex daily realities of their university culture and undergraduate academic lives.

I capture the essence of the experience through analysis of student voices, therefore, extending our current limited understanding of this process. Van Manen (1990) describes six research activities related to the phenomenological approach:

- (1) turning to a phenomenon which seriously interests us and commits us to the world
- (2) investigating experience as we live it rather than as we conceptualize it

- (3) reflecting on the essential themes which characterize the phenomenon
- (4) describing the phenomenon through the art of writing and rewriting
- (5) manipulating a strong and oriented pedagogical relation to the phenomenon
- (6) balancing the research context by considering parts and whole

I engage in all six of these activities to answer my research questions. For instance, as a high school teacher in the context of a college preparatory secondary school, I am committed to this phenomenon and spend my life preparing students for what they may encounter during this transition experience.

One goal of using this approach in this particular investigation is to maintain a pedagogical orientation to the phenomenon. This enables me to act, not as a disinterested researcher, borrowing haphazardly from “other” disciplines, but as an educational researcher, grounded by my strong commitment to understand and improve the lives of the children who I teach. With this pedagogical orientation, I realized that there is a need to investigate this experience as students live it rather than as we currently conceptualize it.

Definition of Key Constructs

Throughout this chapter, I frequently use certain terms to refer to the key constructs of the study. In order to eliminate confusion, and improve understanding, I am using this section of the chapter to define and describe the key constructs as I operationalized during the design of the study. The purpose of this section is to illuminate the assumptions that I attached to certain constructs as I apply them to this research design.

Definition of “transition to college”

Defining “transition to college” is a challenging task because a transition is not a static event, it is a process and signifies a journey from one place, time, or context to another. When speaking of the transition to college, we assume advancement in the educational process, a moving to a higher plane towards the goal of college graduation and post-secondary degree attainment. The dynamic nature of this process suggests that it is more than the steps of preparing, applying, enrolling, financing, and completing a college degree. For individuals involved in the process, it includes the movement from one institution to the next as well as the interactions between themselves, the institutions, their families, and their communities along the way. The phenomenon of the transition to college is therefore, a developmental process, including the lived experiences of the students as they negotiate movement from one institution high school to college.

Definition of “educational success”

We know that previous research on transition to college primarily focuses on “educational success” as the primary outcome (Deil-Amen & Turley, 2007). Using educational success as an outcome variable in understanding students’ transition to college is problematic until the term “educational success” is operationalized.

Transition to college may have positive outcomes for students such as high GPA, social adjustment, and eventual graduation. Transition to college may have negative outcomes for students such as low GPA, poor social adjustment, and attrition. Tinto’s (1993) model of student retention helps us understand how students can be

successful during the transition to college. In this model, both student characteristics and interactions with the social and academic environments affect institutional commitment and educational goals. According to Tinto (1993), if students integrate both socially and academically into the institution, they will have the institutional commitment and educational goals that lead to college graduation, one definition of “educational success.” Guiffrida (2006) argues that Tinto’s model is problematic and cannot be directly applied to minority populations because it does not account for the necessity of minority students to connect to their home, and cultural communities. Guiffrida (2006) encourages an advancement of Tinto’s theory by furthering our understanding of minority students’ need to connect with both their home heritage communities and their college communities. Guiffrida suggests that advancement of Tinto’s theory would mean using the term “connecting” instead of “integrating,” because for minority students, integrating means assimilating into the dominant cultural ideology and de-valuing their heritage ethnic, socioeconomic, or gendered minority status.

Therefore, in this study, “educational success” during the transition to college can be described as how students negotiate their academic and multi-cultural (ethnic, racial, gendered, SES, religious) identities and how they are connecting to both their home and school communities.

For example, in the study of Yemeni girls in Dearborn, Michigan, the term “success” is defined as how these women negotiate home and school worlds (Sarroub, 2005). This definition brings to life the term “success” for the individual participants

in Sarroub's (2005) study. Traditionally, "educational success" in school has been determined by standardized test scores, GPA, and graduation. Other dimensions of success can be interwoven into this definition, including consideration of social adjustment, and involvement in school cultural activities. As Sarroub (2005) points out, the idea of success for individuals can become complex when various aspects of their identities conflict with traditional notions of school success. Due to this complexity, Sarroub opts to define success as it applies to her individual population. As she points out, the participants' personal theories about "educational success" are important in the construction of their individual identities. I use a similar deviation of the normative definition of "educational success" by attempting to understand how students' personal theories of success enable them to construct their multi-cultural, college-going, academic identities.

Therefore, for the purpose of this study, I define "educational success" as ways these students develop both multi-cultural and academic identities, and how these identities impact their college GPA and social adjustment.

Definition of "identities and identity development"

The term "identity" is a complex construct commonly defined in social sciences as an individuals' understanding of her or himself as a separate entity. Identity is the sum of all of our selves including an integration of our conceptions of our ethnicities, races, religions, genders, sexual-orientation, life-histories, and current realities.

“Identity development,” the process that all individuals experience to define their own identities within certain contexts, was first described by Erikson (1968). Erikson (1968) described the process of adolescent identity development and compares identity development and identity confusion. Garcia Coll et al (1996) offered an updated model of identity development for identity competencies in minority children. The Garcia Coll model describes how an individual’s social position variables including gender and race interact with social stratification mechanisms such as racism and oppression in various educational contexts to influence students’ adaptive cultures, and eventually students’ developmental competencies. Using this model, I am defining students’ “multi-cultural identity development” as their understanding of themselves as unique individuals with varying levels of awareness of the intersection of their ethnicities, genders, religions, and socioeconomic status, etc.

Students’ academic identities are another unique aspect of students’ self. The term “academic identity” is defined as the perception of oneself as a student and is related to the students’ behaviors, strategies, achievements, and educational and social outcomes in school. Development of academic identity is related to academic competency and we can categorize students using a continuous scale from novice to expert. Janssen (1996) describes this progression from novice to expert as the development of “studaxology”, the expertise students need to be effective in higher education. He says that academic success is based on learning both content knowledge and “studax”, academic strategies and skills. Aspects of students’ academic identity

can include students' understandings of their own study skills, learning theories of action, and self-efficacy.

Perry (1968) describes the development of students' intellectual and ethical selves in college as a series of nine stages during which a student moves from a dualistic, polar view of knowing towards a more pluralistic view of knowledge, followed by eventual commitment and understanding of responsibility to his or her chosen identity.

Gee (2000) discusses people's multiple identities related to their performance in society and defines identity being recognized as a certain kind of person in a given context. He suggests four interrelated ways to view identity and offers an example of how to use identity as an analytic lens in educational research. According to Gee (2000), one's identity can be categorized in the following ways: nature-identity, an institutional-identity, discourse-identity, and affinity-identity. The nature-identity is one's state, such as gender or ethnicity, developed from forces in nature. The institutional-identity is one's position in an institution as authorized by individuals in the institution. The discourse-identity is an individual trait recognized in the dialogue or discourse with other actors in context. The affinity-identity is related to individuals' experiences shared during participation in groups. I will use Gee's identity categories during data analysis.

Definition of "college preparation"

"College preparation" includes any factor that may influence students' access, achievement, and completion of a post-secondary program. College preparation, in

most cases, refers to students' experiences in secondary schools, including the curriculum, culture, and social networks that the student was exposed to. I acknowledge that students' college preparation may be improved by access to out-of-school programs, including students' family, and community resources and knowledge, however, for the purposes of this study, I am referring to students' "college preparation" as the common high school experience shared by all participants in this study. In this case, for this sample, "college preparation" means attending a college preparatory school with the conditions for college success (Oaks, 1990) including a college going culture, rigorous academic curricula meeting the requirements for college admissions as outlined by the University of California, and access to a social network which systematically helps students apply, enroll, and investigate financing options for college.

Definition of "STEM courses and contexts"

STEM courses include any science, technology, engineering, or math related classes offered at the undergraduate level. STEM contexts include both STEM courses as well as any environment created during a STEM related club, job, or student activity at the undergraduate institution. It is important to deconstruct the notion of STEM and understand the similarities and differences between how students experience science, technology, engineering, and math contexts independently of one another. During data analysis, I will account for some of the differences between science and math and engineering and technology by looking at students' discourse patterns related to each element of STEM as part of a whole.

Sampling Procedures

Working within a socio-cultural paradigm and using a phenomenological approach to inquiry, I originally decided to use a purposeful criterion based sampling technique. In this case, I established criteria for my participants and identified individual cases that met the criteria (Mertens, 2005). An interesting thing occurred when I began to invite individuals to participate in the study. Some students were so eager to participate; they willingly scheduled interviews prior to filling out the survey. Due to this unexpected eagerness and willingness to participate, I adopted an opportunistic sampling strategy. In this case, as opportunities presented themselves to gather rich data from individuals who were living the experience of “transition to college,” I did not refuse to meet with them and hear their stories. Thus, I made decisions “on the spot” during the course of the study and took the opportunity to gather data when opportunities presented themselves. The result of this method was an inconsistency in the order of data collection. Some students participated in the interview first followed by the survey. Other students took the survey first followed by an interview. Fortunately, all of the individuals that I interviewed met the originally established criteria, and all the individuals were able to complete both the surveys and the interviews, albeit not in the originally intended sequence. Regardless, the sample still meets the established recommendations for a rigorous qualitative study using phenomenological approach as my sample includes 28 out of 78 possible individuals who lived the experience being explored.

Criteria for Participants

Using a purposeful criterion sampling technique, I invited 78 college students to participate in this study. All individuals participating in the study were required to be enrolled as full time students in a two or four year, public or private college or university. The individuals were required to be members of the UCSD charter school graduating class of 2007, and were therefore participating in their second year of college during the time of data collection. All participants were required to have experienced a STEM course. All students participating in the study were asked to complete an electronic survey about their college experiences. The students were also invited to participate in an individual, in-depth interview about their academic and personal lives, including provision of specific information about their classes, study habits and reflections on their high school preparation. The surveys were originally distributed in September of 2008 and all of the interviews were conducted from September to November of the same year. At that time, all of the students were enrolled in the fall term at their institutions.

Twenty-eight students agreed to participate in the study. Twenty-five students completed the on-line survey and twenty students agreed to be interviewed. The sample included approximately 40% males and 60 % females. All of the participants were currently enrolled in colleges and universities. Twenty-one of the twenty-eight were enrolled in four year public universities, Five of the twenty-eight were enrolled in four year private institutions, and two of the twenty-eight were enrolled in two year community colleges. Of the participants, 14% identified as African American, 43%

identified as Mexican American, 14 % as Asian American-Vietnamese, 14% as Asian American-Chinese, 9% as Cambodian, 9 % as Asian Pacific Islander and 4% identified as Caucasian. This sample illustrates population validity as the entire population of students meeting the original criteria (n=78) were represented by the sample. One limitation of this study is the lack of data from the other students in the original cohort. The students that chose to participate, at the time of the study, were still enrolled in college. I am missing data from students who may have left college altogether.

Part of the selection criteria was graduation from the college preparatory charter school on the UCSD campus. This school serves motivated students from low income families who will be first-generation college students in their families. Therefore, all of the participants in this study were also first-generation college students from low income backgrounds. All but one of the participants self-identify as a racial or ethnic minority. I selected alumni from the UCSD charter school because, as the literature review indicates, we know little about how preparing underrepresented students for college results in influencing behaviors, such as improving academic achievements or increasing participation in opportunities at their universities. My position as a middle and high school teacher on this campus allowed me to easily access participants for this study.

All participants in this study, as graduates of UCSD charter school class of 2007, participated in Advanced Placement classes, and a single-track, rigorous, college preparatory curriculum from 6-12th grade. High school graduation

requirements included successful completion of the required courses for admission eligibility to the University of California campuses. Potential participants in this study were all members of a University Prep Class, a small cohort of students who worked closely with one advisory teacher. This school is a model that demonstrates the compatibility of social justice and educational excellence, two ideals often viewed as competing virtues (Lytle, 2008). All of the students were explicitly taught coping strategies for academic success. I hypothesize the following: When students internalize these coping strategies, they can enact similar coping strategies for success in college.

Positionality

I teach science at the UCSD charter school. I was an advisory teacher for the class of 2007 at the school, and therefore have a close advisee-advisor relationship with 27 of the 78 potential participants. I am aware that one validity threat to this study is the impact of my former role as the participants' advisor on their responses to survey and interview questions. In order to control for this, I conducted a pilot study using both the survey and interview measures with other university students who were not former students. Also, students agreed to voluntarily participate in the study understanding that their responses would be kept confidential.

Benefits of my positionality include the rapport and mutual trust that was developed between the students and me as their advisory teacher. Our former relationship may privilege me to more comprehensive and sincere responses, particularly related to the students' identity development. Also, as an insider at the

UCSD charter school, the participants and I developed some intersubjectivity regarding their high school experiences and college preparation, which facilitates the analysis of their responses.

Data Collection Methods

I engage in two main data collection activities in order to capture descriptions of the lived experiences of people as they transition from high school to college: survey interviews and individual, in-depth interviews. See appendix A for interview protocol. I focus on the meaning of the lived experience for these individuals. As van Manen (1990) describes, this is only possible by “borrowing” the experience of others. He reminds us that as we investigate the experiences of others, we may have had similar experiences ourselves. In order to capture the essence of the phenomenon without being indirectly influenced by our own conceptualizations of the phenomenon, we can engage in a reflective practice called bracketing, which will be described in the analysis section of this chapter.

Unit of Analysis

The unit of analysis is each individual participants’ experiences as described in the survey and interview. I use these data to obtain experiential descriptions from the participants.

Interviews

The purpose of the interview is to gather an experiential narrative from each individual. The first interview is a computer-generated survey which was distributed to all individuals who met the criteria for participation as described above. Survey data

was compiled and analyzed using descriptive statistics. The second interview was an individual, in-depth interview which was conducted face-to-face when possible. Some of the people involved in the study attend college out of state therefore, I conducted some telephone interviews. All interviews were audio-taped and transcribed.

Data Analysis

Both the surveys and the interviews in this study serve the purpose of collecting narratives in order to develop an understanding of the meaning of this human phenomenon. In order to understand this phenomenon, I engage in the following data collection steps:

1. Bracketing
2. Transcribing the interviews
3. Organizing the survey data
4. Reviewing the corpus of data
5. Reflecting phenomenologically on the experiences of the people whom I interviewed
6. Writing individual narratives describing each participants transition experience and academic identity development
7. Conducting a thematic analysis looking for the structure of the experiences

The first step in data analysis is bracketing. Bracketing is an attempt to identify ones own biases and conceptualization of the phenomenon prior to conducting data analysis. Bracketing is done when a researcher writes down her own experiences first and then analyzes the experiences of the participants only after becoming aware of her

own biases. For instance, prior to beginning my data analysis, I wrote the story of my own transition to college reflecting on my life experiences during this era. Here is an excerpt from the bracketing process in which I engaged. Like my research participants,

I was also a first-generation college student. I had experienced a rigorous, college preparatory track in high school and had exceeded the prerequisites for college admission. I was focused, motivated, and confident. I had been overly involved in extra-curricular activities at my high school including cheerleading, National Honor Society (NHS), French NHS, and marching band. I had a strong social network of peers and adults, including a very supportive family, and had been counseled and supported by my family and friends to enter into college. It was what I expected of myself. Unlike my participants, I was not a member of a racial or ethnic minority group. I was however, a gendered minority as a female entering into a STEM field with aspirations of becoming a medical doctor and a medical-researcher. I wanted to find a cure for Multiple Sclerosis, a debilitating neurological disease which currently afflicts both my Mom and my best friend's Mom. When I entered college, I was a good student. I knew that I should attend class, study, and prepare for exams. I was shocked by the social culture of my school, and when I slept through my first eight o'clock lecture, I was devastated. My friends across the hall told me not to worry about it, and so I didn't. I managed to maintain a 3.6 during my first year, but my GPA declined slightly thereafter. I attended an off-campus tutoring site and sought help for a Chemistry lab that I didn't understand. I paid for these tutoring services and then was promptly scolded by the dean of the chemistry department for using this service. I was told to "never go to the 'Quantum Cow Tutoring Company.'" Apparently, this tutoring service was not an acceptable option for academic support. I was warned that if I used the service again, there would be consequences. I eventually learned of an ongoing dispute between the University and the 'Quantum Cow' that did not necessarily directly involve students, however, I still never sought academic help again. I made a B in Chemistry anyway. I was surprised at the competitive nature and sense of entitlement from the other aspiring medical students. After one MCAT group study session, I decided that medical school was not for me. I changed my major to kinesiology (pre-physical therapy school) in my junior year and then after realizing that it would take me two extra years to graduate, I changed my major back to biology and gave up on the idea of physical therapy school. I made these decisions in isolation consulting no one for advice. I graduated with a bachelors degree in biology and a minor in chemistry and although I loved learning biology and chemistry for the content, I still never saw these courses as being based on problem solving or inquiry. When I graduated, I dreaded the idea of working in a lab, which, at the time, I believed

to be my only option. After graduation, I chose to leave STEM and enter the field of education.

The purpose of bracketing is to help the researcher identify any biases that they may have as a result of their own experiences and then to suspend ones own beliefs about the world in order to study the essential structures of the world. This notion of suspending one's beliefs works only in theory. In practice, it proves to be a challenging yet worthwhile task.

For me, engaging in a 'bracketing' process prior to data analysis enabled me to think about my own experiences as a STEM persister turned STEM switcher turned STEM persister. This experience allowed me to think about the reasons that I was attracted to and repelled from my STEM major and career, and helped me to understand how my research participants' experiences were similar and different from my own.

Following bracketing, I transcribe the interviews, reduce the survey data and compose narratives for each student's case. According to van Manen (1990), there are different ways to uncover the themes in a narrative. The first is a top down or holistic approach. Using this approach, I read each transcript in its entirety, searching for the overall meaning or phrase that captures the essence of the narrative. From this reading, I write an anecdotal narrative for each individual case. The second way to uncover themes is by engaging in a bottom up or selective reading approach during which I look for significant statements in the transcript texts. I then ask what these statements reveal about the phenomenon.

After conducting both the top-down and bottom-up thematic analyses (Sipe & Ghiso, 2004; Erickson, 2004), I develop a list of themes or codes for reflection. Prior to interpreting the themes, I engage in conversation with colleagues and my adviser in an attempt to interpret the narratives and make meanings of the themes. I then attempt to produce a written interpretation of the themes. van Manen (1990) calls this writing exercise linguistic transformation. Through writing, I attempt to determine and present the essential structures of the phenomenon, transition to college. Findings are then validated through triangulation of data sources and rich description of the phenomenon (Creswell, 2007).

Chapter 4 - From College Prep to College: Data Summary

Introduction

In this chapter I provide a summary of the data collected from the surveys. In chapter 5, I begin to answer my first and overarching research question: How do underrepresented students experience the transition from a college preparatory high school to college? This question is best answered by reading the student narratives that I developed based on the analysis of survey and interview cases.

The phenomenon of transition to college can also be understood by answering the additional research questions. In chapter 6, I explain how underrepresented students develop their college-going, academic identities in the context of their educational institutions. I consider the factors that support or constrain student success in college STEM courses and majors. In chapter 7, I discuss the findings and implications for schools and policy as well as suggest future directions for research.

All participants who completed either the on-line survey or the individual interview were included in the analysis. The survey was designed to collect demographic information as well as determine the basic academic strategies and coping strategies that students used to achieve their desired educational outcomes. In addition, the survey assessed students' general perceptions of their college academic experiences including assessing students' beliefs about success in college. Twenty-eight students completed the survey.

The semi-structured interview was designed to understand the students' transition experience from high school to college. Interview questions elicited

information about four main areas in the students' lives: 1) academics - coursework, focusing on science and math courses 2) academics - study habits 3) personal growth and development and 4) college preparation and the transition to college. The development of the student narrative was only possible by analyzing both the data from the survey and the interview. Twenty students completed both the survey and the interview; therefore twenty narratives were written and analyzed using a phenomenological approach.

Data Summary

The sample represents both males and females, however, more females (N=18) than males (N=10) responded to the survey. See Table 4.1.

Table 4.1: Frequency of Female and Male Survey Participants

	Frequency	Percent
Female	18	64.3
Male	10	35.7
Total	28	100.0

The following ethnicities are represented in the sample: See Table 4.2.

Table 4.2: Frequency of Student Identified Ethnicities Represented in the Sample

Student Identified Ethnicity	Frequency	Percent
Mexican American	10	35.7
African American	4	14.3
Vietnamese	7	25.0
Chinese	2	7.1
Cambodian	2	7.1
Asian Pacific Islander	2	7.1
White	1	3.6

The students in this sample represent students from five types of colleges or universities: large research universities (R-1), large public universities, community colleges, large private universities designated by an enrollment of over 5,000 undergraduates, and small private liberal arts colleges designated by an enrollment of under 5,000 undergraduates. See Figure 4.1.

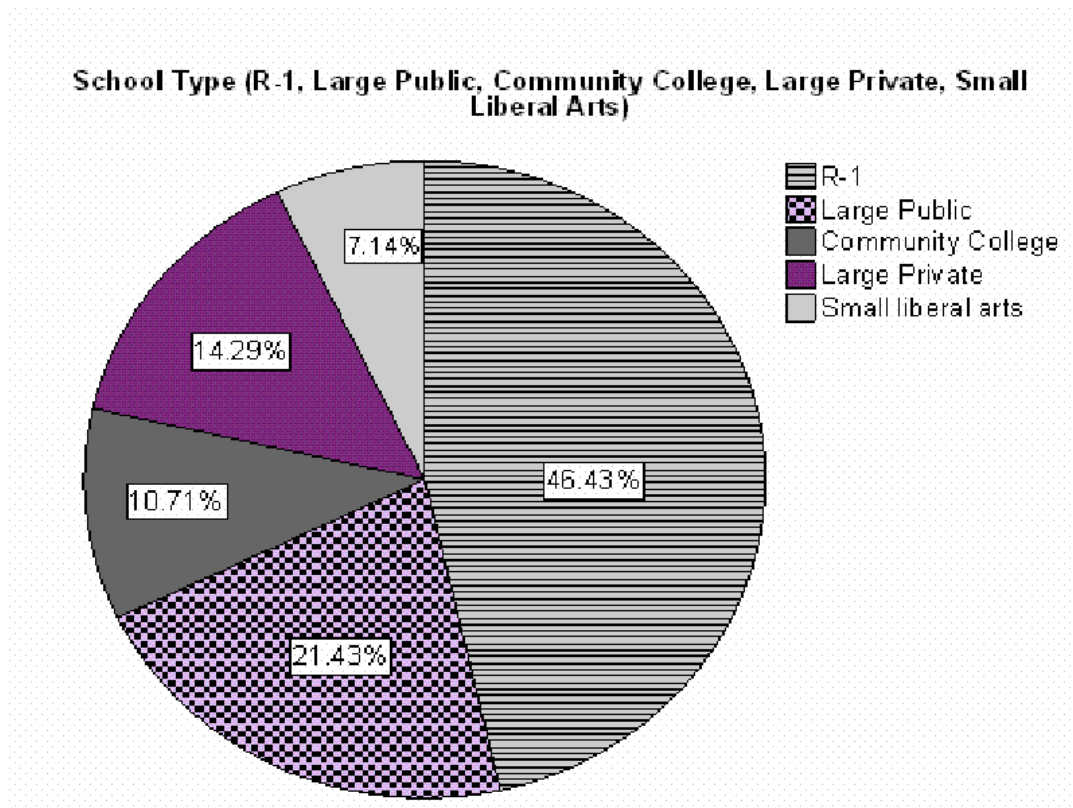


Figure 4.1: Distribution of Students Who Attend Various Types of Universities

Students who responded to the survey also represent students from a variety of majors. Table 4.3 provides a general overview of the survey respondents' (N=28) current or intended majors, and the universities they attend. See Table 4.3.

Table 4.3: Survey Participants' Colleges and Intended Majors

School Type	College	Major	Count
R-1 Public	UCSD	Human Development	2
		Visual Arts	2
		Microbiology	1
		Neuroscience	1
		Psychology	1
	UC Berkeley	Political Science	1
		Ethnic Studies	1
		Political Science	1
		Biochemistry	1
		Computer Science	1
	UCR	Linguistics	1
	UCSB	Electrical Engineering	1
Large Public	SDSU	English	1
		Liberal Studies/Science Education	1
		Accounting	1
		Electrical Engineering	1
	Cal Poly San Luis Obispo	Mechanical Engineering	1
Community College	Mesa	Biochemistry	1
		Political Science	1
	Miramar	Hotel Management	1
Large Private	Colombia	Sociocultural Anthropology/ Pre-Med	1
	Duke	French/Spanish	1
	Harvard	Biomedical Engineering	1
	USC	American Studies and	
		Ethnicity/Political Science	1
Small Liberal Arts – Private	Colgate	Undeclared	1
		Architecture	1
	Woodbury		
Total			28

STEM Persisters versus STEM Switchers

Similar to the findings of Seymour and Hewitt (1997), many of the students in my sample changed their intended major from STEM to non-STEM related fields. I borrow the nomenclature of Seymour and Hewitt and refer to those students as “STEM Switchers.” I refer to students who remain in their originally intended STEM

majors as “STEM Persisters.” One student, who I refer to as a “New-STEM student” changed from a non-STEM liberal studies major into a STEM related field, science education. All of the remaining students are referred to as “Non-STEM students”. Of the students represented in the sample, there are 12 STEM Persisters, 10 Non-STEM students, 5 STEM Switchers, and 1 New-STEM student. See Table 4.4. Reasons for persisting or leaving STEM majors will be discussed in Chapter 6.

Table. 4.4: STEM Student Categories Represented in the Sample.

STEM Student		
Categories	Frequency	Percent
STEM Persister	12	42.9
Non-STEM	10	35.7
STEM Switcher	5	17.9
Non-STEM Switcher	1	3.6
Total	28	100.0

There are both female and male STEM Persisters and STEM Switchers. See Figure 4.3.

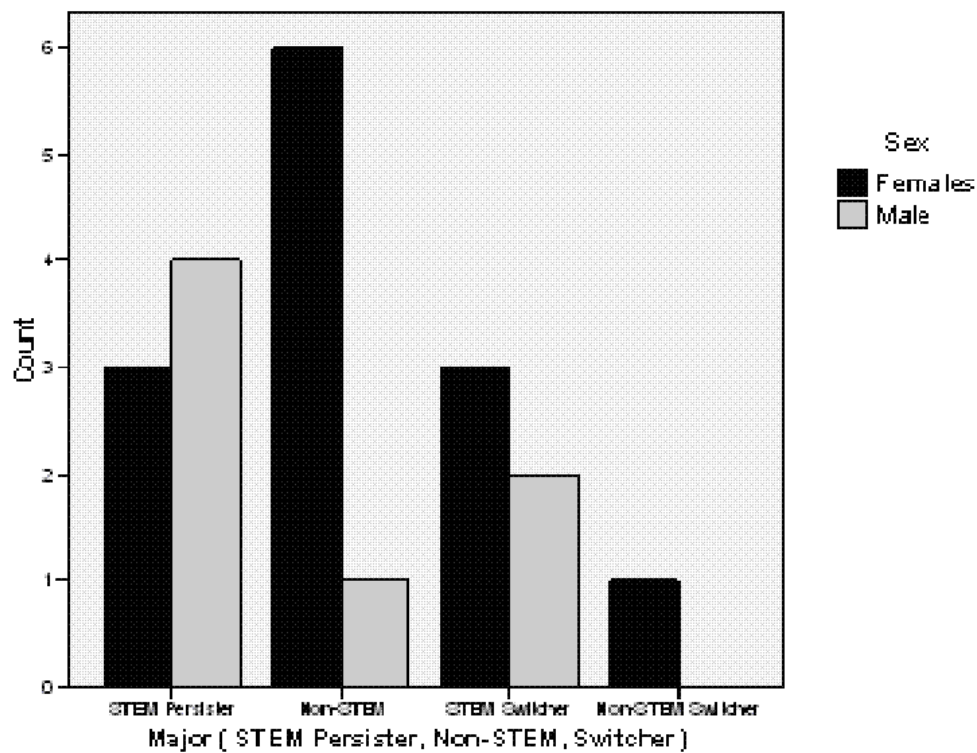


Figure 4.3: STEM Switchers and Persisters: Female and Male

In this particular sample, there are more females who are non-STEM students.

There are more male STEM Persisters than male STEM Switchers. There are more female STEM Switchers than female STEM Persisters, which is consistent with the national data on the numbers of males and females that persist in or leave STEM majors.

Over 53% of students in this sample have a 3.0 college GPA or higher. Only 14.3% of students in this sample have a college GPA of 2.5 or below. The remainder of students, 32.1% have between a 2.6 and 2.9 college GPA. Students in this sample self reported their college GPA. See Table 4.5.

Table 4.5: Student GPAs

GPA	Frequency	Percent
3.6-4.0	3	10.7
3.0-3.5	12	42.9
2.6-2.9	9	32.1
2.0-2.5	3	10.7
below 2.0	1	3.6
Total	28	100.0

Self-reported college GPAs have been reliable within half a grade point average (Bowen & Bok, 1998). I have no reason to believe that students inflated their reported GPAs. GPA as an academic outcome will be discussed in Chapter 6.

The survey results were entered into an SPSS electronic database and statistical program. Descriptive statistics were used to analyze the survey results. I cross-tabulated students' background variables with intervening variables including the enacted strategies and outcome variables. Although the sample size is too small to produce any significant or generalizable results from this use of statistical tests, triangulation with the interview data provides twenty interesting cases to study. In each case, I analyzed students' background variables which included: students' gender, ethnicity, the type of college students attend (defined as R-1, Large Public University, Community College, Large Private, and Small Liberal Arts College), and their common high school preparation, where all the participants were explicitly taught

coping strategies. I analyzed the intervening variables including: students' enactment of coping strategies, students' self-efficacy, and the availability of opportunities at their institutions, such as a transition program, academic related affinity groups, tutorial services, structures to enable student-teacher interaction, and apprenticeships or opportunities for hands-on learning experiences. I also analyzed the outcome variables including: academic major, GPA, and students' persistence in STEM. See Table 4.6.

Table 4.6: Variables For Analysis

Background Variables	Intervening Variables	Outcome Variables
-Gender -Ethnicity -Type of College Attended: R-1, Large Public, Community College, Large Private, Small Liberal Arts -High School Preparation and Explicit Exposure to Academic Coping Strategies	-Students' enactment of coping strategies -Self-Efficacy -Availability of opportunities to develop academic identity in college: transition program, academic affinity groups, tutorial services, opportunities for student-teacher interaction, apprenticeships or opportunities for hands-on learning experiences, STEM related affinity groups	-Academic major -STEM students attrition or retention -GPA -Feelings of Success

Upon analysis of these variables, I developed a narrative for each student. I include a representative sample of the narratives in Chapter 5. The remainder of the narratives are included in Appendix C.

Chapter 5 – Student Transition to College Narratives

Introduction

In chapter 4, I provide a summary of the some of the survey data collected during this study. As part of the phenomenological approach to data analysis, I develop representative narratives from each students' complete data set: the survey and an individual, semi-structured interview. I wrote twenty student narratives. Through analysis of each narrative, I begin to understand the phenomenon of 'transition to college' and how students experience the STEM courses at their universities. Each student's story, albeit a snapshot of their life and a small cross-section of the transition process as a whole, tells of the essential elements involved in transitioning, adjusting, and developing their college- going, academic identities at their colleges and universities.

Student Narratives and STEM

Student narratives tell the story of STEM Persisters, STEM Switchers, Non-STEM students and a New STEM student, a rare case of a student who switched into a STEM related field. In this chapter, I will share excerpts from the narratives of ten of the students who participated in this study. The ten students that I selected represent the various types of students in this study. All twenty narratives in their entirety are included in Appendix C.

I selected the following narratives as a representative sample of both males and females. Both STEM Persisters and STEM Switchers are also represented in these stories. In this sample, I also include stories from STEM persisters who attend all five

types of institutions. I include stories from STEM Switchers from an R-1 and a large private university. I include one story of a New STEM student and one narrative from a Non STEM Student. See Table 5.1.

Table 5.1: Student Narratives Included in Chapter 5

STEM designation	Type of School	Sex	Ethnicity
STEM Persister	R-1	Male	African American
	R-1	Female	Chinese
	Large Public	Female	Mexican American
	Large Private	Female	Vietnamese
	Community College	Female	Vietnamese
	Small Liberal Arts	Male	Mexican American
STEM Switcher	R-1	Male	Vietnamese
	Large Private	Female	Mexican American
Non-STEM Switcher	Large Public	Female	Mexican American
Non-STEM	R-1	Female	Mexican American

Narratives: Stories of STEM Persisters

In this section, I share the narratives of six STEM Persisters: Luke, Rachel, Naomi, Deborah, Elizabeth, and Moses. All of the students' names in all of the narratives have been changed to pseudonyms. All of these STEM Persisters have a high sense of self-efficacy, with the exception of Deborah, who attends a large, highly selective private school where she has lost some confidence in her abilities since high school. She has a medium sense of self-efficacy now, whereas in high school, she had

both a high sense of self-efficacy and a high GPA. Self-efficacy is determined by a the students' responses to a number of the survey items.

Luke's Story:

Luke attends an R-1 University in Southern California. He is currently majoring in microbiology and has a 3.3 GPA. He seems confident and calm as he talks about his experience in college so far. He participated in a high school to college transition program called Summer Bridge. He was invited to participate in that program via an email invitation from the program. This program seemed to help him accept the initial shock he felt during his first large college lecture, an experience which he said made him think about quitting college.

Mussey: How do you find college different from high school?

Luke: No one is watching, so you can pretty much do anything you want. Time management. You have to manage your time, not like high school where they give you the planner, they tell you what is going to be on the board...and um, you know...there is homework assignments everyday in high school. They just want you to read it and expect you to read it so you can talk about it next class. And they may not give you as much time. They expect a lot more from you, and they don't say it. They are just going to say, go ahead. There is no homework, but I want you read this...and you have to read it on your own. They are going to assign the reading you have to self motivate yourself. There is no one to push you. No advisory teacher. You have to self-motivate, motivate yourself.

You gotta do it by yourself.

Mussey: Did that surprise you?

Luke: That did surprise me, but Summer Bridge helped you out. If there is any program, that really helped me out. The first day in summer bridge I wanted to quit college because of the lecture, I was like it is so hard, but I just kind of finally got used to it. I looked at everything like the big picture, but if I take like one step at a time, It is pretty easy.

His feeling of wanting to quit college was short-lived, and as is evident from his interview, Luke adjusted well, and feels successful at his University. He uses some of

the time management strategies that he learned in high school, and he understands that even when the professors don't check your homework, or hold you directly accountable for daily studying, the student is still responsible for the assigned readings. Luke seems to understand what is expected of him and he fulfills this expectation by reading before class, participating in study groups, and studying alone for exams. He also attends professors' office hours and meets with teaching assistants (TAs) regularly in order to gain insight on what will be on the exams. He applies these good study skills and strategies to even his most challenging class, Chemistry.

Mussey: During the first years of college, students are searching for the best ways to prepare for classes and exams. Describe some of the ways that you have prepared for classes and exams during your first year of college.

Luke: For my classes, I would usually read before, usually you have the syllabus and I would read before so you would know what they are going to talk about. This would help me further because I would know what they are going to talk about...Exams, I usually go to TAs and Office hours with the professors. That gives me insight as to what is going to happen on the test.

Mussey: Do you find that a lot of people take advantage of that?

Luke: yes, well no, not the majority, but ya, there are a lot of people in there.

He has internalized the coping strategies that he learned in both high school and in the Summer Bridge program, and often studies in groups.

Mussey: At your high school, students are arranged in advisory classes. During this class, students have had the opportunity to form study groups, and interact with their peers, and teachers. Have you had the opportunity to form study groups or interact with your peers during your first year in college?

Luke: Ya, cause um, well it was like, I was in summer bridge, so they gave you an option to go to, it was like an advisory class where they helped you out. They would form like a summer bridge group where they would form study groups. It carried into the school years so that was pretty helpful. Like people in the same classes, I would usually study with them, I also go to the library and look around for people to study with.

Mussey: What kinds of things do you do in study groups?

Luke: Problem solving, like I ask questions about concepts that I don't understand.

Mussey: How is that different from what you do when you are studying alone?

Luke: When I am studying alone, uhh, I usually just want to do all of the homework problems that I got wrong. I also review what other students got wrong, and I guess read the book over.

Luke finds his math and science classes challenging even though he feels he was prepared for chemistry, biology, and math. Much of what he learned in the introductory courses in college reviewed his advanced classes in high school. He says that the tests in chemistry were hard, but accepts that as part of a typical college science class. He feels that he is a “math person,” and that he acquired the necessary skills in high school to excel in math, so he feels that it is natural to find those classes challenging but manageable.

Mussey: How would you describe a typical science class?

Luke: Its pretty hard. That is the first statement that I would tell them, It is pretty hard, but interesting, because I guess you don’t usually talk about science in that kind of depth so it is pretty interesting.

Mussey: Do you think you are going to stick with the major (microbiology)?

Luke: Yes.

Mussey: What about math?

Luke: Depends on the person who is asking, I could say that it is going to be really easy for you, and it could be really hard for you. Depends on if you did good in math in high school, it is going to carry over into college. It’s pretty much the same skills in math wherever you go.

Luke successfully passed the chemistry pre-requisites necessary to take his first biology class, where he experienced some innovative teaching in a class of over 300 students. His teacher assigned a group video project. He enjoyed the experience where he was able to make a video about AIDS with a group 10 other students. This project grade served as one of his midterm grades, and he described the experience as “fun.” Luke intends to graduate with a degree in microbiology and pursue medical school.

Naomi's Story:

Naomi attends a large comprehensive public university with a commitment to a “learning by doing” pedagogical approach. She is a mechanical engineering major and is currently on academic probation with a below 2.0 GPA. Naomi's GPA and current academic status has not deterred her goals of becoming a mechanical engineer. She has a fierce devotion to academics, and is intent on overcoming the initial obstacles that she has faced in her classes at her institution.

Naomi adjusted to the social aspects and academic demands of college by becoming involved in several on-campus organizations including, SHPE (Society of Hispanic Professional Engineers), *Movimiento Estudiantil Chicano de Aztlán* (MEChA), and a Latina Sorority. All three organizations are affinity groups related both to Naomi's identification with her ethnicity, and her strong commitment to academics. She developed a social and academic network of peers through participation with these groups, and as a result, her self-efficacy and confidence in her abilities has improved regardless of her academic achievement as measured by her GPA.

Her participation in affinity groups helped her adjust to her minority status in terms of both ethnicity and gender in her major, an experience that she refers to as a “culture shock.” She speaks of this experience.

Mussey: Historically, women, have been underrepresented in certain fields in college. Do you find yourself, as a woman, to be in the minority at your institution?

Naomi: At Cal Poly, for one woman, there are 10 guys. And so that is a BIG change. I guess for some people it could be intimidating, I guess in my engineering class it was intimidating at first. So as you as a woman or as a

minority...I am here to learn. And I am going to make these kind of mistakes, but we are all here to learn, and I will ask someone, "hey I don't get this, can you explain it to me." You know, it makes it easier if you forget about you being a minority and keep participating in class, it makes it easier to think about that we are all just students.

Mussey: Part of your high school's mission is to prepare minority students for college because historically black, and Latino students have had less access to college. Do you find yourself to be in the minority at your institution?

Naomi: Definitely, There are mostly Caucasians. There are Latinos here. And, I mean, Preuss prepared me to understand like how much like I can do as far as I am bright student and It doesn't matter if I am Mexican or not. I can do these things. In Preuss there are a lot of Latinos, the majority and when I come here it is kind of a culture shock, the majority is Caucasian. I got involved with SHEP for that reason because they were Latino and they were engineers. And its like you build a family.

Another aspect of Naomi's university, the hands-on approach, helps her to remain a mechanical engineering major.

Mussey: Tell me about your favorite class in college so far.

Naomi: Mechanical Engineering (ME), Intro to mechanical engineering, last year we did a lot of projects, whether it was building a bridge outta toothpicks to learn about force OR learning about, or making a little go-cart made out of the motor of a lawn motor to learn about how the gear transmission works and all that...it was crazy...can I tell you about my second favorite class?

Mussey: Absolutely.

Naomi: It was IME...it was a machining class and I actually got to build a screwdriver and an air motor in that class. So I got to work with the machines that I will be working with when I graduate.

Mussey: So, do you like the hands-on aspect of those classes?

Mussey: Yes, exactly, that is how I learn best. By doing. We get lectures in the classes but once a week we actually have a three hour lab where we take what we read about and actually apply it to what we are doing.

She received support from the teachers in her classes. The experiences in high school instilled in Naomi the value of taking the initiative to build relationships with her instructors.

Mussey: Could you talk about the teachers from those classes? (physics and mechanical engineering)

Naomi: For the most part, the teachers are really friendly, they say come to my office hours and I will help you whether it is homework or a project...if I have time I will stay after with you guys. They are pretty nice, especially my physics teacher. He actually had examples in class to show us more than just the paper. The classes are not that big, the only big class was my history class, which was just a lecture. You just have to take the initiative to talk to the people around you or the teacher, and once you get to know the teacher, well obviously they are not going to know everyone, but if you get your face out there, it will be easier for them to help you or relate to you and giving you help in certain areas.

Naomi learned what types of study environments work best for her. She has transferred some of the strategies she learned from high school to college, including some time management strategies such as the planner. She also utilizes some of the reading strategies that she was taught in high school including Cornell note-taking. She values the knowledge that she can gain from her peers through group study, another practice that she was exposed to in high school.

Mussey: What are some things you do when you are studying in a group?
 Naomi: When you are with yourself, you tend to study more the things you do. I go over most of the things that I know. You can't get help for what you don't know. I guess when you are in a group it is a better way to learn because they can ask you questions and if you can't answer, then there is your check...You can say, oh, I don't know that...if there is more people, everyone knows their little area, you tend to study more of everything than you do by yourself...Here at my college there are study groups that you can sign up for. Last year, I did a summer group, we became a family, and a lot of them turned out to be in my classes or...SHEP offers mentoring and tutoring. And we can assign you with a mentor or a place to study.

The most powerful take away that she seems to have internalized from her time at Preuss is the strong sense of self-efficacy and her responsibility to make the world a better place. She has certainly become a “globally aware and responsible student”, part of the learning goals for the high school that she attended, and she hopes that other Preuss School graduates have internalized this awareness as well.

Mussey: Is there anything else that you would like to add that I have not asked you? (This question came immediately after I asked her to give advice to current seniors.)

Naomi: yes (to current Preuss students) stand up for what you want and make sure you are out there changing something, because we are here to change the world. That is one thing I got from Preuss.

Deborah's Story:

Deborah attends a large, highly selective, out-of-state private school. She currently maintains between a 3.0-3.5 GPA, and is majoring in biomedical engineering. Although, she has maintained an B grade point average, she is dissatisfied with her academic achievements thus far, and feels that she has had to lower her academic standards in college. Deborah made straight A's in high school and was recognized for her academic achievements at her high school graduation. She was always at the top of her class, and for the first time in her academic career, she is not. She is certainly achieving success by most standards, although she doesn't always perceive it that way. Part of the reason is her feeling of anonymity at her large institution.

Mussey: Do you feel like you have been a successful student? Why or why not?

Deborah: Not really, since my grades aren't what they were (and might be getting worse) and I haven't done anything impressive or great. Most of my teachers don't know me. I feel like I'm just another number, another nameless face, sometimes.

Unfortunately, this feeling is resulting in a lowering of confidence in her academics abilities. Deborah also feels that her academic abilities are getting worse, an ironic conclusion, considering the fact that she attends one of the top schools in the nation, and is learning computer programming, linear algebra, genetics, chemistry, Spanish, and expository writing from what she calls "accomplished professors, and teaching

fellows.” As a result of this perceived lowering of abilities, she worries. When asked about the experiences in her courses, she discusses her worries about her performance when compared to her peers:

Deborah: I worry about the students in my classes only when it comes to grading. Scary smart people means there might not be a curve, or I’ll be at the lower end of it. Other than that, they’re just students.

Deborah is adjusting to college life away from home, and part of her adjustment involves becoming more socially competent. She interacts most often with two close friends, who are both science majors and therefore on a similar pathway. She studies with them often, and relies on them for both social and academic support. At her university, she has joined several groups including the Vietnamese Student Association and the Refugee Youth Enrichment program, where she tutors immigrant students as part of a community outreach program. She began to understand the importance of community service through various community service projects at her high school and she has continued to answer this call to service in her college community.

Adjusting to a different approach to teaching and learning at her college has been another part of the transition process for Deborah. She recognizes some similarities in teaching methods that occur at her college, and discusses some of the “good teaching” that goes on at her university as being similar to what she experienced in high school.

Mussey: How were you most prepared for college?

Deborah: Preuss is similar to college in its rigorousness. The material we learn, *and how we learn it* at Preuss is similar to the **good** teaching here. I’ve recognized some of the techniques I learned and practiced at Preuss being

taught here such as the types of hooks for an essay, how to draw Lewis dot structures, partial fractions. There's a lot of thinking to do and the critical thinking skills from Preuss really help such as working backwards from the answer, looking at similar problems.

She also notices differences in teaching methods at her university compared to high school and particularly points out the lack of scaffolds at her college.

Deborah: At Preuss, I feel the teachers really aim to have the students succeed, going over things step-by-step and emphasizing the important parts. Here, I think the teachers just review and add onto what's in the book, or rely on other means of teaching to teach the student (e.g. smaller sections, independent reading). The need for self-motivation and initiative is bigger at college; just being in class won't be enough to understand the material. In a way, the teacher seems less invested in the student here. This might be because of the time difference between Preuss and college too.

The type of teaching that occurs in her STEM classes directly impacts her perceptions of them. For instance, her physics class is the most challenging class that she has taken, due in part to the professor's teaching style:

Mussey: Tell me about the most challenging class that you have taken in college.

Deborah: Physics! Ugh! The professor can't teach, or doesn't try to. The demos he does are interesting, but everything else is disorganized, unfocused, and not helpful to learning. It's basically like an independent-study class with homework and tests.

On the other hand, she seems to appreciate and understand the teaching style that occurs in her favorite class, Computer Science, which she also describes as the most interesting, meaningful, and applicable to life. Even though the class is huge, over 300 people, the professor arranges to meet with students in small groups, by offering to eat lunch with any student on Fridays.

Mussey: Tell me about your favorite class in college so far.

Deborah: My favorite class this semester is Computer Science 50, or CS50. It meets MW from 1 to 2:20pm. It's a lecture hall class of some 300 students

with one professor who stands on stage and lectures (he has a blackboard, laptop, and proxima, though). He switches between explaining concepts and actual coding the concepts. We're given handouts on Monday for the week's lecture slides and program codes. The lectures are filmed and all the materials are on the course website. Every Friday, the professor goes out to lunch with whoever RSVPs to the event. For help/support, there are office hours (with the teaching fellows and course assistants—CAs are like TFs, but they only hold office hours and don't teach section) online and in-person at the computer lab. There is also an anonymized course bulletin board. Everyone also has an additional, optional section, grouped by how comfortable the students feel with programming. This section is headed by TFs, who in this case are students who've taken the class before, and goes over the section notes. Nine students usually show up to my section.

So far, Deborah says, "I'm not too happy with my math/science classes." She feels that she cannot always follow her math professors, and in her most recent science class, she mentions that "neither the professor nor the TF (teaching fellow) is very interested in teaching." This fact worries her, as she understands the important relationship between good teaching and learning.

Rachel's Story:

Rachel attends a large R-1 University in Southern California. Rachel was always a student who showed a strong aptitude and interest in the biological sciences. In high school, she took advanced biology during her junior year, and AP Chemistry during her senior year. She intended to major in general biology at her college, and started taking courses to pursue this course of study. During her first quarter in college, she took 3 courses: Math, Chemistry, and a writing course called Dimensions of Culture. She currently is a human development major with between a 2.6-2.9 GPA.

Although Rachel participated in "Summer Bridge," a high school to college transition program offered on her university campus, she still struggled with meeting

the academic demands of her introductory math and science classes. She ended up dropping both her Math and Chemistry class.

Mussey: You mentioned that you struggled with that Chemistry class. Could you talk about that experience?

Rachel: We were asked to take like this test, and then to see where we were placed, I actually got placed into that class (Chemistry). There is actually a like beginner class before that, which was like Chemistry, which was more like an intro to chem, like if you haven't taken chem. in high school before. I got placed into the first class, so I thought I could handle that class. But, it was actually much harder and they went really quick, they pretty much like speed through the whole chemistry book, first half of the book, So, I kind of fell behind in that class, and I dropped out of that class. Kind of the same thing for math too, I should have taken like a beginners intro class because I don't think I was like really prepared for that college level, so that is what I am going to do this year I am going to re-take that math class and take the intro chem. class before I jump into the series.

Rachel, was intimidated by the large class size and competitive culture that existed in her chemistry class.

Mussey: About how many people approximately?

Rachel: For the chem. class, it would fill the whole lecture. 300, I would probably say, and it would always be full and people would sit in the stairs and stuff. And that was, The atmosphere was really hard. It felt really crowded and it really wasn't that comfortable. And it feels like there is so much students just trying to compete in that class...

Unfortunately, because Chemistry is a prerequisite for taking any biological science courses at her college, Rachel decided to change her major prior to even being able to take a biology class in college. Rachel changed her major from a pure biological science track to a more applied integrated major, human development. This major is still considered to be a science major. Part of the reason that she changed her major was because of the experience in her chemistry class. Regardless of the good teaching

that she perceived was going on in her science class, she still felt unsuccessful in this major.

Mussey: What about the teachers for your science and math class?

Rachel: The math class, the teacher that I had I couldn't really understand him, so I had a harder time in that class. But, for my chemistry class, It was a really good professor, and um, ya, but, the only problem that I think I had was that I didn't read all the materials. I didn't read the textbook. So I think that was one of the main reasons, that was the main reason why I fell really behind.

Mussey: Could you say a little more about your chemistry professor?

Rachel: It was a female and she, everyone told me she was really good and she is really clear, and she actually teaches us during her lectures, her lectures are really well taught. And she makes us participate by using a remote control and that's how she knows that we actually attends classes. And um, the questions that she gives us, they actually appear on the mid-terms and finals, and so she goes over them and tells us how to do them, a lot of the homework problems were on the midterm and the final, so it was easy if you know how to do the problems. I think the homework questions that she gave out were really helpful, if you know how to do all of them.

In the face of challenges, Rachel maintains a positive attitude and describes how she has grown as a student over the course of the year. She attributes much of this growth to her involvement in the summer bridge and OASIS academic enrichment programs at her institution. During her first quarter in college, Rachel earned a 2.0 GPA. She was disappointed with this academic outcome, but improved over the course of her freshman year.

Mussey: What is your current GPA?

Rachel: My GPA in the fall was below a like a 2.0 so I did like really bad in the first quarter, so did you want to know the next quarter and the next quarter it went back up to a 3.2 and I have kept it the same during the spring quarter.

Mussey: What kinds of things did you do differently between the fall and the winter and spring quarters to raise your GPA?

Rachel: I think the what was really hard for me when I first went in was like the quarter system and how at Preuss it was much longer because we had the trimester system and then we switched to the semester system and I guess I procrastinated a lot in High School and I guess I could do the same in college, and it didn't seem like it was that much work because it was like very few in

class meetings time, and a lot of your study time depended on yourself and you had to learn how to time management, so that is what I really like learned between the fall and the winter. And I got a lot of help with summer bridge program that I was in. they helped me manage my time and set my time. They taught me how to use my time. I guess I wasn't really paying attention to how I was using my time. So that was one of the biggest mistakes that I made.

Rachel was able to apply this learning to her courses in the spring quarter. She found success in her physics class, but since this class is designated for non-science majors, this experience does not seem to boost her confidence in her abilities as a science student.

Rachel: The physics class was much easier for me because it was the last quarter of my freshman year so I had learned how to manage my time a lot better and because it was a non-science, it seemed really easy because I took physics before in high school and then some of the stuff they went over was like exactly the same thing. We also had a textbook, but it was much easier because it was for non science....That professor also used the RAD control to know that we are participating, and this time I knew that the questions that he asked were on the midterm and this time I knew that so I wrote them down, he also posted them on line and he had study sessions. He gave us a lot of options for study sessions and he stayed after. And the classes were smaller. And the teacher led the study session.

Another reason that she found success in her physics class is due to the smaller class size, when compared to her chemistry class.

Rachel: the physics class which was smaller and the atmosphere was just a lot different (from the chemistry class) and I really like that smaller feeling, maybe because how Preuss was, maybe because it was in a smaller class, it was easier to talk to the professor compared to being in a large lecture hall.

Elizabeth's Story

Elizabeth attends a community college in southern California where she has been admitted to a transfer program, guaranteeing admission to the four year school, upon successful completion of a series of courses at the community college. She is

currently on track to transfer at the end of her second year. She intends to transfer to a large R-1 university in the same city, where she will major in biochemistry, and pursue a career as an OB/GYN. She has a 4.0 GPA.

After graduating from high school, Elizabeth attended a recruitment training program for the Navy. At the end of that 6 week boot camp program, she decided that the military “wasn’t the best solution.” She had the option to enlist or go to college, and she promptly enrolled in community college in her home town. Over the course of the year, Elizabeth has developed into a successful college student. She says that the biggest ways that she has changed is by becoming more studious, a characteristic that she did not feel she had in high school.

Elizabeth seems to have adjusted easily to college academic demands. Her class sizes are small and range from 15 to 45 people. She has been to professor’s office hours where she was surprised to learn that she could get academic help.

Mussey: Have you had the opportunity to form study groups or interact with your peers during your first year in college?

Elizabeth: Ya, I had a lot of study groups because there were a lot of freshman. We would help each other out. Like tell each other, ‘oh ya – you should go to this professor’s office hours. Because I thought the office hours was just sitting talking to the teacher about something, but it is actually them sitting there helping you . It’s a one-on-one. It is the closest you can get for a one-on-one.

She has also learned that she is accountable for keeping up with the assigned course reading. She even called her biology textbook her “best friend.”

Mussey: During the first years of college, students are searching for the best ways to prepare for classes and exams. Describe some of the ways that you have prepared for classes and exams during your first year of college.

Elizabeth: Basically, you have to do the reading. I learned that the hard way for uh, what was it, my bio class. For, uh, it was chapter one. I decided to skip chapter one and go straight to chapter 2 because it was longer, but oh, on the

test, oh geez, I was like a C. But, the whole section on chapter one, I didn't know what they were talking about. It was horrible, it was horrible. So, you actually have to do the reading and take notes. I do the Cornell Notes, write a question and an answer, and I do the key terms. You have to read along. Whenever you are assigned the reading, I read it.

She is also able to apply the skills that she learned in high school to college, such as Cornell Note taking and studying in groups. She utilizes the resources offered by her professors, including accessing study guides that are available in the library and notes that are on-line.

Her favorite classes have been her psychology and Japanese classes, since she has been able to directly apply this knowledge to her life. She has struggled most with her English classes, and the writing that is required in college. She describes her typical science class.

Mussey: Describe a typical science class at your college.

Elizabeth: It was actually so similar to high school, like our AP Bio classes, we dissected a class too, we also dissected a cat in that class. Two days a week you have a lecture, and one day you spend in the lab. It was like here is your set of procedures, read it, do it, turn in your work, go home.

Mussey: Could you talk about the teacher in that class.

Elizabeth: The teacher, It was horrible, he was just like read the book, read the book, and it was just like lecture, lecture, lecture. No PowerPoint. He was just lecturing out of the book, so the book was your best friend, so I did the reviews out of the book.

Elizabeth is excited about her academic success and her future aspirations. She says that the biggest adjustment that she has had to make is the social transition.

Mussey: Some students find the transition from the Preuss School to college difficult. Talk about some of the ways that The Preuss School is different from college. In what ways is Preuss similar to college.

Elizabeth: The biggest one would be social. Because you are so used to high school you know everybody but then you go to college and everybody is on their own, so basically you sit alone. That is why I study alone. I mean, you do

make friends, but It is more of a social transition. Academically, it is not that bad, its not that different from high school, from what we had here.

Moses' Story

Moses attends a small private university in southern California. He is majoring in architecture and plans on becoming either an architect or starting his own business when he graduates. He feels that he is excelling academically. He has a 3.4 GPA.

Moses successfully manages his time in college and is very proud of the fact that he spends 30-40 hours a week in the design studio, while still managing to work part time on campus. In his free time, he de-stresses with classmates from his studio class, a tight-knit group of friends, one of the results of the cohort model that exists at his school.

Moses loves his studio classes describing them as both his favorite and most challenging classes.

Mussey: Could you talk about your favorite class?

Moses: My favorite class was that studio 1A, the first semester, that is the main class that architecture students take. I enjoyed it because I got As and the thing was that not many, two or three other students got As too. It made me realize that we could have done so much more, I guess that the analytic process came naturally to me, but I think that Preuss could have done better in offering more about architecture, since it concentrates so much on politics, science, and engineering. If Preuss, had something more, I could have performed better in that class.

Even though he got As in the class, he feels like he could have been more prepared for the analytic and critical thinking that would be required of him in college. He is learning how to think in different ways, “problem solve,” and successfully complete design projects. One of the biggest factors that helped him to be successful is the

teaching that is going on at his university. When I asked him about his studio teacher, he says,

Moses: The teacher, you would have to meet him. He would work and then come to this class. He just brings, he just opens everyone's mind. Even as an analytic person that I considered myself. He just opened my eyes, and I could see more in a abstract way. He just opened my mind to a new way of thinking.

Moses had an 'eye-opening' experience in this class, an experience that engaged, challenged him, and solidified his commitment to his major and career choice, architecture. He has developed personal relationships with many of the faculty members at his school and keeps in communication with them via email, by going to office hours, and by staying after class to talk.

Mussey: What has been your most challenging class?

Moses: Studio or Design Com. 2. They asked for a lot of money for everything. Every project I had to at least spend like \$100 on every project and we had like 5 of them, so the financial and what they asked for in the project was challenging.

Mussey: What did you find challenging about those classes?

Moses: Oh, it was something that I was never asked to do at Preuss, like build a certain model out of wood using certain criteria and you couldn't go off of this point and you have to build within this limit. Things I never encountered at Preuss.

Moses describes the challenge as being twofold: 1) It is a financial challenge to come up with the extra money necessary to build projects throughout the semester, and 2) It is an academic challenge, because authentic problem solving is an intellectual task, he has never done before. The financial challenge may deter low-income students from participating in this major. There are few low income students at the expensive private school where Moses attends college.

Moses works as a math tutor for the office of academic support and instructional services (OASIS) program. As a tutor, he has the opportunity to help other college students develop academic competencies, while gaining confidence in his own identity as a math student.

Mussey: Could you talk about a typical math class at your school?

Moses: All the classes are very small, maybe 20 students. (name of school) is a private school and the classes are very small. I guess I was the most prepared one there. Everything they were teaching us, I found to be review. The teacher, he was nice. He would even ask me to do the problems, because sometimes he would get confused. But, he would work around it and show us different ways to work the problems.

Moses does not have the sense that he is ‘just a number’ at his institution. Due to the small class size and confidence in his academic abilities, Moses has met and made positive impressions on some of the faculty at his college. Moses does most of his studying alone, and finds group study to be distracting and unnecessary.

Similarities Among STEM Persisters

From the narratives of Luke, Naomi, Rachel, Deborah, Elizabeth, and Moses, we can see that the decision to persist in STEM is not always easy. All of these students have faced challenges with coursework and adjusting to teaching styles at their institutions. Although all of the students had above a 3.0 GPA in high school, not all of the students have high college GPAs. Naomi and Rachel both struggle to improve their GPAs. The other students in these examples have over a 3.0 GPA, but not all of them are satisfied by this outcome. Luke and Elizabeth have high GPAs and seem to be satisfied and even proud of their accomplishments. Deborah and Moses have a high GPA, but seem somewhat dissatisfied by their academic outcomes.

They all feel they are prepared for college, and display a medium to high sense of self-efficacy. They also share the understanding that it is their responsibility to get motivated, and to manage their time and academic success. These students have accepted the responsibility for their educational outcomes. All of the STEM Persisters in this study have experienced some successes in either their science or math courses or in their science or math related extra-curricular activities. All six of these individuals are actively involved with academic related affinity groups that have helped them persist in their major despite any challenges. Luke, Rachel, and Moses were involved in a summer transition experience. Naomi and Moses are actively involved in STEM related affinity groups at their institutions. Rachel, Deborah, and Elizabeth have built relationships with other students at their institutions. They are all supported by their peers and get academic support from those social supports. Finally, all the students in these examples, regardless of the size or type of their institution, have had a positive experience and close interaction with a STEM professor at their institution. See table 5.2.

Table 5.2: Common Experiences of STEM Persisters

Common Experiences of STEM Persisters
<ul style="list-style-type: none"> • All students felt prepared for introductory science and math classes in college. • All students are engaged in an Academic Affinity Group which supports their learning. • All students understand their role and responsibilities related to their academic outcomes. • All students receive academic support from peer social networks. • All students have had at least one positive interaction with a STEM teacher at their institution. • All students have experienced at least one ‘success’ (as defined by the students in a STEM course or STEM affinity group.)

Further discussion of STEM Persisters will be included in Chapter 6.

Stories of STEM Switchers

In this section, I share the narratives of two STEM Switchers, one male who I call John, and one female, called Martha.

Martha’s Story:

Martha attends a large, highly-selective, private, out-of-state school. In high school, she was confident, independent, and at the top of her class. She consistently earned above a 3.75 GPA in high school. She loved biology and planned on majoring in biology and chemistry in college. She participated in several biological science related internships in high school, and seemed intent on a science related research career. After two semesters in college, although she has not yet officially declared a major, she has decided to double major in Spanish and French instead. She currently has below a 2.5 college GPA.

Martha does not feel as though she has been successful in college. She has faced many challenges, both personal and academic, and she is struggling to overcome the challenges and re-focus on her academic work. She says one of the greatest mental challenges is being below average, a new experience for her. One of the most important life lessons that she says she has learned is that, “Mental health is worth more than any grade, or any class.”

Even with this new mantra, she realizes that her poor performance at the beginning of her college experience may affect her future opportunities. When I asked her about the possibility of studying abroad, emphasizing her interest in language, she said that she doubts that will be possible due to her low GPA.

Part of the reason that her GPA is below a 2.5 is the rough start that she had in her first semester freshman classes. At the time, she was planning on majoring in biology and chemistry. The first chemistry classes that she took impacted her life by influencing her decision to both change her major and her career path. She says that these were the most challenging classes that she has taken.

Survey Question: What class has impacted your life the most and why?

Martha: Chemistry 21 and 22 both impacted me because I did so badly, so I was able to change up the course I was setting myself up for.

After taking these classes, she says that she feels as though she was “weeded out,” of the sciences. The fast pace and competitive environment of the introductory chemistry classes, coupled with the adjustment of moving far from home left her feeling exhausted and incapable.

Mussey: You started as a Chemistry major, could you talk about why you are changing your major?

Martha: I changed because I was completely weeded out. I couldn't keep up with the pace. I couldn't keep up with anything because I am so far away, and I didn't study well my first year. I didn't really do much work. I was a little disillusioned. I got a C in AP chem., so maybe I should have realized that wasn't the best way to go...I changed a lot because it was really competitive here and I just couldn't do it. I got Ds in my first two chem. classes and if I get anymore (pauses)...I was too exhausted from these intro classes. I felt pretty incapable by myself.

She describes the introductory science lecture classes as being large and “completely useless.” From her discussion of the professor, she seems to think that he is more interested in his own research than teaching, a common feeling among undergraduate students at large universities. One structure at the university, in place to help students learn the content, is a small discussion group called ‘recitation.’ This experience did not benefit Martha since she had trouble understanding the recitation teacher’s accent.

Mussey: Describe one of the introductory classes.

Martha: We meet 3 days a week for lecture that lasts a little over an hour. They always schedule those intro classes early pretty early so they can get kids outta bed. And we have an hour and a half lab. Our first professor hadn't taught an undergraduate class in like 20 years and the 2nd was like a crystallography like specialist so he would always talk about his own science. It was just very like, here is the info you have to learn it, and it is just very...I should have taken the initiative and done it myself. The lectures are just completely useless. They don't go over how to do any problems. Or do any questions on exams at all..there is also chem. recitation where they are supposed to teach you and my first chem. recitation prof was a visiting prof who was Russian who wasn't really doing anything. I never went because he just made me more confused. I think that my high school teacher gave me a really good base, but then it got worse. Noone would tell you how to go about solving the problems, so it was just a disparity between what was going on in class and what we were being tested on. There were over 100 people in the class...

Martha's frustration with her academic performance seems to be amplified by her feeling of isolation at this large institution far from home. As a low income student, she feels like she is in the minority, and doesn't understand what she calls the “work-

hard/play-hard” mentality of her more privileged peers. The result is that she is left feeling like she is struggling in isolation. She perceives that most of her peers are performing better academically than she is, and even calls this struggle to develop her academic identity in this new context as an “identity crisis.”

Mussey: Part of the Preuss School mission is to prepare URM students for college because historically black, and Latino students have had less access to college. Do you find yourself to be in the minority at your institution?

Martha: Its hard because I have had a huge identity crises. I feel like I can't claim the Latino heritage because of how I look. I may fit in more because I am light skinned. The student population is really diverse and I didn't see it my freshman year. Now, I am really aware of the race issue ad there are tons of people that I have met because I have looked for them. In one sense, I am in the majority because of how I look and the way that white people are stereotyped is as sorority girls and frat guys that have so much money I can't wrap my mind around it. How...I don't even know. I have \$7.00 in my bank account. I can't imagine. The majority isn't white people, it is rich white people. It is not just black people, it is rich black people. It is not just Latino, it is rich Latino. The minorities that are here are wealthy. The financial aid kid is the minority here. I have been trying to identify as the Latino, but even that group is wealthy. I haven't been around “poor minority” kids.

Since changing her major, she has started to feel successful in some areas of her life.

She attended a summer language program which positively influenced her perception of herself as a student. This program helped her gain a global perspective on life and has helped her do what she calls, “carve her path.”

Mussey: Could you talk about the (name of school) college summer program (language immersion program) ?

Martha: That was pretty much the best decision that I ever made in my life other than coming to Preuss that really had a huge impact on me. It was for 7 weeks. We couldn't speak English. I wasn't talking to my family or listening to music. There was a huge range of people. I really learned how to study well and to work well. It really opened up my eyes because it wasn't just about taking French classes. It was about how French has an impact on the world. And French speaking countries in Africa,. It gave me more of a global sense than anything in college so far. It is going to shape what I do in the future.

Mussey: You said you want to go into education...

Martha: After I went to Middlebury, I am thinking about teaching English to second language learners, and I found a joint program at Columbia that teaches in inner city schools in NYC. I think it is important to continue my own studies. I feel like that is one of the reasons that I want to go to grad school, especially if I want to teach English or adults. I also know I want to work on myself.

She has already adopted a life-long learner perspective on life and intends to use her education to fully develop this part of herself. She has also had some positive experiences at her University, including building a relationship with a professor, and attending a student organization retreat. Both of these experiences have helped Martha feel more connected and less anonymous at her institution. But she remains estranged from STEM fields.

Mussey: Tell me about your favorite class.

Martha: The one that had the biggest impact on me was my psychology class. The professor reached out to me when he realized that there was a problem with all my grades. That had a big impact on me in terms of how I felt about my teachers and classes in general because I felt really lost in the crowd before that.

She misses the sense of connection that she had with her teachers in high school. One of the most challenging aspects of transition to college for Martha is the absence of having a small community of learners, with people who know her name.

Mussey: What do you miss most about high school?

Martha: The teachers that know your name. The teachers that have known you since you were 10 or since you were 14. You don't realize the importance of that until you don't have it anymore. You don't realize the teachers at Preuss are more dedicated than we were. And the teachers in college, ya, they are funny, but they are teaching a class because they have to, so they choose the intro class because it is the least amount of work and that is apparent. I miss the smallness and knowing everyone. I used to think that was bad, but now, being unknown is the worse thing ever. I miss the teachers and miss people knowing who I am.

In spite of her struggles, she definitely felt prepared for college in terms of having the basic academic skills to be successful and the basic time management skills to manage her time.

Mussey: How were you most prepared for college life and college academics?

Martha: I think what made me most prepared was the long schedule for the day. I feel like I have enough base like, I can do math, and I can do science, and I can write an essay.

But, she is still adjusting to the social culture that exists at some large campuses in the United States. She describes this culture as the college “hook-up culture” and she sounds shocked as she describes the nature of social relationships that exist at her school. She avoids this culture and surrounds herself with students who are like her in that respect

John’s Story:

John always wanted to major in science, or so he thought. John attends a large R-1 University in Southern California where he started as a biochemistry and cell biology double major. After completing two quarters, John decided to change his major to Visual Arts with an emphasis in film and cinema. This decision was not easy for John since he felt pressure to major in science, a discipline that he always associated with being successful. In our interview, John talks about the decision to change his major and discusses two reasons and one major realization that came out of this decision.

John: I am going to switch to visual arts majors.

Mussey: Why?

John: Because, well um, because I really like making movies and I really like art and I know like coming to (university name), I always felt like pressure to come a science major, so I wanted to try something new, and I took Visual

Arts, and I really like the class. I could have got an A in it, but it was just my essays, like making movies, I always got an A in making movies. (He got a B+ in the class.)...I decided that sitting in a lab, and I decided that med school is not for me. I really like science, but after chem. It was really hard, Chemistry just turned me off. It is really hard.

John: I thought the other majors were just like taking the easy route. Because (this school) is medicine and known for biology, I thought I had to be a bio major and I could maybe do pharmacy. But, I learned that you don't need to be a bio major to be successful. That's what I learned.

John decided to switch from a biochemistry/biology major into a visual arts major because he discovered that both his interests and abilities are more directly aligned with tasks that he was completing in those classes. His perception of science as a major that would lead him to "sit in a lab" or go to medical school was not attractive especially after coming to the realization that he could find success in another discipline. John has become very successful at college by maintaining a 3.18 GPA, becoming involved with the Asian Pacific Islander Student Association, a service fraternity, and a grass roots newspaper. He aspires to make movies for Disney or Pixar.

John's theory of action about learning is similar to other students who attended The Preuss School UCSD. He understands that learning can occur in groups, and that group study can help students "fill in gaps" of missing information. Because he has internalized this theory of action about learning, John participates in study groups often, occasionally initiating groups, through use of online social networks such as www.facebook.com. He plans "events" on these social networking sites, inviting students from classes to participate and meet at the library for group study. John also studies alone, but he uses that type of study time to practice already acquired knowledge. He has attempted to attend professors' office hours, but he admittedly

made the mistake of waiting until the end of the term to go to the professor's office. At this point in the term, the office was crowded and he was unable to make a connection with the professor. He says that he has learned from this experience and will attempt to attend office hours earlier in the quarter to attempt to build personal connections with the teaches.

According to John, the interaction and personal connections between teachers and students is one aspect of the high school experience that is missing from the R-1 University experience. He relates this connection with caring, and since this relationship is absent in college, he assumes that the professors don't care.

Mussey: What advice would you give teachers in high school to better prepare students for college?

John: Well, I like the student and teacher interaction because we are so close to each other, we know, we talk and know each other well. To get the college feel, Ya'll should be more harder like really harsh.

Mussey: In what ways.

John: In testing...because I swear on, sometimes on exams, I swear we did not go over this questions...oh, and homework does not count in college.

Homework is up to you. You can do whatever you want. You don't have to do the homework. The class is quizzes test, and participation...attendance is not required. Math they don't care. Chem. they don't care. The Prof. doesn't care. It is like whatever.

John felt prepared for college in terms of the work load. He attributes this preparation to AP courses and scaffolding in high school.

John: I also wanted to add...I really just like the system where at where at Preuss we take APs, and like how, you know, I remember like Mr. E and you and the advisory teachers they help us with, like you guys help us with prep. And going to college and applying for college, and like financial aid and letting us know about scholarships and stuff like that. And like meeting people like a lot of my friends from here they go to like these big high schools and their counselors don't care about them, and I am just really thankful that I came from here and I got enough money to go to college and other people are

like, oh, I didn't know about FAFSA and I didn't know about SATs, and I am like, 'are you serious?' you know? So, I am really glad about Preuss, does that.

Discussion of STEM Switchers

Martha and John's stories seem different on the surface, but there is a common underlying thread. Both of these students attributed studying science with being "successful" and smart. They were both at the top of their class in high school and rarely experienced any academic failure prior to entering college. At their large universities, however, they felt anonymous and unsuccessful as science majors. They both, in one way or another, failed their introductory science courses. Martha failed her chemistry course, and John withdrew failing in order to protect his scholarship. Both students felt like failures in a major that they originally associated with the only path to success. Fortunately, both students found other avenues to success. Martha became very successful in her summer language program. John became very successful in his visual arts courses. Both students left STEM to pursue an area of study where they felt confident, capable, and successful. Further discussion of STEM Switchers will be included in chapter 6.

New-STEM Students

Although it happens less frequently, occasionally, students become interested in science and math during college and change their majors into STEM fields. I provide one example of this case here. Lydia, a student who entered college a liberal studies major, decided to switch into a science related field after experiencing geology course with a dynamic teacher who provided quality and relevant instruction. Lydia's

geology teacher influenced her to choose science as her focus and aspires to become a science teacher.

Lydia's Story:

Lydia attends a large public college in Southern California where she is a liberal studies major. She originally planned to get her teaching certificate and teach either kindergarten or 4th grade. Lydia feels very successful in college. She is proud of her academic accomplishments and feels like she has adjusted to college life well.

Mussey: Tell me about the most significant things that have happened to you since you graduated from Preuss.

Lydia: Well, uh, I was really proud of myself for finishing the first semester of college. It was personally hard for me because I was going through a lot of changes. One of my best friends had passed away, and I was re-thinking everything. The second semester, I was really proud of myself, my GPA went up a whole point, I even got on the Dean's list or something like that.

As you can see from her interview, Lydia gained some renewed pride in her academic accomplishments when she was recognized at her institution for good grades.

Lydia has been influenced positively by some of the interactions with her professors at her institution. Even in her most challenging class, the relationship that she built with her professor helped her to see this as a positive learning experience.

Mussey: Tell me about the most challenging class that you have taken in college.

Lydia: Hmm, challenging, let me think, well, I'm thinking math, 211, um that was a class I took, spring '08. The material itself was hard for me because I had a really hard time during elementary school, and I just I don't remember a lot of basics overall, so the class was to teach us how to teach those basics, and so I felt like I was one step behind. It was just harder for me, so I would give like 150% and I would make sure I was there early and I would stay late. The teacher, it was hard because of the material we were covering, but the teacher was really good even though she had just like transferred from China, and she had problems communicating what she was trying to say but I actually worked with her, and I ended up getting to know her very well, I even ended up

interpreting for her in class. So, that class ended up being a positive experience for me even though it was really hard. At one point I had a D, and then it went up to a C, and then a B, and that is where I stayed.

Through the interaction with her professor, she gained a renewed sense of her capabilities in math, a subject that has produced anxiety for Lydia since elementary school.

Lydia has also had positive experiences in some of her science classes. One class in particular, geology, impacted her so much, that she now plans to specialize in science for her liberal studies degree. She says that:

Survey Question: What class has impacted your life the most and why?
 Lydia: Geology. It has taught me how wonderful learning about this earth can be and has renewed my interest in science. I used to hate it and now I have decided to specialize in science for the liberal studies major.

A positive learning experience in science has renewed her interest in science. She goes so far as to say that she used to “hate it.” When I asked her in the interview to tell me about her favorite class, she talks about this geology class again.

Mussey: Tell me about your favorite class in college so far.

Lydia: (She talks about a PE class first.) The other class is geology, and I have learned a lot, just a lot. She jokes with us about that we are going to talk about this at home with our friends and I actually do that because it is so interesting.

Mussey: Could you talk about the teacher in that class?

Lydia: She usually lectures to a PowerPoint, but um, she does, what I like about it is that it is not a usual PowerPoint, very little writing on the PowerPoint, just mostly images, and figures, and maps, and very beautiful images too. And that is how she captures our attention with amazing facts, like she will tell us how right by where we live there is a transform boundary right by where we live, and she will show a picture of it actually moving and that is when the whole class starts paying attention, we are like, what? And um, and its just really an interesting class because of what we can see there and she has amazing images, amazing videos, and the material itself is just like really cool. That is one thing I wanted to mention. For attendance she has a little apparatus, and just by answering, she counts you as there. I have done 80% or above on every test. Most of the material on the test, she does in class.

Lydia likes this class because the teacher makes the content interesting and relevant to the student's lives. By using images on PowerPoint, the teacher captures the attention of the visual learners, which Lydia claims to be. By teaching all of the material in class, she lowers the affective filter for students and they feel like they can be successful on tests. Lydia tells me that the teacher uses the textbook as a reference. Lydia has adjusted to college academics well. She says that the hardest part of the transition process for her was getting used to a different accountability system. In high school, teachers hold students accountable for every piece of work that they do. In college, students are accountable for learning the material and displaying this knowledge on exams. For Lydia, this was an adjustment, as you can see from the following quote:

Mussey: Some students find the transition from high school to college difficult. Talk about some of the ways that your high school experience is different from college. In what ways is high school similar to college?

Lydia: Ya um, well one of the main things that I found difficult is that I was very homework oriented. I would always do my homework always, always and I would always do a top notch job on it because I had the resources, because homework is homework, you could take it at home and just go crazy. So I would rely on that homework grade to get an A. So, my test average would be a B or C and I would never worry about it because I would still have an A. So I would be like, it's cool, I have a good average. So when I went to college I realized I had a problem, because I would read on every syllabus didn't say anything about homework, just 75% exams and tests, 20% finals, and 10% attendance, so that was kind of scary and I was really, really scared the first semester. I was sure that I would fail at least one class...but, I didn't. I was just really scared because it was just me alone with my brain. It wasn't like I didn't know about it. I was told, just getting there to college and seeing it, that was scary.

Lydia advises her former high school teachers to adjust their workload to reflect the college style of accountability. Specifically, she says:

Survey Question: What advice would you give Preuss Teachers about how to better prepare students for college?

Lydia: Workload needs to be reduced....A LOT. There's no reason to master bookwork/classwork. There is NONE in college, if hardly any. Concentrate on tests and essays, critical thinking, reading. I know Preuss does this already but I just think the amount of homework was un-necessary. Most kids were burnt out after graduation and in my opinion, that caused a lot not to finish/go to college. College has no work except reading, LOTS of it and 3 exams that make up your one grade. At Preuss, mostly 50% of grade was HW and classwork and the other 50% was attendance and tests. Make it at least 75% tests.

Lydia is a rare example of a student whose positive experiences with a science course in college encouraged her to change her major to science. The experience in her geology class provided her with an example of good science teaching, as well as a role model for her future career as a teacher. She saw the power of culturally relevant pedagogy, and teaching to students particular learning styles.

Non-STEM Students

Not all of the students that I interviewed were STEM students. Mary is an example of a non-STEM student experiencing the transition from a college preparatory high school to a large R-1 University.

Mary's Story

Mary attends an R-1 University in California. She doesn't know what she will end up doing in life, but she remains excited about all of the possibilities that lay before her. She seems to have many options before her, due in part, to her taking advantage of all of the opportunities that exist at her large institution. When asked about the most important things in college, she says, "what comes after." She is always looking to the future. Even as a college sophomore, she already has her eye on

graduate school or law school and her ideal post-college lifestyle options. She may even move to the east coast. I'd say that graduate school is definitely in her reach as she is a successful college student by any definition, and she seems to know this and know why. She confidently offers advice to new and incoming students, urging them to get involved. "Talk to people," she says, and "get to know the orgs."

Mary's life in college is more than academics and seems to revolve around the myriad of student organizations, clubs, and communities with which she successfully networks. She is currently an ethnic studies and political science double major and she has between a 3.0-3.5 GPA.

Mary was always a successful leader. She emerged as a sort of entrepreneur on her high school campus, and was heading towards a career in business, or so she thought. Choosing to stay closer to home and attend a college that would not put her into sizeable debt, she was introduced to ethnic studies, and began to understand the social inequities that exist in society. Formally studying how both class and racially based inequities afford and constrain opportunities for individuals in society provides a framework for Mary to understand and build her own story. As a first generation college student and a Mexican-American female from a low-income background, Mary relates to the coursework and finds relief in learning about multiculturalism and access to education issues for Latinos and African Americans. In fact, everyday, as she attends class at her prestigious university, learns about inequity, and reads about stereotypes, she sees evidence of the inequity before her very eyes. She could not

believe that only 9% of her fellow freshman class are Latino, and she seems to be in shock knowing that she is part of that small percentage.

Her interest in the ethnic studies coursework, as well as her interaction with her ethnic studies professors are some factors that contributed to her changing her major to ethnic studies. These were not the only contributing factors that led to a major change so early in her academic career. Her original intention to major in business still persisted, until the end of her freshman year, when after realizing the large size, difficult requirements which would prolong her graduation, and impacted nature of the business major at her school, she decided to change her major to political science and ethnic studies. She is now a double major and may graduate a semester early if she stays on track.

When Mary arrived at her university in the fall of 2008, it was actually the first time that she had ever seen her college campus. She did not have the luxury or resources to make a visit earlier that year. During the college application process, she had a tough decision to make. She was admitted to numerous prestigious schools around the country, most of which she knew by reputation alone. She agonized over the choice that would ultimately decide where she would receive her undergraduate education and she eventually selected a school in a town where she had never set foot. She laughs at the memory of making the ten hour drive from home to college with her parents, remembering, in disbelief, how they got lost on the way. Her parents dropped her off, alone at the dorm, and she immediately got to work, accessing the many

resources on campus and getting involved. She keeps herself busy to stave off homesickness and makes visits home for holidays when she can.

Mary spent the first year in the dorms. Dorm-life was not what she expected and she missed aspects of her home life including having a kitchen for cooking, or a living room for socializing and lounging. She was surprised by the lack of social interaction among the girls in her dorm and she didn't meet many people there, even though she did attend dorm-based functions including a floor meeting that she remembers vividly.

She recounts one of her first experiences in the dorm at her institution, where she lived as a freshman, an experience that she only describes as "Culture Shock." During this meeting, all of the floor members introduced themselves. Of the eighteen girls, ten of them had parents' who attended graduate school and held Masters' degrees or higher. Five of the girls were from affluent and quite famous neighborhoods in Southern California, and everyone came from families where college attendance was a tradition. Mary was the only girl on her floor who was a first generation college student from a low income background. The interesting thing about this interaction is that Mary implied that she was not the only one who was shocked. The other girls on her floor in her dorm were equally shocked by the differences in background and Mary became motivated by this interaction. She seems even more committed to sticking with it, as she says and she even seems to feel a sort of responsibility for educating "them" about where she comes from and the mission and goals of schools that are trying to increase access to college for students like her.

Following this interaction, Mary joined some ethnic based social organizations including a Chicana based sorority. This sorority, which she identifies as “not mainstream” has goals which focus on philanthropy, sisterhood, and social activism. Mary also joined a political activist groups and is involved in promoting the “Dream Act” a piece of legislature which would provide immigrant students who graduate from high school the opportunity for citizenship. Mary also participates in Americorp where she works at a pre-school teaching low-income minority students. As she speaks of this experience she starts to see the connection between early educational opportunities and access to college. Her awareness is emerging and she is beginning to connect the dots between her academic and her lived experiences, although, she does not speak explicitly about this connection. She may or may not be aware that she may share some similar characteristic\’s with the pre-school students that she serves or that her background motivates her to join and participate in the communities in which she works and lives.

She does not know what the future holds, and even though she is interested in the non-profit sector in which she is involved, She seems to be open to the possibility of “more” and she knows that where she is “opens doors.”

You can imagine Mary up late in the library. In fact, during her first year, she spent most of her nights into the early morning doing her studying in the library. The library closed at 2:30am, and she would stay until it closed. During her sophomore year, she had to change her study routine slightly, since living off campus without a

car left her at the mercy of the bus schedule. Since the busses stopped running at nine, she studied until then and would then go home and finish any assignments there.

Mary does most of her studying in groups and has really gained a sense of academic belonging at her institution by participating in these study groups. She speaks of her study groups proudly, wondering if the same type of collaborative learning is occurring at other Universities or if it is unique to her own. She talks about discussing readings, and lectures in these groups, and even using ideas that she gained from her study group to make stronger arguments in her papers. She has had to write a paper for every one of her classes thus far, research papers and critical analysis papers and although she thinks she was prepared for college in terms of the reading load, she wishes she would have been more prepared for the writing she would be expected to do. Writing in college continues to challenge Mary.

Mary is an exceptional case and in the minority at her institution in another respect. She has attended office hours for every class that she has taken. She networks with other students and professors during these office hours and uses the interaction as additional study time. She learns during the office hours and although she has only formed a relationship with one of these professors, it is a strong one that has impacted both her decision to major in ethnic studies as well as provided her with a research opportunity for her undergraduate education.

She hasn't taken many science related courses. The one class that she took is a biology class that is cross-listed with psychology. She did not have much to say about it with the following exception. The class was huge, 520 students, 10 TAs and 1

professor. This was the class with the fewest students of color. Most of the people in her class were either white or Asian and biology or pre-med majors. Apparently, she was in the minority in this course. She doesn't speak about the teaching style content, or application to her life which is interesting because she recalls the title: Drugs and the effect on the human body. This sounds like an interesting course, but she would rather talk about her political science classes.

Discussion of Narratives

The students' narratives provide a picture of how these underrepresented students are experiencing the transition to college. In this sample, five factors impact the students' academic identity development, major choice, and career path: 1) college preparation in high school, 2) self-efficacy, 3) success in college academics, 4) affinity group participation, and 5) interaction with teachers. See figure 5.5.

In the next chapter I provide examples of how each of the five factors influence students' academic identity development, major selection, and possible career choice. The analysis of how these factors impact students help us answer the following research question: How are students developing their college-going, academic identities in the context of their educational institutions?

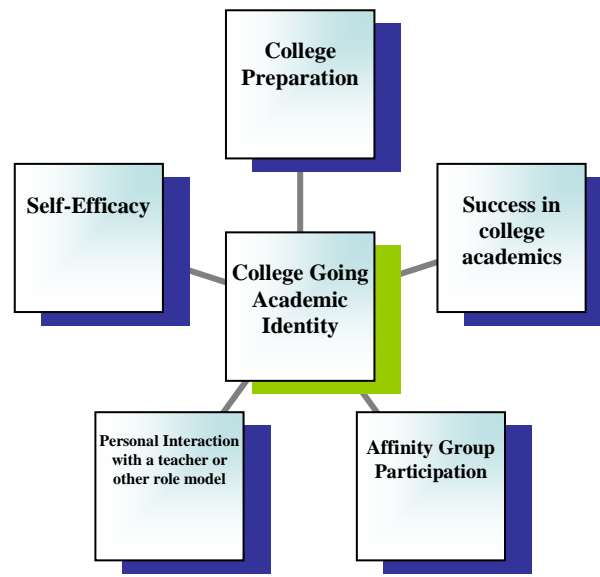


Figure 5.5: Factors that Influence Students' College Going Academic Identity Development

Analysis of how these factors can influence students' science and math identity development in STEM contexts allows me to answer the final research question: What factors support or constrain student participation in STEM majors at their institutions of higher learning?

Chapter 6 - Transition to College

Factors that Influence Students' Academic Identity development

Through the process of writing and reflecting on the student narratives, I learned that all students who are engaged in the transition process from high school to college enact coping strategies that they have internalized as strategies that will enable them to find success in college. Many of these coping strategies were strategies that they were explicitly taught at their college preparatory school. These coping strategies and students' understanding of how to enact them in their educational contexts make up each students' theory of action about learning, a theory of action that influences each students' college-going academic identity development.

Much of the transition process involves enacting theories of action on two planes of their lives: 1) the academic plane and 2) the social plane. Some students integrate the academic and social planes harmoniously, engaging in social interactions and affinity groups which actually enhance their academic experiences and improve their academic outcomes. Other students search to find balance between the sometimes conflicting academic and social planes in their lives. In either case, students' academic and social experiences are intertwined and both impact college-going academic identity development. In most cases, students search for and find pathways to success. Many of the students in this study reveal their desire to find success and discuss the realization that there are, in fact, multiple pathways towards their goals. Some students have found ways to feel successful and other students are

still searching. For many of the students in this study, success cannot necessarily be defined by a high GPA.

In this chapter, I discuss the important findings related to the “transition to college” experience for students. These findings are organized around the five factors that impact student college-going, academic identity development:

- 1) The role of college preparation
- 2) The enactment of coping strategies
- 3) Affinity group participation
- 4) Perceived self-efficacy and the importance of feeling successful, and
- 5) The role of the teacher

I will conclude this chapter with a discussion of how each of the above factors are related to one another and how they are related to the students’ decisions to persist in or switch out of their originally intended STEM related major.

The Role of College Preparation

Students’ academic identity development in college is influenced greatly by their college preparatory experience. As described in chapter one, the students in the study attended a college preparatory, 6-12 grade school where they completed a rigorous, single-track college preparatory curriculum. Alongside this curriculum, the students who attend this school are offered academic and social supports to assist them to be successful in this type of program. Supports include explicit teaching and practice of such academic coping strategies as reading and note-taking skills, writing across the curriculum skills, time-management skills, and math problem solving skills.

Teachers collaborate regularly to vertically align the curriculum which supports students preparation for the Advanced Placement (AP) courses that they are required to take in high school. Participation in the advanced placement curriculum and the testing process helps to expose students to the rigorous work-load that they are likely to encounter in college.

The mission of The Preuss School UCSD is to prepare first-generation college students for college by providing a rigorous college preparatory curriculum with the supports necessary to be successful. At the same time, the school also hopes to foster the development of students' multi-cultural college going academic identity. In support of this goal, the teachers at the school developed the expected school-wide learning results (ESLRs). The ESLRs describe the ideal Preuss School graduate. The high school curriculum coupled with the social and academic support structures at the Preuss school prepares Preuss graduates to be knowledgeable, critical thinkers, communicators, collaborators, technologically-literate users, healthy, balanced, and globally aware citizens. Overall, the students in this study were high achievers in high school. Each of them had above a 3.0 GPA in high school, and met or exceeded the Preuss School ESLRs. Academically, they had successfully completed the college admission requirements as set forth by the University of California. All of the students in this study experienced identical college preparatory curriculum and were explicitly taught coping strategies to be successful in a rigorous academic environment.

This study aims to understand how each of the participants in the college preparatory program described above had internalized the coping strategies and

subsequently enacted them in their academic contexts at the college level. In the following paragraphs, I describe the ways that this college preparatory program prepared students for college, as well as the coping strategies that these students use in their educational contexts. I also describe ways that students felt under-prepared for college.

Ways Students were Prepared

Although both female and male students in this study, 65% of the research participants, report that they are doing less well in college than they would like, over eighty-four percent of the students report that they do feel as though they were prepared for college. Female and male students who were interviewed (n=20) felt prepared for college in certain ways. Many students report being prepared for college academics in terms of the heavy workload and rigor that they experience.

See Table 6.1.

Table 6.1: Ways Students Report Being Prepared For College

Ways Students Report Being Prepared For College Academics
<ul style="list-style-type: none"> • Many students felt prepared for the workload and rigorous coursework. • Some students felt prepared for the writing that would be required in college. • Some students felt as though they had an idea of what career path they wanted to follow because of exposure to that career during high school courses or internships. • Many students felt as though they had been exposed to some of the content that they would be expected to learn in college, such as biology, chemistry, and math. • Students were prepared to be critical thinkers and problem solvers. • Students understood the process of getting into college, and applying for financial aid. • Students were prepared for managing long days and a hectic schedule. • Students were prepared to be dedicated to their schoolwork. • Students were prepared to utilize the resources provided by their professors and take advantage of opportunities that were presented. • Students were prepared to enact specific coping strategies that they were taught in high school.

Students discuss how both the content and the way that they engage with the academic content in high school courses benefits them in college. The following observation typifies students' responses about this issue.

Mussey: How were you most prepared for college?

Deborah: Preuss is similar to college in its rigorousness. The material we learn, *and how we learn it* at Preuss is similar to the **good** teaching here (at her college). I've recognized some of the techniques I learned and practiced at Preuss being taught here such as the types of hooks for an essay, how to draw Lewis dot structures, partial fractions. There's a lot of thinking to do and the critical thinking skills from Preuss really help such as working backwards from the answer, looking at similar problems.

Students attribute that preparation to the advanced and AP courses that they took during middle school and high school at Preuss. Some students were even exposed to their future career path in those advanced courses.

Mussey: How were you most prepared for college?

Noah: The classes, like, the classes at Preuss made it a lot easier. If I went to a public high school, I wouldn't have learned half the crap I learned at Preuss and I think that was a big part, also, I was so, I mean, every year I heard, like, 'you are going to have to write essays, you are gonna need to know how to write one. This is what you should expect. It might be a lot harder, it might not be. That was the biggest thing. I think if I went to another school I would not have been doing as well. I probably wouldn't know what I wanted to do. It was my senior class in AP government when I found out what I wanted to do.

Like Noah, Hannah also attributes much of her preparation to the AP courses that she took in high school. She feels that AP courses put her on par with other students at her university and that the experience in AP courses lowered her affective filter and her ability to cope with difficult courses in college.

Mussey: In what ways were you most prepared for college?

Hannah: I think I was prepared because I feel like AP classes...like in my classes, everyone took AP classes, so I feel like everyone is on the same level. I feel like I am prepared in the sense that AP made me study more, so I feel like I am definitely not afraid when the class is hard.

Students who attended Preuss also talk about the way that they were prepared to understand the process of applying to college. Students were prepared to seek out scholarships and other opportunities and that experience prepared them to seek out opportunities in college as well.

Mussey: In what ways were you most prepared for college?

Abigail: Well, I think the first thing that I would like to say is before I went to Preuss I didn't know anything about college at all, I mean like, just thought that I was going to college, but I didn't know what it was about. So, I mean, Preuss definitely told you all the steps that it takes to go to college and now I am here. Um, And, throughout that experience, throughout all the steps, those

steps you learn that there are opportunities out there for you like so many opportunities for what you want to do with your life, what you want to do in school and how to go about that. You learn that there are opportunities for your life and you learn to look for those opportunities.

Beyond being prepared academically, students in this sample report being prepared to understand that they are capable of completing rigorous work. For example, Naomi tells us that she was able to adapt to the culture shock that she experienced as a minority in engineering because Preuss prepared her to be confident in her abilities as a student.

Mussey: Part of the Preuss School mission is to prepare minority students for college because historically black, and Latino students have had less access to college. Do you find yourself to be in the minority at your institution?

Naomi: Definitely, There are mostly Caucasians. There are Latinos here. And, I mean, Preuss prepared me to understand like how much like I can do as far as I am bright student and It doesn't matter if I am Mexican or not. I can do these things. In Preuss there are a lot of Latinos, the majority and when I come here it is kind of a culture shock, the majority is Caucasian. I got involved with SHEP for that reason because they were Latino and they were engineers. And its like you build a family.

Naomi is an example of a student with high self-efficacy that resulted in part from her high school experience. Naomi feels that she has adjusted well both academically and socially in college, although there are ways that she feels she could have been better prepared.

Ways Students Felt Unprepared

Female and male students in this study discuss some of the ways that they feel they could have been more prepared for college. See Table 6.2.

Table 6.2: Ways Students Report being Unprepared For College

Ways Students Report Being Unprepared For College
<ul style="list-style-type: none"> • Many students experienced a “culture shock” when they learned that they were a minority in terms of either socioeconomic status, ethnicity, or both. • Some students felt they could have had more experience with longer writing assignments similar to what would be expected in college. • Students were not prepared for how little teachers and students would interact during class time. • Some students were not prepared to independently manage their time. • Students were not prepared for the accountability systems that they would encounter in college, including emphasis on tests for grades, and curve-grading. • Some students felt prepared for science and math courses, but felt under prepared for other subjects. • Students were unprepared for the social transition from a small, close school community to a large university.

Overwhelmingly, both female and male students feel as though they were prepared for college academically. Writing in the social science and humanities courses is the area where students feel as though they could have been more prepared. Although Preuss students have had extensive experience in writing across the curriculum by highly qualified teachers, they were still surprised by both the quantity and length of writing assignments that they would be expected to complete in college. For example, Mary, a student at a large R-1 university in California has been required to write at least one paper in all of her classes thus far. Mary, like all of the students at Preuss had to write extensive research papers, analysis essays, reflection papers, and technical research reports in high school. Even though she had this experience in high school, she still felt under prepared for both the research and critical analysis papers that she would be

asked to write in college. Eunice, a student at a large public school in Southern California says, “Writing in college is a very valuable skill.”

Students also said that they felt unprepared to make the social transition from high school to college. Elizabeth who attends community college describes the complexity of this transition during her interview:

Mussey: Some students find the transition from the Preuss School to college difficult. Talk about some of the ways that The Preuss School is different from college.

Elizabeth: The biggest one would be social. Because you are so used to Preuss you know everybody but then you go to college and everybody is on there own, so basically you sit alone. That is why I study alone. I mean, you do make friends, but It is more of a social transition. Academically, it is not that bad, its not that different from high school, from what we had here.

Students who are attending large public and large private institutions also expressed concerned with this social transition. Martha wrestles with her new-found realization about her status as a minority in terms of ethnicity and socioeconomic status at her large private institution.

Mussey: Part of the Preuss School mission is to prepare URM students for college because historically black, and Latino students have had less access to college. Do you find yourself to be in the minority at your institution?

Martha: Its hard because I have had a huge identity crises. I feel like I can't claim the Latino heritage because of how I look. I may fit in more because I am light skinned. The student population is really diverse and I didn't see it my freshman year. Now, I am really aware of the race issue ad there are tons of people that I have met because I have looked for them. In one sense, I am in the majority because of how I look and the way that white people are stereotyped is as sorority girls and frat guys that have so much money I can't wrap my mind around it. How...I don't even know. I have \$7.00 in my bank account. I can't imagine. The majority isn't white people, it is rich white people. It is not just black people, it is rich black people. It is not just Latino, it is rich Latino. The minorities that are here are wealthy. The financial aid kid is the minority here. I have been trying to identify as the Latino, but even that group is wealthy. I haven't been around “poor minority” kids.

Other students discuss the “culture shock” in terms of their ethnicity. Ruth who attends a large public R-1 institution talks about the loss of the “sense of community” that existed in high school.

Mussey: What do you miss about the Preuss school?

Ruth: I guess the sense of community is different – I guess racially too because there is a big racial difference in ethnicity and stuff and I guess the teachers because in college the teachers will not know your name if it is a big lecture, the interaction one on one with the teachers because they care more and they care if you learn more.

Mussey: Could you say more about the racial difference? How do you feel about it and what do you do?

Ruth: Preuss was very diverse I guess, there was more like Hispanic, it was very heavily Hispanic, and I guess at UCSD, its just whites and Asians are the most dominant ones and everyone else falls underneath, about 14% or less. And but, well here, my roommates, the people that I live with are very diverse. There is another Mexican girl, and 2 Asian girls and one Caucasian girl. So what I have done about it is join a Mexican Dance group and I am also pledging a Latina Sorority so that I will have a community of girls who come from a familiar cultural background.

Ruth, like many of the students in this study join affinity groups related to their ethnicity to cope with the feeling of isolation and anonymity that can come with attending a large public university. I discuss the importance of student participation in affinity groups later in this chapter.

The Enactment of Coping Strategies for Success

Female and male students in this sample enact coping strategies in college that were explicitly taught to them during their college preparation in high school. In this way, the college preparatory experience is closely related to enactment of coping strategies for success in college. Some of the strategies that are used most often by students are time management strategies, reading strategies, and social networking strategies, such as the formation of study groups. See Table 6.3.

Table 6.3: Coping Strategies that Students Use in College

Coping Strategies that Students Use In College
<ul style="list-style-type: none"> • Many students use specific time management strategies that they learned in high school including using a planner. • Some students felt prepared for the reading load and use some of the reading strategies that they learned in high school including taking Cornell Notes. • Many students learned the value of studying in groups in high school and use that strategy for studying in college.

Beyond these strategies, some students are enacting other strategies for success such as regularly attending lectures, attending discussion sections with teaching assistants (TAs), attending professor's office hours, participating in study groups, studying alone, seeking academic help from a friend, and attending university tutoring services. A list of the strategies, as well as the number and frequency of students who participate in these strategies is included in Table 6.4.

Table 6.4: Academic Strategies Used by Students

Strategy	% of students who engage in these activities daily	% of students who engage in these activities weekly	% of students who engage in these activities monthly	% of students who engage in these activities Once per term	% of students who never engage in these activities
Attending lecture	69.6	30.4	0	0	0
Attending discussion sections with TA	27.3	40.9	4.5	13.6	18.2
Attending professors' office hours	0	17.4	26.1	39.1	17.4
Participating in study groups	4.3	43.5	17.4	17.4	17.4
Studying by yourself	43.5	47.8	8.7	0	0
Seeking academic help from a friend	26.1	39.1	30.4	0	4.3
Attending university tutoring services	4.5	27.3	22.7	9.1	40.9

Students who are enacting these strategies regularly are benefiting academically. Students in this sample who regularly attend lecture, discussion sections with TAs, and professor's office hours tend to have a higher GPA. Although, there are cases of students with high college GPAs who have never taken advantage of professors' office hours. See table 6.5.

Table 6.5: Academic Strategies and Student GPA

Strategy		3.6-4.0	3.0-3.5	2.6-2.9	Below 2.5
Attending lecture (N=21)	Daily	0	7	5	3
	Weekly	1	3	1	1
Attending discussion sections with TA (N=21)	Daily	0	4	2	0
	Weekly	0	4	3	1
	Monthly	0	1	0	0
	Once	0	1	0	2
	Never	0	1	1	1
Attending professors' office hours (N=21)	Daily	0	0	0	0
	Weekly	0	3	0	0
	Monthly	0	1	2	2
	Once	1	4	2	2
	Never	0	2	2	0
Participating in study groups	Daily	0	1	0	0
	Weekly	0	4	3	1
	Monthly	1	2	0	1
	Once	0	0	3	1
	Never	0	3	0	1

Males and females both engage in the academic strategies: attending lectures, attending discussion sections with TAs, attending professor's office hours, participating in study groups, organizing study groups, seeking academic help from a friend, and attending university tutorial services.

In this sample, however, females seem to be more likely to seek help from TAs or professors, whereas males are more likely to organize and participate in study groups. See Table 6.6.

Table 6.6: Percent of Academic Strategy Enactment by Gender

Strategy		% of Males	% of Females
Attending lecture	Daily	50	80
	Weekly	50	20
Attending discussion sections with TA	Daily	12.5	33.5
	Weekly	37.5	40
	Monthly	12.5	0
	Once	12.5	13.3
	Never	25	13.3
Attending professors' office hours	Daily	0	0
	Weekly	25	13.3
	Monthly	12.5	33.3
	Once	25	46.7
	Never	27.5	6.7
Participating in study groups	Daily	25	13.3
	Weekly	62.5	40
	Monthly	12.5	40
	Once	0	6.7
	Never	0	0
Organizing Study Groups	Daily	12.5	0
	Weekly	25	26.7
	Monthly	12.5	6.7
	Once	12.5	20
	Never	37.5	46.7
Seeking academic help from a friend	Daily	25	26.7
	Weekly	50	33.3
	Monthly	25	33.3
	Once	0	0
	Never	0	6.7
Attending university tutoring services	Daily	12.5	0
	Weekly	25	26.7
	Monthly	25	20
	Once	0	13.3
	Never	37.5	40

This table suggests to me that if females are less likely to organize and participate in study groups, then they may be more apt to feel isolated and anonymous at large institutions. When students feel anonymous, it may contribute to decisions to

change majors and or leave school altogether. Participating in study groups, one type of affinity group, is important to students' academic identity development. Affinity group participation will be discussed in the next section.

Affinity Group Participation

According to Gee (2000) a crucial part of identity development is being recognized as a member or participant in a particular group in particular contexts. Students who share in an affinity group experience, such as a study group, derive power as students from this group membership. In this section, I will discuss female and male students' participation in affinity groups and how this participation influences their academic identity development.

Many students engage in affinity groups by participating in study groups associated with their course or majors. Although the majority of students in this sample do most their studying alone, they are developing their college-going academic identities when they participate in study groups with roommates, and classmates. The majority, over 87%, of students do most of their studying alone. However, 81% of students have also joined a study group. Sixty-six percent of the students have even initiated study groups and all of the students have studied with other students at least one time.

Developing social capital in academic contexts leads to students' sense of belonging. The experience of participating in a study groups at college helps Preuss graduates make friends with other students at their colleges, therefore increasing their

academic knowledge and their sense of belonging. Mary talks about the social and academic benefits of studying in a group.

Mussey: When you study do you usually study alone, or in a study group, with roommates, or with classmates?

Mary: Study groups whenever it is possible, I know all of us have different schedules. Sometimes it is really hard to form a study group, but ya, I always study with someone else or in a room. I'm not the type that has to lock myself in a quiet room to study, I can study pretty much anywhere. But um Ya, whenever possible in a study group. It's more helpful.

Mussey: When you are in those study groups, are you actually studying the same subject or are you studying there quietly together?

Mary: Oh um, I don't know if this is specific to education here, or if it is universal across the board at any college, but I like studying in a group. I get different perspectives on what we are learning. I get... When we are in a group, we've all read. We've all been to class. So we know we are on the same page, but we all give different interpretations on the reading and that's what I go to study groups for. And since most of my classes are reading classes so they are mostly graded on papers, so you can always include everybody's interpretations in the papers and make a stronger argument. So, I really like the study groups. I don't know. (laughs)

In addition to increasing their sense of belonging, students enact their own theories about learning as they participate in these study groups. Students know and understand that learning is a social activity and that they can improve conceptual understandings by participating in groups. Naomi talks about what she does and how she benefits from studying in a group.

Mussey: How do you prepare for tests and classes?

Naomi: Obviously, you have to read the material you are assigned to before class so when it comes to class you can participate, which is something that Preuss taught me. Also, study groups, you can teach other students. Also, teachers give you quizzes. So you ask yourself, how does this apply in real life...

Mussey: What are some things you do when you are studying in a group?

Naomi: When you are with yourself, you tend to study more the things you do (know). I go over most of the things that I know. You can't get help for what you don't know. I guess when you are in a group it is a better way to learn because they can ask you questions and if you can't answer, then there is your

check... You can say, oh, I don't know that... if there is more people, everyone knows there little area, you tend to study more of everything than you do by yourself... Here there are study groups that you can sign up for. Last year, I did a summer group, we became a family, and a lot of them turned out to be in my classes or... SHEP offers mentoring and tutoring. And we can assign you with a mentor or a place to study...

Students in this sample have internalized some of the theories of learning from high their high school experiences. For example, Luke discusses his participation in a college transition program, and how that led him to develop study groups, at his institution.

Mussey: At the Preuss School UCSD, students are arranged in advisory classes. During this class, students have had the opportunity to form study groups, and interact with their peers, and teachers. Have you had the opportunity to form study groups or interact with your peers during your first year in college?

Luke: I was in Summer Bridge... it was like an advisory class where they helped you out. They would form like a Summer Bridge group where they would form study groups. It carried into the school years so that was pretty helpful. Like people in the same classes, I would usually study with them, I also go to the library and look around for people to study with.

Mussey: What do you do in a study group?

Luke: Problem solving, like I ask questions about concepts that I don't understand.

Mussey: How is that different from what you do when you are studying alone?

Luke: When I am studying alone, uhh, I usually just want to do all of the homework problems that I got wrong. I also review what other students got wrong, and I guess read the book over.

Both Naomi and Luke provide examples of how students benefit from participating in study groups. When studying in groups, students co-construct knowledge and learn new information. When students are alone, they either study what they already know, read, or complete practice problems that they previously got wrong. Of course, this theory of learning is not consistent for all students. Some students do not feel that studying in groups is effective.

Mussey: When you are studying, what are you doing?

Samuel: I take notes on what I read. So I can understand it. I never study in groups because I get distracted easily. It just doesn't work for me.

Students who are experiencing the transition to college often struggle to find the balance between college "life" and academics. As I described above, many students, both females and males engage in an activities, including affinity group participation, that are both social and academic. Students also attempt to balance college life and academics by participating in social groups that are also related to their academic and career interests. See Table 6.7.

Table 6.7: List of Affinity Groups in which Students Participate

Affinity Groups
Movimiento Estudiantil Chicano de Aztlán (MEChA) Ballet Folklorico La Joya de Mexico Summer Bridge Asian/Pacific Islander Student Association Alpha Phi Omega Sorority Collective Voice Newspaper Vietnamese Student Association Society of Hispanic Engineers Student Support Services Program Office of Academic Support and Instructional Services (OASIS) Americans with Disabilities Act (ADA) Black Student Union (BSU) ExperiMentors Vietnamese Dance Troupe Cambodia Student Association Students for Sensible Drug Policy Republican Party of San Diego LGBT and Allies undergraduate group French Club Pura Vida Club (Spanish speaking club) GANO (ESL tutoring for community residents) ELLA (Latina mentorship for middle school girls) African Students Association The Achievement Award Program Volunteering at the Children's Oakland Hospital Photography club Los Ingenieros Freshman Summer Sessions Program Summer Sessions Model United Nations Mexican American Student Association

Many of these affinity groups are academically oriented organizations, while others are more social, cultural, or interest based. Some of the organizations allow students to explore their cultural identities while participating in either an academic or other-interest oriented organization. Regardless of the groups that students join, group participation benefits students by helping them feel connected to their university.

Students seem to rely on relationships with peers to reassure them that they are not experiencing college life and college academics alone. Students talk about keeping in touch with high school friends, working with new friends from the dorms or affinity groups, and forming romantic relationships with people who are “going through the same things.” Students seem to allude to the fact that only others who are “going through” this college “thing” too can understand the struggles and triumphs that they are experiencing. They seem to take refuge in this fact and seem to forge a close bond with others in their peer groups because of this perception of a shared experience.

As a result of this, students who participate in these groups develop their academic and social, college-going identities. For STEM students, participation in STEM related affinity groups, such as the Society of Hispanic Engineers, can help them interact with other like-minded students and adults, find success, and construct their academic identities in the context of college.

Perceived Self-Efficacy and the Importance of Feeling Successful

Students who feel successful have a sense of satisfaction with their lives in college, while students who have not found ways to be successful seem dissatisfied and discontent with their college experience thus far. One important factor related to

students' feelings of success is perceived self-efficacy. Another factor that contributes to students' feelings of success is their GPA.

Both GPA and self-efficacy influence students' feelings of success. However, these two factors vary independently. When students have both a low GPA and low self-efficacy, they tend to have low feelings of success. Conversely when students have both a high sense of self-efficacy and a high GPA, they feel successful academically. Findings from this study indicate that when students have high self-efficacy and a low GPA, they can also experience a feeling of success in college. This third case prompts the examination of the relationship between the three variables: self-efficacy, GPA, and feelings of success. In this study, the sample size is too small to conduct a significant statistical analysis. However, upon analysis of the individual cases in this study, there seems to be direct and positive relationship between self-efficacy and feelings of success. Most students who have a high sense of self-efficacy, as determined by analysis of the survey data, also report experiencing feelings of success. See Table 6.8.

Table 6.8: Self-efficacy and feelings of success

			Feelings of Success			Total
			High	Medium	Low	
Self-Efficacy	High	Count	15	3	0	18
		% within Self-Efficacy	83.3%	16.7%	.0%	100.0%
		% within Success	100.0%	33.3%	.0%	64.3%
	Medium	Count	0	4	1	5
		% within Self-Efficacy	.0%	80.0%	20.0%	100.0%
		% within Success	.0%	44.4%	25.0%	17.9%
	Low	Count	0	2	3	5
		% within Self-Efficacy	.0%	40.0%	60.0%	100.0%
		% within Success	.0%	22.2%	75.0%	17.9%
Total	Count		15	9	4	28
	% within Self-Efficacy		53.6%	32.1%	14.3%	100.0%

All students who have high feelings of success also have a high self-efficacy. In this sample, there are no examples of students who represent the fourth case- students with low self-efficacy and high feelings of success. See Figure 6.1.

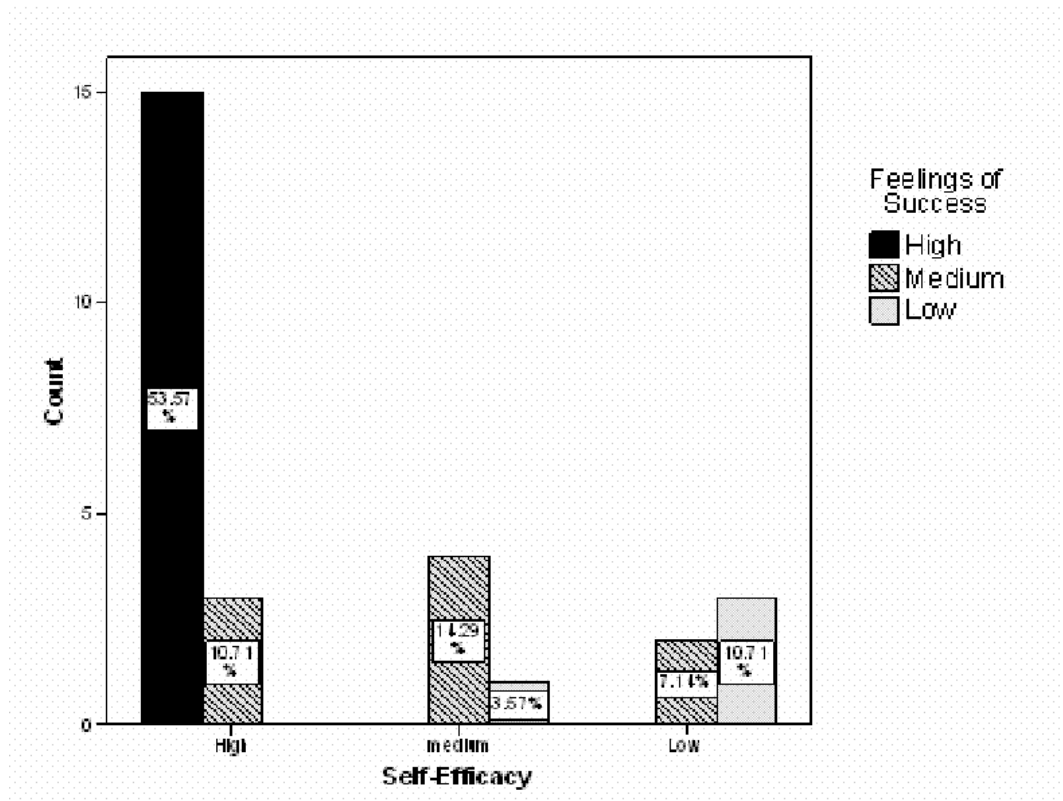


Figure 6.1: The Relationship of Self-Efficacy and Feelings of Success

For the students with high self-efficacy, feelings of success are not necessarily directly related to having a high GPA. There are students with high self-efficacy and a high GPA, but there is also the case of a student with high self-efficacy and a low GPA. This student does feel successful in college which suggests that students can view failure as an opportunity for growth and learning. For this type of student, one failure does not diminish the belief that they have the ability to be successful in college. For some students, this belief allows them to persist in their originally intended major even when they may experience initial setbacks. For example, Naomi, a Latina at a large public university, believes that she can persist in her engineering major

regardless of her natural identity (Gee, 2000) as an ethnic minority in an engineering field or her current status on academic probation:

Naomi: Preuss prepared me to understand like how much I can like, how much I can do, as far as I am a bright student and I can do these things. It doesn't matter if I am Mexican or not. I can do these things.

In the above statement, we see how Naomi's sense of self-efficacy is related to her positive experiences at her high school. Later in the interview, Naomi talks about her most challenging class and her new understandings of herself as a student. She mentions that she believes that she is a slower student in terms of learning new information. Therefore, in order to be successful in a fast-paced Calculus class, she understands that she has to seek outside help. She takes advantage of the academic assistance offered by her University in an effort to improve her GPA.

Mussey: Could you talk about your most challenging class?

Naomi: I wanna say Calculus Three because there are a lot of sequences and series because its at a faster pace, I have to catch up quicker, and I actually had to re-take the class because I didn't pass the class. There are a lot of little technicalities that you have to understand. And since it was a faster pace um, I am actually starting to figure out that I am a slower student when it comes to taking tests and when it comes to learning things. Ya, but it was my hardest class, but I am getting help now, there is a lot of help here.

Mussey: How was your GPA?

Naomi: Well, I am on AP (Academic Probation), so I think it is like a 1.8, so right now, I have to work on getting off of it. So, **I have to get off of it.** (with emphasis) It was just that class, oh man...

Naomi realizes the importance of getting off of academic probation, and indicates that she plans to "get off of it" by utilizing the academic support networks at her school.

Naomi: Can I tell you about my second favorite class?

Mussey: Absolutely.

Naomi: It was IME 134...it was a machining class and I actually got to build a screwdriver and an air motor in that class. So I got to work with the machines that I will be working with when I graduate.

As evidenced by the above quote, you can tell that Naomi is confident that she will be able to achieve her goal of improving her GPA, graduate, and become an engineer.

Researchers and educators often gauge student success numerically, using high GPA as a prime indicator of academic success. Students claim to measure their success in a similar way, however, as we see in Naomi's case, students with a high sense of self-efficacy can find success in their failures. Students with both a high sense of self-efficacy and a metacognitive awareness of how they can learn from failures can re-evaluate their path, and set new realistic goals for their future. Moreover, as we see in Naomi's example, students can implement effective strategies to meet their new academic goals. For these students, long term goals of college graduation and career opportunities seem to be more in focus than the immediate GPA. Although students are concerned about their GPA, they are not fixated on that as their only measure of success, and therefore do not become debilitated by a failure in the domain GPA ostensibly measures. Instead, these students seem to view the experience as a journey and see failures as opportunities for growth. Students' chances of finding success increase when opportunities for academic support exist at their colleges and universities.

For female and male students with low-self efficacy, poor academic performance may have a greater impact on their feelings of success. All the students who have low self-efficacy as determined by analysis of the survey data, also have a GPA below 3.0. Most of these students report that they do not feel successful in college. As a consequence, some plan to change their major into a field where they

have experienced or anticipate feeling success. In Martha's case, she felt incapable of completing the work in chemistry and talks about this experience of being 'weeded out.'

Mussey: You started as a chemistry major, could you talk about why you are changing your major?

Martha: I changed because I was completely weeded out. I couldn't keep up with the pace. I couldn't keep up with anything because I am so far away, and I didn't study well my first year. I didn't really do much work. I was a little disillusioned. I got a C in AP chem., so maybe I should have realized that wasn't the best way to go...I changed a lot because it was really competitive here and I just couldn't do it. I got Ds in my first two chem. classes and if I get anymore (pauses)...I was too exhausted from these intro classes. I felt pretty incapable by myself.

After a freshman year of failure, Martha was able to attend a summer enrichment program where she did feel successful and capable. This experience influenced the development of her academic identity by luring her out of chemistry into a new major, French.

Mussey: Could you talk about the college summer program?

Martha: That was pretty much the best decision that I ever made in my life other than coming to Preuss that really had a huge impact on me. It was for 7 weeks...I really learned how to study well and to work well. It really opened up my eyes because it wasn't just about taking French classes. It was about how French has an impact on the world. And French speaking countries in Africa,. It gave me more of a global sense than anything in college so far. It is going to shape what I do in the future.

From these two examples, I am attempting to show that there is a relationship between grades, self-efficacy, and feelings of success. There is also a relationship between 'success experiences' and students' selection of an academic major or career. Self-efficacy and success for students is not always necessarily defined by having a high GPA. In this sample, students with a high self-efficacy have GPAs ranging from a 1.8

to a 4.0. Students with a medium self-efficacy have GPAs that range from a 2.0 to 3.4.

Students with low self-efficacy have GPAs ranging from 2.0-2.9. See Table 6.9.

Table 6.9: GPA and Self-Efficacy

			GPA					Total
			3.6-4.0	3.0-3.5	2.6-2.9	2.0-2.5	below 2.0	
Self-Efficacy	High	Count	3	11	3	0	1	18
		% within Self-Efficacy	16.7%	61.1%	16.7%	.0%	5.6%	100.0%
		% within GPA	100.0%	91.7%	33.3%	.0%	100.0%	64.3%
	Medium	Count	0	1	3	1	0	5
		% within Self-Efficacy	.0%	20.0%	60.0%	20.0%	.0%	100.0%
		% within GPA	.0%	8.3%	33.3%	33.3%	.0%	17.9%
	Low	Count	0	0	3	2	0	5
		% within Self-Efficacy	.0%	.0%	60.0%	40.0%	.0%	100.0%
		% within GPA	.0%	.0%	33.3%	66.7%	.0%	17.9%
Total		Count	3	12	9	3	1	28
		% within Self-Efficacy	10.7%	42.9%	32.1%	10.7%	3.6%	100.0%
		% within GPA	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

The above findings are consistent for students regardless of gender, ethnicity, or type of college or university they are attending. From analysis of this small sample, we cannot determine the significance of the relationships between GPA, self-efficacy, and feelings of success. However, it is interesting to notice that although there are some students who have both a high self-efficacy and a low GPA, there are no students who have both low self efficacy and a high GPA. In this sample, GPA impacts students' feelings of success only for students with low self-efficacy. GPA also seems to be a less important factor in students' decision to persist in STEM fields, particularly for students with a high self-efficacy. Self-efficacy is related to students' persistence in STEM fields. See figure 6.2. In fact, one characteristic shared by all of the STEM Persisters in this study is a medium to high self-efficacy. See figure 6.2.

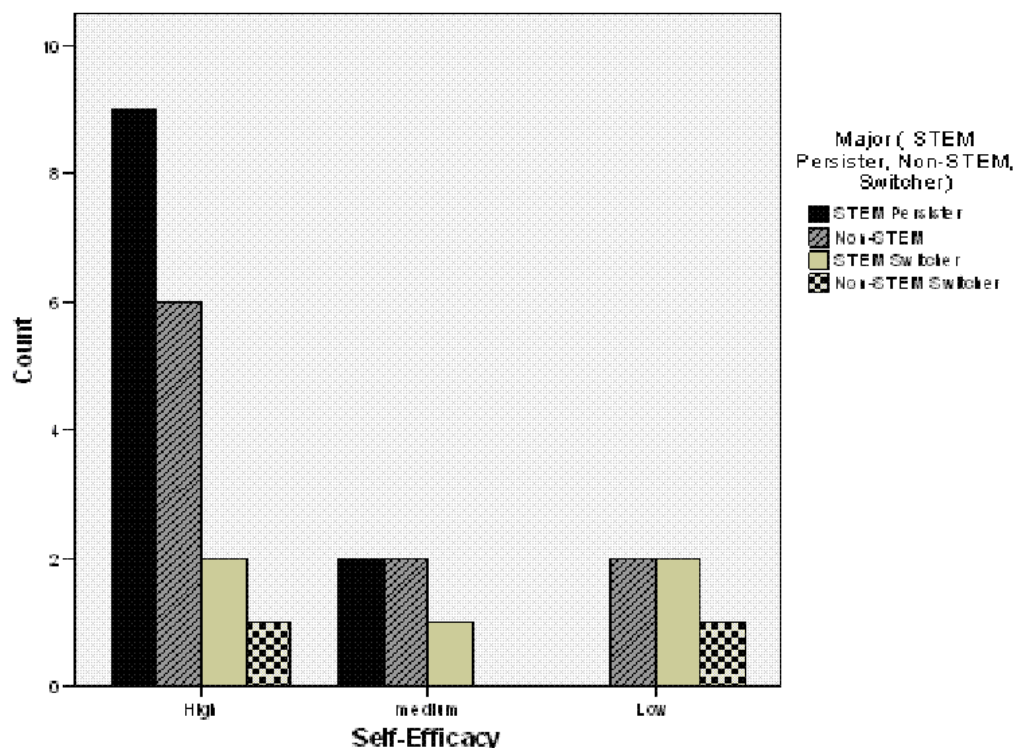


Figure 6.2: The Relationship of Self-Efficacy and STEM Designation

Less important to STEM persistence is GPA. There are cases of STEM Persisters with high GPAs and low GPAs. There are also cases of STEM Switchers with high and low GPAs. See Table 6.10.

Table 6.10: GPA and STEM Status

Major	GPA					Total
	3.6-4.0	3.0-3.5	2.6-2.9	2.0-2.5	Below 2.0	
STEM Persister	2 28.6%	4 57.1%	0 0	0 0	1 14.3%	7 100%
STEM Switcher	0 0	2 40%	2 40%	1 20%	0 0	5 100%

The Role of the Teacher

The final factor that seems to influence both female and male students' academic development is the quality of instruction at their institutions and the opportunities to interact with their college teachers. Not unrelated to student-teacher interaction and classroom instruction is class size and curriculum requirements set forth by the colleges and universities.

Although the large class size and high student to teacher ratio at large public and private universities could potentially lead to an impersonal environment where students feel disconnected with the faculty, many of these students seek out relationships with faculty advisers and teachers. These students share a similar high school experience in which relationships between teachers and students were encouraged by the institutional structures and the culture at the high school. Students have internalized this notion of the importance of networking with teachers during the college experience.

Also, the students who have a strong sense of self-efficacy are not intimidated by the "professor" or the unknown experience of the office hour. Eighty-two percent of students in this sample visit professors' office hours at least once per quarter or semester. Seventeen percent visit professors office hours weekly and have developed academic relationships with their teachers at their institutions.

Developing social capital with professors in academic contexts leads to students' sense of belonging and connection with the university. These academic connections with teachers impact students' lives and influence the direction of their

journey and their transition to adulthood. For instance Mary who attends office hours for every class at her large R-1 institution says the following:

Mussey: Have you ever gone to your professors office hours?

Mary: Yes – all of them

Mussey: All of them? Really?

Mary: Yes, well not every single office hour, but I've gone to at least four for every single one of my professors.

Mussey: Really? What is that experience like?

Mary: um haha it's funny because a lot of people say that it is intimidating. And it was. It really was my first semester. I was like, oh my God, I didn't know what to expect. Um and the turn out is really low, there is probably like 5 at most, at most 8 of us. I really like it. You get to see a more informal side of the professor, feel a little more confident about your reading. I like the small group office hour setting. Um, I know during lecture, especially in the bigger ones, sometimes the professors ask you not to ask questions because its such a big group, but in office hours you are have the freedom, able to do that, so, but it was a little intimidating at first, but once you start going, you get the hang of it. I really liked it. Its really useful too.

Mussey: Have you formed any lasting relationships with any of your professors?

Mary: umm, mmm. like just one of them. And I am still talking to him. He was my ethnics studies professor for fall semester last year and he is one of the dept. heads for one of my majors. So, Ya, just with him. All of the other professors, not really Sometimes I see them on campus and say hi or I recommend their classes to people I know., but no no follow up. And I think I am going to be doing some research with Prof. SsRosa?? next year, so I am excited for that. But, no, just one.

Martha, a STEM switcher, says she was deeply impacted positively by an interaction with her psychology professor at her large private institution:

Martha: I was able to change up the course I was setting up for myself and it was very encouraging because my professor reached out to me and got coffee with me while I wasn't doing well in his class. (it was a class of over 100). It encouraged me to do better and raise my grade.

Similarly, Abigail, a non-STEM student at a large R-1 university was influenced by one of her professors. She felt as though the professor really inspired her and related

the content to her in a way that was relevant. As a result, she started a travel club on campus.

Mussey: Could you talk about the professor in that class? (MMW)

Abigail: Ya, I had Professor Hertz. I am actually taking him again. He is just one of those professors. You hear that professors don't care about you, you are just a number. He actually cares about who you are. You hear that you are just a number like you are one of the hundreds of student in the class. He inspires you. In the fall, I am actually starting a traveling club. I am in the process of registering it now. And it's the little things that he talks about in class. He just talks about traveling and makes it feel like it is a bigger importance than you thought it was.

Luke, a STEM Persister at a large R-1 university, discusses the academic benefits of interacting with his college professors during their office hours.

Luke: Before exams, I usually go to TAs and office hours with the professors. That gives me insight as to what is going to happen on the test.

Mussey: Do you find that a lot of people take advantage of that?

Luke: Yes, well no, not the majority, but ya, there are a lot of people in there.

Interaction with faculty members both in and out of the classroom is an extremely valuable part of the educational process and one that many undergraduates miss out on and miss from high school.

Mussey: What do you miss most about high school?

Martha: The teachers that know your name. The teachers that have known you since you were 10 or since you were 14. You don't realize the importance of that until you don't have it anymore. You don't realize the teachers at Preuss are more dedicated than we were. And the teachers in college, ya, they are funny, but they are teaching a class because they have to, so they choose the intro class because it is the least amount of work and that is apparent. I miss the smallness and knowing everyone. I used to think that was bad, but now, being unknown is the worse thing ever. I miss the teachers and miss people knowing who I am.

Negative interactions with instructors can steer students away from STEM fields.

Martha, a STEM Switcher at a large private institution had this experience in her chemistry class:

Mussey: Describe one of the introductory classes (in science).

Martha: We meet 3 days a week for lecture that lasts a little over an hour. They always schedule those intro classes early pretty early so they can get kids outta bed. And we have an hour and a half lab. Our first professor hadn't taught an undergraduate class in like 20 years and the 2nd was like a crystallography like specialist so he would always talk about his own science. It was just very like, here is the info you have to learn it, and it is just very...I should have taken the initiative and done it myself. The lectures are just completely useless. They don't go over how to do any problems. Or do any questions on exams at all..there is also chem. recitation where they are supposed to teach you and my first chem. recitation prof was a visiting prof who was Russian who wasn't really doing anything. I never went because he just made me more confused. I think that my high school teacher gave me a really good base, but then it got worse. Noone would tell you how to go about solving the problems, so it was just a disparity between what was going on in class and what we were being tested on. There were over 100 people in the class.

Paul, a STEM Switcher from a large R-1 university had a similar negative experience with an instructor in his chemistry class who "did not captivate" him. This loss of engagement during class lectures led him to stop taking notes or even listening in class. Eventually, Paul changed his major from chemistry to visual arts, where he felt more engaged and connected with the people and course content.

Deborah, a STEM Persister at a large private school has had a negative experience in her physics class. She says:

Mussey: Tell me about the most challenging class that you have taken in college.

Deborah: Physics! Ugh! The professor can't teach, or doesn't try to. The demos he does are interesting, but everything else is disorganized, unfocused, and not helpful to learning. It's basically like an independent-study class with homework and tests.

Issues in STEM Courses

Martha, Paul, and Deborah are not alone in their issues with STEM courses. Other students have issues that contribute to their dissatisfaction with and possible departure from STEM majors. A list of issues suggested by my participants appears in Table 6.11.

Table 6.11: Issues in STEM courses

Issues in STEM courses related to teacher interaction, instruction, content, and class size
<ul style="list-style-type: none"> • Anonymity • Worries about curve grading • Having to learn on your own • Fast Pace • Large class • Intimidating and competitive culture • Accountability system and assessment practices • Curriculum and pre-requisites that prevent students from taking content classes in their area of interest • Poor teaching that does not stimulate interest • “Weed-Out” Classes • Boring content and instruction • Difficulty communicating with teacher • Lack of Collaboration

Some of these issues have existed as part of university science culture for so long, that we often take it for granted that things “have to be this way.” Students complain that prerequisites prevent them from taking classes in their major until they are sophomores. Students refer to these prerequisite courses as “weed-out” classes. For example, at one R-1 university in Southern California, students are required to pass three chemistry courses prior to taking a biology class, even if they are biology majors. The chemistry series is challenging and as a result, some students have changed their major before they even get to take a class in their intended major. Rachel’s case is an

example of a student impacted by these curricular requirements. Another traditional practice that confuses and worries students, regardless of the type of school they attend, is the common practice of grading on a curve. Deborah, a STEM Persister, who attends a large private university says that this practice worries her:

Deborah: I worry about the students in my classes only when it comes to grading. Scary smart people means there might not be a curve, or I'll be at the lower end of it. Other than that, they're just students.

Noah, a political science major at a community college doesn't understand the practice and considers his teacher's use of curve grading in his biological anthropology class to be "shady," or inappropriate even questionable.

Mussey: What is the most challenging class that you have taken?

Noah: Anthropology by far, anthropology class is probably the craziest class that I have ever taken, I should have just taken AP Chem, I would have done a lot better...the teacher, she teaches at UCSD and then she comes over here, not exactly the same caliber of school, and every chance that she gets, I think she has pretty much read the thesaurus 5 times and looks for the biggest word. Skin, She could've said skin, but she says epidermis, and ya I know what it means, but it just takes that much more time to process it and that plus 10 more big words in a row... The first test, half the class failed, and she was pretty much like, you guys can't study well, there are people in the class if you need to study, and you guys are bad students...She was really shady about it (grading the test). If you went by pure normal grading, I got a D...she said something like a C. I am going to figure out my next test score, coming up on Monday. If it is bad, I might change that class.

Hannah, who attends a large R-1 school talks about her experience with his calculus teacher, and the general culture of the science and math courses at her university.

Mussey: Could you talk about the teacher that you had in your calculus class?

Hannah: Um, I guess he was a good teacher, but he was like this old man and he didn't try to build relationships with students at all, I would get to class and he was like, 'OK class, and he would just start writing on the board.' And he had this rigid schedule and everything went according to planned. So he didn't really have time to talk to the students or kind of like be flexible, its like a 50 minute class so at 50 minutes he would just stop writing, and we just kind of

left. so I would look at my notes, and try to pick up everything and have to learn it all over since I felt like the class was going kind of fast. Noone ever asked questions. After class, everyone kind of looked confused and they have to learn it on their own. I felt like he was not a very approachable teacher.

Mussey: Is this typical of the math classes at your school?

Hannah: I think there is a big difference between the science classes...All the science classes are graded on a curve, and people are pretty much pre-med and everyone knows what they want to do, so noone helps each other out. And the North Campus classes, more art, history, social sciences, since it is not graded on a curve, everyone helps each other out.

Hannah believes that the curve grading system is responsible for the lack of collaboration on the science side of campus.

Many of the other issues in STEM could be addressed by the faculty members directly, such as improving the quality of the instruction and the students' accessibility to the content as well as the accountability and grading system used by instructors. Unfortunately for undergraduate student, high-quality teaching is not highly rewarded, especially at R-1 universities, public or private. Until universities begin to reward high-quality instruction, issues in STEM will have to be addressed by individual faculty members. Fortunately, there are examples of excellent teaching occurring at all types of schools. Sometimes this teaching even influences students to change their majors into STEM fields. Take Lydia's case, for example. Lydia has decided to change her emphasis to science education as a result of good teaching in her geology class. Lydia is a student at a large public university.

Survey Question: What class has impacted your life the most and why?

Lydia: Geology. It has taught me how wonderful learning about this earth can be and has renewed my interest in science. I used to hate it and now I have decided to specialize in science for the liberal studies major.

Deborah has also experienced some good teaching in her Computer Science class at her large private institution. She describes this course as the most interesting, meaningful, and applicable to her life. Even though the class is huge, over 300 people, the professor arranges to meet with students in small groups, by offering to eat lunch with any student on Fridays.

Mussey: Tell me about your favorite class in college so far.

Deborah: My favorite class this semester is Computer Science 50, or CS50. It meets MW from 1 to 2:20pm. It's a lecture hall class of some 300 students with one professor who stands on stage and lectures (he has a blackboard, laptop, and proxima, though). He switches between explaining concepts and actual coding the concepts. We're given handouts on Monday for the week's lecture slides and program codes. The lectures are filmed and all the materials are on the course website. Every Friday, the professor goes out to lunch with whoever RSVPs to the event. For help/support, there are office hours (with the teaching fellows and course assistants—CAs are like TFs, but they only hold office hours and don't teach section) online and in-person at the computer lab. There is also an anonymized course bulletin board. Everyone also has an additional, optional section, grouped by how comfortable the students feel with programming. This section is headed by TFs, who in this case are students who've taken the class before, and goes over the section notes. Nine students usually show up to my section.

As is evidenced by the above statements, students know that teacher quality greatly influences their education. Noah, a student at a community college says that if he could give any advice to incoming freshman it would be to choose teachers wisely. He uses an online, teacher rating website to help him select his teachers. When I asked him what he looked for in a teacher, this is what he said.

Mussey: You have mentioned teachers a few times, and I noticed in your survey you did as well. So, when you choose a teacher, what are you looking for?

Noah: Pretty much what I do, it is very scientific, haha...I go to rate my professors.com. and I look for, clarity is nice to have in a teacher. I look for easiness. I don't pick the easiest teacher. I look for a 3 or 4 rating on the

easiness. And everything else, as long as its above 3, then I will look at the comments to see what the teacher is like. It's good information to know.

The role of the teacher is very important, even at the college level. Considering the advancements that we have made in our understanding of best practices in teaching and learning, there is no reason to have poor teaching occurring at our nation's top institutions of higher learning. One implication for our institutions of higher learning would be to offer some teacher professional development to professors in all departments on campus.

Summary

Five factors influence female and male students' college going academic identity development: college preparation, enactment of coping strategies, affinity group participation, self-efficacy, and student-teacher interaction. Due to the small sample size, I found it difficult to determine differential effects of the five factors for males and females. For all of the students in this sample, a common college preparatory experience has directly impacted their enactment of coping strategies and their affinity group participation. These students, many of whom feel prepared for college academically enact coping strategies that they were explicitly taught in high school such as time management strategies, Cornell note-taking, reading strategies, etc.

Many students from this background felt under-prepared for the social transition to college. As a result, students transfer some of the academic strategies that they learn in high school in order to cope with the social transition to college. The primary way that students adjust to the social transition is by joining affinity groups such as Movimiento Estudiantil Chicano de Aztlán (MEChA), Summer Bridge, the

Asian/Pacific Islander Student Association, Alpha Phi Omega Sorority, and the Vietnamese Student Association to name a few.

Many of the affinity groups that students join are both related to their academic interests and to their ethnic identities such as the Society of Hispanic Engineers. In this way, students are demonstrating that they have internalized coping strategies that they were taught in high school and that they can transfer and apply these strategies in other areas of their lives.

The other two factors that impact students' academic identity development: self-efficacy and student-teacher interaction at the college level seem to more directly influence students' decisions to persist in or switch out of STEM majors. In this study, students with a high self-efficacy persist in STEM fields more often than students with a low self-efficacy regardless of GPA. Students who have at least one positive interaction with a college instructor or more capable peer at their universities seem to persist more often in STEM majors than students who feel anonymous at their large institutions. Students may find this interaction by participating in STEM related affinity groups, or from interacting directly with a professor during small seminar classes or during professor's office hours.

The final factor that seems to impact students' decisions to persist in or switch out of STEM majors is "success." Students who have experienced even one small success in a STEM course are more likely to persist in a STEM major. This success does not necessarily have to come in the form of a grade. It may come in the form of successfully accomplishing a task during a hands-on activity or by participating in an

out-of-class STEM related affinity group. When students feel unsuccessful in STEM, they will search for success in other areas. Students who find success in other disciplines or courses may gravitate towards those opportunities and eventually change their major. The five factors that positively influence students' identity as a STEM student are shown in figure 6.3.

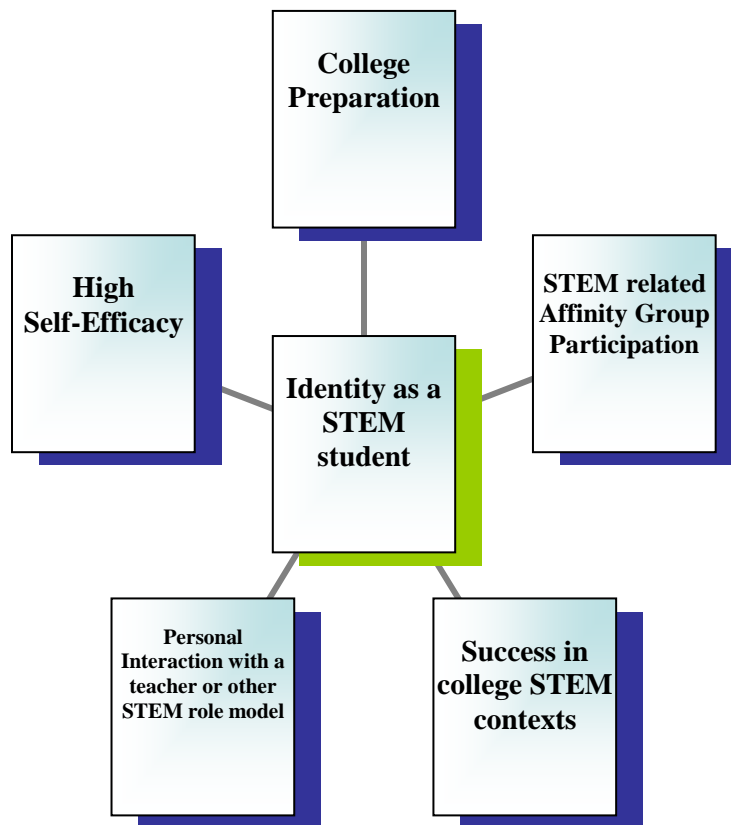


Figure 6.3: Factors that Positively Influence Students' Identity as a STEM Student

In chapter 7, I will discuss the implications that these findings may have for K-12 schools and institutions of higher learning. I will also suggest future directions for research in the area of transition to college for underrepresented populations and for students interested in STEM majors and careers.

Chapter 7 - Conclusion and Implications for Attracting Underrepresented

Students to STEM Fields

Recently, I coached a team of five middle school students in the 2009 National Science Bowl in Washington DC, a science contest where our nation's brightest science and math students compete for the title of National Science Bowl Winner. As a first time participant in this prestigious event, sponsored by the United States Department of Energy, I was impressed by the investment that our nation is making to encourage our students' participation in STEM fields. But, as I looked up on the stage during the final round for the high school students, I was disappointed to see an all male cast of players competing for the gold. As it turns out, there was one female student on the winning team, the alternate. The other 9 participants in the final round were boys. I looked around the room noticing many all male teams, many from elite prep schools and private schools around the country. The experience helped me realize that in terms of gender and class equity in STEM fields, we still have work to do.

This study contributes to and extends the research that has been conducted on equity and excellence in education. In this study, I investigated the phenomenon of the transition to college for underrepresented students, graduates from a college preparatory 6-12 grade school. Using a qualitative research design, specifically a phenomenological approach to inquiry, I surveyed 28 students who were high school graduates from the class of 2007. Of the 28 students that I surveyed, twenty students agreed to an individual interview. Guided by vanManen's (1990) operationalization of 'phenomenology' as a viable methodology for qualitative research, I composed

narratives based on surveys and interviews with twenty students. I analyzed each narrative looking for significant statements derived from the student individual interviews. After categorizing statements into themes, and reflecting on the narratives, I began to develop the findings for this study. Following this activity, I entered all of the survey data into a statistical program, SPSS, where based on the emergent themes from the narratives, I could analyze some of the data using descriptive statistics. The ability to triangulate my findings from the surveys, interviews, narratives, and descriptive statistics emerged from this process.

The student participants in this study, unlike some students from traditional high schools in the United States were taught specific coping strategies to use in the context of a rigorous academic curriculum. I investigated the students' enactment of these coping strategies in college. Specifically, I investigated the STEM experiences for women and men as well as the factors that influence their college-going academic identity development and persistence in STEM fields. Findings from this study help us to understand how students are experiencing the transition to college as well as the reasons that students leave or persist in STEM fields in college. After a summary of my findings, I suggest some possible implications for policy and practice which may help us to address equity issues and improve both equity and excellence in STEM education for all students.

Summary of Findings

In this section, I provide a summary of the findings related to each of three primary research questions addressed during this study.

Students' Experience with the Transition from High School to College

How do underrepresented students experience the transition from a college preparatory high school to college? This question was answered by analyzing the student narratives. All twenty narratives are included in Appendix C. By reading each student narrative, I obtained an overall sense of the students' transition experience, ways that they have found success, ways that they struggle, and rationale for some of their academic and social decisions.

How Students Develop an Academic Identity in College

The second research question addressed in the study is: How are students developing their college-going, academic identities in the context of their educational institutions? Based on the student narratives, I found five main factors that influence male and female students' college-going academic identity development: 1) college preparation in high school, 2) self-efficacy, 3) enactment of coping strategies in college academics, 4) affinity group participation in college, and 5) interaction with college teachers. Differential effects of the five factors for males and females could not be determined given the small sample size, one limitation of this study.

Upon closer analysis of these five factors, I find that college preparation in high school is closely related to students' enactment of coping strategies for academic success in college. Students in this sample report being prepared for college in the following ways. Many students felt prepared for the workload and rigorous coursework. Some students felt prepared for the writing that would be required in

college. Some students felt as though they had an idea of what career path they wanted to follow because of exposure to that career during high school courses or internships. Many students felt as though they had been exposed to some of the content that they would be expected to learn in college, such as biology, chemistry, and math. Some students reported they were prepared to be critical thinkers and problem solvers. Students understood the process of getting into college, and applying for financial aid. Students report feeling prepared for managing long days and a hectic schedule. Students were prepared to be dedicated to their schoolwork. Students were prepared to utilize the resources provided by their professors and take advantage of opportunities that were presented. Overall, students were prepared to enact specific coping strategies that they were taught in high school.

Students also transfer coping strategies for success in the academic realm of their life to other areas of their lives. Even though students felt under prepared for the social transition from high school to college, many students coped with this challenge by joining affinity groups to help them make this transition. Other ways that students felt unprepared for college include being surprised by their status as a minority student in terms of socioeconomic status, ethnicity, or both. Some students felt they could have had more experience with longer writing assignments similar to what would be expected in college. Students were not prepared for how little teachers and students would interact during class time. Some students were not prepared to independently manage their time. Other students were not prepared for the accountability systems that they would encounter in college, including emphasis on tests for grades, and

curve-grading. Some students felt prepared for science and math courses, but would have like to have been exposed to other subjects earlier, such as ethnic studies, psychology, and sociology. Overall, many students felt unprepared for the social transition from a small, close school community to a large university.

The Factors Supporting or Constraining Students' Participation in STEM

The final research question addressed in this study is: What factors support or constrain students' participation in STEM majors at their institutions of higher learning? Both STEM Persisters and STEM Switchers report the following issues in their STEM courses in college: large, competitive classes where they feel anonymous, assessment practices including curve grading and focus on tests, fast pace, poor teaching and having to learn on your own, structures which prevent students from studying in their area of interest, lack of culturally relevant pedagogy, lack of interaction with teachers and other students.

In this study, the students who switched out of STEM experienced all of the above issues in STEM courses but experienced a success and a positive interaction with a professor or peer in another, non-STEM related field.

Students who persist in STEM fields in college, on the other hand, share the following experiences. All students felt prepared for introductory science and math classes in college. All students are engaged in an Academic Affinity Group which supports their learning. All students understand their role and responsibilities related to their academic outcomes. All students receive academic support from peer social networks. All students have had at least one positive interaction with a STEM teacher

at their institution. All students have experienced at least one ‘success,’ in a STEM course or affinity group as defined by the students.

Implications for College Preparation in Schools

The above findings provide evidence of the importance of both the academic and social preparation of students for college. Offering students a rigorous curriculum with advanced placement courses prepares them for the reading load and types of exams that they will experience in college. Students in this sample attended a college preparatory school with an extended school day and school year. This structure in a 6-12 school benefited students by preparing them for the long days and nights of classes and studying that they would have to manage in college. Students who attend a 6-12 school with a college going culture already have dedicated themselves to putting their education as a priority, another benefit to the students in this study. One implication for policy and practice would be to offer this type of college preparatory program more widely to students in America.

There are several implications for how we, at the Preuss School, can improve students’ preparation and improve their chances for success in college. Students in this study felt unprepared for the accountability system that they would experience in college as well as the lack of interaction and support from teachers in their college courses. Perhaps this is because the scaffolds and supports offered at their high school are extensive and continue unabated to graduation day. When students enter college, often as minorities, they find themselves without these support networks for the first time in their academic careers. There are two possibilities to address this issue. One

possibility is to extend some of the support networks into college, easing the transition for students by providing some similar supports to Preuss alumni as freshman in college. There are advanced social networking technologies that may make this option viable. The other option is consistent with Vygotsky's theory of the zone of proximal development that I described in the beginning of this thesis, that is, educators at Preuss should be encouraged to slowly remove some of the scaffolding that exists at the Preuss School near the end of students' careers. One way to accomplish this is to re-think the accountability system in place for students at Preuss. Students receive points for almost every task that is asked of them in school. This practice may be reducing students' internal motivation to learn while increasing students reliance on external reinforcement for motivation. Modeling some of the senior level courses after college courses by reducing the daily accountability and increasing the accountability for learning the material, as evidenced by performance on two or three tests per term may benefit students. Also, it may be beneficial to students entering STEM fields to expose them to the culture of curve grading in high school. I am not advocating implementing this type of grading system across the board in high school, but perhaps a little exposure will allow students to develop some strategies to deal with this practice of grading in college.

Some students in this study felt as though the curriculum in their high school focuses too much on science and math. They mention the lack of exposure to any social sciences or culturally relevant coursework in high school, such as ethnic studies, sociology, or psychology. When they got to college, many students in this sample,

including some STEM students, were attracted to these new, “eye-opening” fields. One implication for Preuss and other high schools is to expose students to social justice themes in a range of courses at Preuss. In this way, students would not need to abandon their interests in science and math simply because they were attracted to other “new” fields. Students would then be able to make more informed decisions about their career paths. Also, if students are taught earlier how STEM could also be culturally relevant and applicable, students may be more likely to persist through the large introductory courses in college, where they may be unengaged and bored. One way to accomplish that would be to provide students with more internship and STEM career opportunities as well as allowing students to work with mentors in their fields of interest.

Implications for Institutions of Higher Learning

Based on the findings in the study, I make recommendations for improving students’ access and interest in STEM. In order to address students’ feelings of anonymity in large “weed-out” and “gate-keeping” classes, universities could utilize smaller sections or discussion groups as opportunities for students to meet in smaller groups with their peers and become connected to a TA or younger faculty member in their field. For most of the large R-1, large public, and large private institutions, this structure already exists. Unfortunately, students who attend discussion or smaller sections aren’t necessarily gaining a sense of belonging or connection with the instructional leader in the course. One way to take advantage of the structure that is already in place would be to train the teaching assistants in content related pedagogy.

TAs, which are often graduate students hoping to enter academia in the future would benefit from learning some of the best practices for teaching their discipline. In turn, when these graduate students do become full time professors in the future, they will already be accustomed to attending professional development for improving their teaching in their disciplines.

Currently, large public and private R-1 universities reward the conduct of basic research much more than they reward high-quality instruction. One logical, albeit difficult to implement recommendation to stem the flow of underrepresented populations from STEM fields, would be to provide greater rewards for high-quality instruction in college. Until that revolutionary idea is implemented, half-measures are possible. For example, requiring regular professional development for professors would benefit students by providing them with the most updated methods in teaching. Holding professional development for university faculty would ultimately improve the disciplines themselves, as young students would have access to the best teaching by experts in their fields. Undergraduate students would then obtain a solid foundation in their discipline, addressing any misconceptions that they entered college with and building on the scaffolding and prior knowledge that they learned in their high school science courses. As part of the professional development series offered to university faculty, professors could have access to the high school curriculum offered through the college board advanced placement courses. With these structures in place, high school teachers and university faculty can begin to align their curriculum, making the transition from high school to college easier for students. Once faculty begin to do a

better job teaching the content to undergraduates, the use of curve grading, may not be as much of a necessity as it is currently.

Finally, ensuring that all students have one positive interaction with a teacher and one successful event in their field of interest seems reasonable. One way to ensure this occurs is by encouraging students to join academic affinity groups on their campus. Another option is to offer small seminar courses to freshman, where they can explore their area of interest in a learning context other than the lecture. For many STEM course, students are required to take small lab classes. This is one venue in which to engage students. Lab instructors would benefit from some training in pedagogy. There is also the possibility of conducting graduate-like seminar courses for freshman.

One large public R-1 University in Southern California is already doing this. In this example, students meet and interact closely with one professor and approximately twenty peers. Perhaps requiring an introductory seminar for all freshmen would be beneficial to both students and their universities. During these seminar classes, students are accountable for their learning as they are required to read and discuss content weekly. Students can learn content, while simultaneously asking their expert faculty member questions and exploring the content in a culturally relevant way.

Most universities, even research oriented R-1 universities, include educating undergraduates as a top priority. When professors are not trained as to how to accomplish this task, it becomes difficult to meet this aspect of their mission. Good teaching is universal and there are some basic pedagogical techniques that professors

need to be taught if they are responsible for educating America's youth. Some of these methods include: increasing students' metacognition, using inquiry based instructional techniques, teaching in the zone of proximal development, motivating students in their fields, creating learner centered learning environments rather than assessment centered learning environments, using writing to learn, and increasing students' self-efficacy in their disciplines. If professors were taught how to implement some of these instructional strategies in their classrooms, students may have increased access to educational opportunities at their colleges and universities.

Theoretical Implications

The results of this study reinforce and deepen our understanding of constructivist theories as lenses through which to view identity development as constructed in educational contexts. I consistently found that the meaning of STEM in college is constructed through social interaction. The students in this study act on the meaning they perceive. Based on my findings that students change their perceptions of their colleges or universities, their majors, and their relation to their courses of study, it is fair to say that meanings are not fixed – but change due to a host of contextual factors. Feminist theories proved to be particularly useful during the conceptualization of this study, but were less relevant to the analysis. It is possible that the small sample size or the similar college preparatory background of the student disabled me from discerning clear differences in female and male identity development in STEM.

Consistent with the formulation of learning as a “process of becoming”

(Lave, 1992) and the need to understand how the learner engages in science and how this engagement relates to who they are and who they want to be (Brickhouse, 2001), I considered students' identities carefully. Gee's (2000) conception of categories of identity, as described in chapter two, proved to be the most productive model for analysis of student identity in this study. Gee (2000) discusses people's multiple identities related to their performance in society and defines identity as being recognized as a certain kind of person in a given context. He suggests four interrelated ways to view identity and offers an example of how to use identity as a lens in educational research. According to Gee (2000), one's identity can be categorized as "natural" (such as gender or ethnicity), as attached to an institution (such as college or a workplace), or an identity recognized in discourse with others related to individuals' experiences shared during participation in groups.

Even though students did not specifically articulate the tension between their natural identities - gender and ethnicity – and their institutional identities as STEM students, they do give evidence in their talk (discursive identities) about the larger social structures that exist and influence their participation in STEM.

Seymour & Hewitt (1997) provide a useful distinction between students in relation to their courses of study in college: persisters and switchers. Whereas they did not find much difference between the "kinds of people" who switch versus persist in STEM, I found that students who persist tend to have a high sense of self-efficacy when compared with students who switch out of STEM fields.

Implications for Educational Researchers: Future Directions

Findings from this study provide us with some insight as to how underrepresented students who were explicitly taught coping strategies for success enact these strategies in their STEM contexts at their universities. The small sample size limits the option to run statistical tests or models on the five factors that influence students' academic identity development. I recommend that further studies be conducted to compare the academic outcomes of low-income female students who were explicitly taught coping strategies at The Preuss School UCSD with the academic outcomes of female students who were not explicitly taught coping strategies in their conventional high schools. Furthermore, future studies should also compare the outcomes of low-income female and male students who were explicitly taught coping strategies using a large sample size.

Final Thoughts

Americans do want and expect both equity and excellence from our nation's institutions of higher learning. In fact, President Obama has called for an unprecedented commitment to improving education in general and science and math education in particular. One of our goals has been to improve access and opportunity in the areas of STEM for all students. By preparing low income students to be the first in their families to attend college, we are moving towards meeting these goals. We need to do more.

Obama is "challenging states to enhance teacher preparation and training, and to attract new and qualified math and science teachers to better engage students and

reinvigorate these subjects in our schools.” By studying students’ transition from high school to college science, we further understand that enhancing teacher preparation cannot stop in our nations’ secondary schools. Understanding the structures that support and constrain students’ participation in STEM at the university level help us understand how to improve teaching and learning at our nations’ colleges and universities as well. Clearly, we still have work to do. Fortunately, with advancements in educational research we are beginning to understand how collaborative efforts between American high schools and colleges could revolutionize science and math education, an action sure to help us answer Obama’s call.

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Appendix A – Interview Protocol

CLASSES

1. Tell me about the most significant things that have happened to you since you graduated from Preuss.
2. Tell me about your favorite class in college so far.
3. Describe some of the successes that you have experienced in college.
4. Some students find college science and math classes intimidating due to the class size, make-up of students, and professors. Other students enjoy college science and math classes because of class size, make-up of students, and professors. Describe how you feel about your science and/or math classes.
5. Tell me about the most challenging class that you have taken in college.
6. Think back to your last day of classes. Describe your day from the time you woke up until you went to sleep. Was this a typical day?
7. Historically, women, have been underrepresented in certain fields in college. Do you find yourself, as a woman, to be in the minority at your institution?
8. Part of the Preuss School mission is to prepare URM students for college because historically black, and Latino students have had less access to college. Do you find yourself to be in the minority at your institution?
9. Some students find the transition from the Preuss School to college difficult. Talk about some of the ways that The Preuss School is different from college. In what ways is Preuss similar to college.
10. Describe a typical science/math class at your college.

STUDYING

1. During the first years of college, students are searching for the best ways to prepare for classes and exams. Describe some of the ways that you have prepared for classes and exams during your first year of college.
2. At the Preuss School UCSD, students are arranged in advisory classes. During this class, students have had the opportunity to form study groups, and interact with their peers, and teachers.
 - a. Have you had the opportunity to form study groups or interact with your peers during your first year in college?
 - b. If so, how did you get connected with a study group? (Who initiated it? Where did you meet the people?)
 - c. What kinds of activities have you done in your study group?
 - d. If not, why do you think you have not had this opportunity?
3. Describe your most recent exam. How did you prepare for that test? How do you feel about that preparation now?

YOU

1. How would your old friends and family say that you have changed over the past year?
2. How would your new friends describe you?
3. How would you say that you have changed over the past year?
4. What do you want to be when you grow up? How is what you are doing now preparing you to become a _____? Do you have a role model that is helping you on your journey?
5. What are the most important things to you about your life at college?
6. Do you feel like you have been a successful student? Why or why not?

PREUSS

1. What do you miss most about the Preuss School UCSD?
2. How were you most prepared for college?
3. In what ways did you feel that you were the least prepared for college?
4. What are some specific things you learned at Preuss that you use in college?
5. How could Preuss better improve students for college?

FINAL QUESTIONS

1. What advice would you give an incoming freshman about how to succeed in college?
2. What advice would you give Preuss teachers about how to better prepare students for college?

Appendix B – Survey

Instructions: Please answer each question to the best of your ability and send to:

The Preuss School UCSD
9500 Gilman Dr. #0536
La Jolla, CA 92093-0536

1. What is your gender? _____
2. What is your ethnicity? _____
3. List the schools that you have attended since you graduated from Preuss.

4. What is your current major? _____
5. List each of your fall courses (including courses that you dropped), departments, and grades, earned. (See example)

Courses	Department	Grade (A, B, C, D, F, incomplete, pass, no pass, Withdraw)
<i>Example: BILD 20 – Genetics</i>	<i>Biological Sciences</i>	<i>C</i>

6. List each of your current courses and departments.

Courses	Departments

7. What is your cumulative GPA? _____

8. Do you currently live: (Check one)

- ☐ with your parents
☐ in an on-campus dorm
☐ in an off-campus dorm room
☐ in an on-campus apartment
☐ in an off-campus apartment
☐ in a fraternity/sorority house
☐ other (describe: _____)

9. How many roommates do you have? (Check one)

- ☐ zero
☐ one
☐ two
☐ other (describe: _____)

10. Do you have access to technology where you live?

- ☐ yes, laptop computer
☐ yes, personal home computer
☐ other: _____
☐ no

11. Where do you do most of your studying? _____

12. How many hours do you study per week? _____

13. If you live away from home, how often do you visit where you grew up?

- ☐ once a week
☐ every weekend
☐ once a month
☐ never
☐ other: (please specify) _____

14. When you study, do you usually study: (check only one)

- ☐ alone
☐ with your roommates
☐ with your classmates
☐ in a study group
☐ other (_____)

15. Describe a typical weekday's activities, starting from the time you wake up until the time you go to sleep.

16. Think back to your last week of class, estimate how much time you spent on the following activities:

Example:

6 hours attending class or labs

_____ attending class or labs
 _____ studying
 _____ doing extra-curricular activities
 _____ watching television
 _____ working for pay
 _____ playing sports
 _____ volunteering
 _____ going to parties
 _____ socializing with friends (other than parties)
 _____ sleeping
 _____ other (Describe: _____)

17. Think back to your last weekend, estimate how much time you spent on the following activities:

Example:

6 hours attending class or labs

_____ attending class or labs
 _____ studying
 _____ doing extra-curricular activities
 _____ watching television
 _____ working for pay
 _____ playing sports
 _____ volunteering
 _____ going to parties
 _____ socializing with friends (other than parties)
 _____ sleeping
 _____ emailing
 _____ other (Describe: _____)

18. On a scale of 0-4 where 0 indicates NEVER and 4 indicates that you ALWAYS engage in this behavior, how often do you do the following?

- _____ ask professors questions in class
- _____ go to professors' office hours
- _____ raise your hand in class when you don't understand something
- _____ study in the library
- _____ look for a book in the library
- _____ study with other students
- _____ study by yourself
- _____ seek help from a private tutor
- _____ organize study groups
- _____ seek academic help from a friend
- _____ attend university tutoring services
- _____ take classes to improve study skills
- _____ take classes to improve reading
- _____ take classes to improve writings
- _____ see your academic adviser
- _____ seek help from financial aid office
- _____ visit the health clinic

19. List the extracurricular activities that you are involved with.

20. On a scale of 0-4, where 0 indicates total disagreement and 4 indicates total agreement, rate the following statements.

- _____ I am doing less well in college than I would like.
- _____ I am having problems with my financial aid.
- _____ I have too little time to do schoolwork.
- _____ I am having problems with a family member.
- _____ I am having problems with my schoolwork.
- _____ I am having problems with a roommate.
- _____ I was prepared for college.
- _____ I am afraid of failing out of college.
- _____ My grades are an inaccurate measure of what I have learned.
- _____ Most students are having trouble with their coursework.
- _____ I know where to seek help if I need it.

21. How did Preuss prepare you for college?

22. What are some specific things you learned at Preuss that you use in college?

23. How could Preuss better improve students for college?

END OF RESPONSE FORM

Appendix C – Student Narratives

Mary's Story:

Mary, who attends an R-1 University in southern California, doesn't know what she will end up doing in life, but is excited about all of the possibilities that lay before her. It seems to me that she has many options, due in part, to her taking advantage of all of the opportunities that exist at her huge institution. When asked, what are the most important things about college, she says, "what comes after." She is always looking to the future. Even as a college sophomore, she already has her eye on graduate school or law school and her ideal post-college lifestyle options: She may even move to the east coast. I'd say that graduate school is definitely in her reach as she is a successful college student by any definition, and she seems to know this and know why. She confidently offers advice to new and incoming students, urging them to get involved. "Talk to people", get to know the "Orgs..." Join clubs or orgs, she repeats herself. Mary's life in college is more than academics and seems to revolve around the myriad of orgs, clubs, and communities with which she successfully networks. She is currently an ethnic studies and political science double major and she has between a 3.0-3.5 GPA.

Mary was always a successful leader. She emerged as a sort of entrepreneur on her high school campus, and was heading towards a career in business, or so she thought. Choosing to stay closer to home and attend a college that would not put her into sizeable debt, she was introduced to ethnic studies, and began to understand the social inequities that exist in society. Formally studying how both class and racially based inequities afford and constrain opportunities for individuals in society provides a framework for Mary to understand and build her own story. As a first generation college student and a Mexican-American female from a low-income background, Mary relates to the coursework and finds relief in learning about multiculturalism and access to education issues for Latinos and African Americans. In fact, everyday, as she attends class at her prestigious university, learns about inequity, and reads about stereotypes, she sees evidence of the inequity before her very eyes. She could not believe that only 9% of her fellow freshman class are Latino, and she seems to be in shock knowing that she is part of that small percentage.

Her interest in the ethnic studies coursework, as well as her interaction with her ethnic studies professors are some factors that contributed to her changing her major to ethnic studies. These were not the only contributing factors that led to a major change so early in her academic career. Her original intention to major in business still persisted, until the end of her freshman year, when after realizing the large size, difficult requirements which would prolong her graduation, and impacted nature of the business major at her school, she decided to change her major to political science and ethnic studies. She is now a double major and may graduate a semester early if she stays on track.

When Mary arrived at her university in the fall of 2008, it was actually the first time that she had ever seen her college campus. She did not have the luxury or resources to make a visit earlier that year. During the college application process, she had a tough decision to make. She was admitted to numerous prestigious schools around the country, most of which she knew by reputation alone. She agonized over the choice that would ultimately decide where she would receive her undergraduate education and she eventually selected a school in a town where she had never set foot. She laughs at the memory of making the ten hour drive from home to college with her parents, remembering, in disbelief, how they got lost on the way. Her parents dropped her off, alone at the dorm, and she immediately got to work, accessing the many resources on campus and getting involved. She keeps herself busy to stave off homesickness and makes visits home for holidays when she can.

The Dorms: Mary spent the first year in the dorms. Dorm-life was not what she expected and she missed aspects of her home life including having a kitchen for cooking, or a living room for socializing and lounging. She was surprised by the lack of social interaction among the girls in her dorm and she didn't meet many people there, even though she did attend dorm-based functions including a floor meeting that remembers vividly.

Culture Shock at the Dorm Floor Meeting: She recounts one of her first experiences in the dorm at her institution, where she lived as a freshman, an experience that she only describes as culture shock. During this meeting, all of the floor members introduced themselves. Of the eighteen girls, ten of them had parents' who attended graduate school and held Masters' degrees or higher. Five of the girls were from affluent and quite famous neighborhoods in Southern California, and everyone came from families where college attendance was a tradition. Mary was the only girl on her floor who was a first generation college student from a low income background. The interesting thing about this interaction is that Mary implied that she was not the only one who was shocked. The other girls on her floor in her dorm were equally shocked by the differences in background and Mary became motivated by this interaction. She seems even more committed to sticking with it, as she says and she even seems to feel a sort of responsibility for educating "them" about where she comes from and the mission and goals of schools that are trying to increase access to college for students like her.

Following this interaction, Mary joined some ethnic based social organizations including a Chicana based sorority. This sorority, which she identifies as "not mainstream" has goals which focus on philanthropy, sisterhood, and social activism. Mary also joined a political activist groups and is involved in promoting the "Dream Act" a piece of legislature which would provide immigrant students who graduate from high school the opportunity for citizenship. Mary also participates in Americorp where she works at a pre-school teaching low-income minority students. As she speaks of this experience she starts to see the connection between early educational opportunities and access to college. Her awareness is emerging and she is beginning to connect the dots between her academic and her lived experiences, although, she does not speak explicitly about this connection. She may or may not be aware that she may

share some similar characteristics with the pre-school students that she serves or that her background motivates her to join and participate in the communities in which she works and lives.

She does not know what the future holds, and even though she is interested in the non-profit sector in which she is involved, she seems to be open to the possibility of “more” and she knows that where she is “opens doors.” All doors are open.

You can imagine Mary up late in the library. In fact, during her first year, she spent most of her nights into the early morning doing her studying in the library. The library closed at 2:30am, and she would stay until it closed. During her sophomore year, she had to change her study routine slightly, since living off campus without a car left her at the mercy of the bus schedule. Since the busses stopped running at nine, she studied until then and would then go home and finish any assignments there.

Mary does most of her studying in groups and has really gained a sense of academic belonging at her institution by participating in these study groups. She speaks of her study groups proudly, wondering if the same type of collaborative learning is occurring at other Universities or if it is unique to her own. She talks about discussing readings, and lectures in these groups, and even using ideas that she gained from her study group to make stronger arguments in her papers. She has had to write a paper for every one of her classes thus far, research papers and critical analysis papers and although she thinks she was prepared for college in terms of the reading load, she wishes she would have been more prepared for the writing she would be expected to do. Writing in college continues to challenge Mary.

Mary is an exceptional case and in the minority at her institution in another respect. She has attended office hours for every class that she has taken. She networks with other students and professors during these office hours and uses the interaction as additional study time. She learns during the office hours and although, she has only formed a relationship with one of these professors, it is a strong one that has impacted both her decision to major in ethnic studies as well as provided her with a research opportunity for her undergraduate education.

STEM experience: She hasn’t taken many science related courses. The one class that she took is a biology class that is cross-listed with psychology. She did not have much to say about it with the following exception. The class was huge, 520 students, 10 TAs and 1 professor. This was the class with the least numbers of colored people. Most of the people in her class were either white or Asian and biology or pre-med majors. Apparently, she was in the minority in this course. She doesn’t speak about the teaching style content, or application to her life which is interesting because she recalls the title: Drugs and the effect on the human body. This sounds like an interesting course, but she would rather talk about her political science class.

Paul’s Story:

Paul attends an R-1 university in Southern California where he has between a 3.0 and 3.5 GPA. He says that he is doing less well than he would like in college. He,

like many young college students is content exploring college life. He loves his new found freedom and opportunity to get involved with numerous social organizations. Paul agrees that he has adjusted to the social aspects of college well, however, he does not seem as satisfied with his academic adjustment.

Paul spent his first college academic terms preparing for his courses and exams by reading. He read his textbooks over and over from cover to cover, and always felt prepared for his exams prior to taking them. But, after taking the exams, he would always walk out feeling like he did less well than he thought, and that was usually confirmed with his grades.

This pattern was particularly true in his Chemistry course. He seemed confused and as though he was just beginning to understand the importance of actually learning course material, as a path towards academic achievement. He compared his study method to those students who worked numerous practice problems, noting that their methods were more efficient and earned them higher academic grades.

He spent this confusing term, reading and then doing less well than he would like, but instead of going to the many friends and connections that he had made in the five on campus organizations that he joined, he studied for chemistry in isolation. He was alone, unproductively reading the text, and ultimately, he earned a "C". As a result of this experience, in combination with the many positive experiences he had in his visual arts courses, he changed his major from Biology to Visual Arts. He did not have positive engaging experiences in his college chemistry class. The teacher "did not captivate" him and this lack of interest resulted in his loss of engagement during class lectures. HE wouldn't even take notes and often stopped listening in class. Even though he has changed his major, he continues to work at the aquarium on campus.

Paul seems happy, as if he has socialized well into the culture of college. He has many friends and feels successfully a part of the life on campus. He lives on campus, and spends most of his time working and participating in his ethnic-related affinity groups. One such affinity group that he is involved with is the Vietnamese student association. He helped to put on their culture night last year, and he is also involved with two Asian dance groups and takes an Asian Martial arts class as well. He wishes there would have been more opportunities for him to get involved with similar affinity groups in high school, and finally has the opportunity to meet more individuals from his same ethnic background at the University. The population at the high school that he attended was overwhelmingly Latino. These experiences have allowed him to break out of his shell and he is very proud at the growth in his social life.

With all of this emphasis on social growth, he is less concerned with his academic growth, or lack thereof. He knows that he should "study more," but for now, he is content with late night cramming sessions and just getting by. He says that he will worry about studying more "next year." Why do today what you can put off until tomorrow.

He does say that he was prepared for college, but seems to be in shock at how little teacher, one-on-one interaction there is compared to the close connection with the high school teachers that he experienced. He believes that he may have been more

successful if he would have been forced to take more responsibility for his learning earlier on. He still is not taking responsibility for his learning, blaming his lack of note-taking on his professors. He feels that he is not alone in this experience. He agrees that most students are struggling in college academically.

Eunice's Story:

Eunice attends a large public university in southern California. She is currently majoring in English and has between a 2.6 and 2.9 GPA. Eunice, unlike Mary, has never been to a professors' office hours. She does most of her studying alone and rarely interacts socially with other student on campus expect for her boyfriend. Eunice lives at home and is trying to finish her education quickly with as few distractions as possible. She is motivated and she thinks that staying motivated and focused are the keys to success.

The STEM classes that Eunice has encountered have been intimidating and challenging. She is one of 500 in her biology class where all of the course materials can be found online. There isn't even a book. Biology feels like a class where the content is learned by memorizing. Flashcards is the tool that Eunice is using to memorize the biology content and that seems to be working for her. She has been more prepared for her exams than she expected going in, and that is because she works the practice problems online prior to the test day. She doesn't study with other people. That thought is also scary. She doesn't want to appear not to know the information and doesn't have much interest in the content anyway. She is only taking this class because it is required, and seems like she is ready to be finished with it.

Eunice is focused on her academic life and feels very successfully academically. She has had her eyes opened to a whole new culture by learning French and she hopes to teach English and French in the future.

One thing that surprised Eunice about her college experience is the lack of diversity. She believes that there are a large % of Hispanics and Latinos on her campus, but they are not in her classes. She doesn't see them and wonders where the people are. As she thinks about this, I can see the wheels turning in her head. The awareness of herself as an ethnic minority in her classes has never occurred until now.

Eunice knows what she wants to do and is excited about becoming a teacher. She has been most influenced by her godfather who is also a teacher, but has also been influenced by other teachers in her life including the teachers that she has encountered at her university. Even though she feels as though the content of her biology class is intimidating, she enjoys the professors teaching style. He brings in speakers to discuss real world issues weekly. The teachers in college were not what she expected. She is relieved to know that they are nicer than she originally thought they would be. She attributes good teaching to her preparedness for college, but wishes that she would have been taught how to write more efficiently. Writing in college is a very valuable skill.

Rachel's Story:

Rachel attends a large R1 University in Southern California. Rachel was always a student who showed a strong aptitude and interest in the biological sciences. In high school, she took advanced biology during her junior year, and AP Chemistry during her senior year. She intended to major in general biology at her college, and started taking courses to pursue this course of study. During her first quarter in college, she took 3 courses: Math, Chemistry, and a writing course called Dimensions of Culture. She currently is a human development major with between a 2.6-2.9 GPA.

Although Rachel participated in "Summer Bridge," a high school to college transition program offered on her university campus, she still struggled with meeting the academic demands of her introductory math and science classes. She ended up dropping both her Math and Chemistry class.

Mussey: You mentioned that you struggled with that Chemistry class. Could you talk about that experience?

Rachel: We were asked to take like this test, and then to see where we were placed, I actually got placed into that class (Chem). There is actually a like beginner class before that, which was like Chem A, which was more like an intro to chem, like if you haven't taken chem. in high school before. I got placed into chemistry, so I thought I could handle that class. But, it was actually much harder and they went really quick, they pretty much like speed through the whole chemistry book, first half of the book, So, I kind of fell behind in that class, and I dropped out of that class. Kind of the same thing for math too, I should have taken like a beginners intro class because I don't think I was like really prepared for that college level, so that is what I am going to do this year I am going to re-take that math class and take the intro chem. class before I jump into the series.

Rachel, was intimidated by the large class size and competitive culture that existed in her chemistry class.

Mussey: About how many people approximately?

Rachel: For the chem. class, it would fill the whole lecture. 300, I would probably say, and it would always be full and people would sit in the stairs and stuff. And that was, The atmosphere was really hard. It felt really crowded and it really wasn't that comfortable. And it feels like there is so much students just trying to compete in that class...

Unfortunately, because Chemistry is a prerequisite for taking any biological science courses, Rachel decided to change her major prior to even being able to take a biology class in college. Part of the reason that she changed her major was because of the experience in her chemistry class. Regardless of the good teaching that she perceived was going on in her science class, she still felt unsuccessful in this major.

Mussey: What about the teachers for your science and math class?

Rachel: The math class, the teacher that I had I couldn't really understand him, so I had a harder time in that class. But, for my chemistry class, It was a really good professor, and um, ya, but, the only problem that I think I had was that I didn't read all the materials. I didn't read the textbook. So I think that was one of the main reasons, that was the main reason why I fell really behind.

Mussey: Could you say a little more about your chemistry professor?

Rachel: It was a female and she, everyone told me she was really good and she is really clear, and she actually teaches us during her lectures, her lectures are really well taught. And

she makes us participate by using a remote control and that's how she knows that we actually attends classes. And um, the questions that she gives us, they actually appear on the mid-terms and finals, and so she goes over them and tells us how to do them, a lot of the homework problems were on the midterm and the final, so it was easy if you know how to do the problems. I think the homework questions that she gave out were really helpful, if you know how to do all of them.

In the face of challenges, Rachel maintains a positive attitude and describes how she has grown as a student over the course of the year. She attributes much of this growth to her involvement in the summer bridge and OASIS academic enrichment programs at her institution. During her first quarter in college, Rachel earned a 2.0 GPA. She was disappointed with this academic outcome, but improved over the course of her freshman year.

Mussey: What is your current GPA?

Rachel: My GPA in the fall was below a like a 2.0 so I did like really bad in the first quarter, so did you want to know the next quarter and the next quarter it went back up to a 3.2 and I have kept it the same during the spring quarter.

Mussey: What kinds of things did you do differently between the fall and the winter and spring quarters to raise your GPA?

Rachel: I think the what was really hard for me when I first went in was like the quarter system and how at Preuss it was much longer because we had the trimester system and then we switched to the semester system and I guess I procrastinated a lot in High School and I guess I could do the same in college, and it didn't seem like it was that much work because it was like very few in class meetings time, and a lot of your study time depended on yourself and you had to learn how to time management, so that is what I really like learned between the fall and the winter. And I got a lot of help with summer bridge program that I was in. they helped me manage my time and set my time. They taught me how to use my time. I guess I wasn't really paying attention to how I was using my time. So that was one of the biggest mistakes that I made.

Rachel was able to apply this learning to her courses in the spring quarter. She found success in her physics class, but since this class is designated for non-science majors, this experience does not seem to boost her confidence in her abilities as a science student.

Rachel: The physics class was much easier for me because it was the last quarter of my freshman year so I had learned how to manage my time a lot better and because it was a non-science, it seemed really easy because I took physics before in high school and then some of the stuff they went over was like exactly the same thing. We also had a textbook, but it was much easier because it was for non science....That professor also used the RAD control to know that we are participating, and this time I knew that the questions that he asked were on the midterm and this time I knew that so I wrote them down, he also posted them on line and he had study sessions. He gave us a lot of options for study sessions and he stayed after. And the classes were smaller. And the teacher led the study session.

Another reason that she found success in her physics class is due to the smaller class size, when compared to her chemistry class.

“the physics class which was smaller and the atmosphere was just a lot different (from the chemistry class) and I really like that smaller feeling, maybe because how Preuss was, maybe because it was in a smaller class, it was easier to talk to the professor compared to being in a large lecture hall.”

Samuel's Narrative:

Samuel attends a large R-1 University in Southern California where he is working on a double major in both communications and neuroscience. Samuel says that the most important thing that he has learned since graduating from high school is that he is responsible for his own life and actions. This sense of ownership permeates his academic affairs, and even as he speaks of his most challenging classes, he attributes the challenge to the fact that he did not put in the time or effort needed to be more successful. Samuel agrees that he is doing less well in college than he would like even though he has between a 3.0-3.5 GPA.

Survey Question #15: What has been your most challenging class and why?

Samuel: The class that proved to be the most challenging was my Calculus 10A course. The reason being that I generally dislike Calculus and therefore I would not devote the proper time and effort during my time studying for exams and quizzes. However I still managed to do well due to the fact that I would only did the bare minimum of what was required as oppose to going above and beyond what was expected of me (e.g. doing extra credit assignments or attending office hours).

Samuel seems to have adjusted well to college life. He is active on campus, staying involved with academic support organizations such as OASIS, and the Black student union. He also works part time for the association of disabled students. On the evenings and on weekends when he is not preparing food with his four roommates, one of his favorite hobbies, he is getting his real estate license.

Samuel speaks of college with a calmness and confidence that is unusual. He does not seem phased by the science and math courses that he has taken, including math 10A, and two introductory physics classes. He describes typical math and science courses as requiring a large amount of work, particularly when preparing for midterms and finals. He says that he was prepared for the workload that he would experience in college due to the heavy workload and rigorous coursework that he encountered in high school.

In fact, one major difference that he sees between high school and college is the tests, in terms of both the difficulty and the impact on grades.

Mussey: In what ways is college different from high school?

Samuel: The first thing that I found out and I found this out very quickly is the difference between tests at Preuss School and tests at UCSD. They are a little more challenging and the teachers are less lenient. Our grades are dependent on tests. 2 midterms and a final ...and I definitely have to say that 'it is our responsibility' there is no one there to tell us to do our assignments. You have to be motivated.

A second difference that he sees, and one thing that he misses about his high school is the connection with the teachers, and the supportive environment that existed at his high school. He remembers high school as a place where there was "support all around." He has not been able to make any similar connections with professors at his university, as he has not even attended an office hour thus far.

Noah Narrative:

Noah attends a large community college in the San Diego area. Noah often failed to find academic success in high school, despite his intelligence and consistent ability to earn high test scores. Like many gifted students, he refused to complete certain tasks that were required in his high school classes, the daily work and homework assignments, a decision that was evident by his high school GPA and subsequent ineligibility for direct admittance into a four year University in California. His high school GPA was below a 3.0 and all UC and CSU colleges require a 3.0 minimum GPA for admission. Noah was among the minority in his high school graduating class since 96% of his peers were admitted to four year schools. He intends to major in political science after transferring to a four year institution. He has between a 2.6 and 2.9 GPA.

Noah applied to four University of California campuses and six California State schools. He was not admitted to any of these institutions. Instead of being discouraged, Noah enthusiastically implemented his 'plan b' by quickly getting a job at a local grocery store, and enrolling, full time, in community college. What may have initially seemed to some like failure, Noah seized as a great opportunity. Noah has finally found success in school. He feels like he is thriving academically, boasting his 3.0 GPA as one of his most significant recent achievements, second only to graduating from high school.

Noah has found his niche in college classes where he is free from tasks which he calls "busy-work." Instead, Noah is able to focus his intellectual interests and become involved in critical thinking, problem solving, and active intellectual dialogue with teachers and peers.

Noah has learned that he can also engage in his passion at his college, studying politics. He loves his political science classes, and finds success in his active involvement in political discussions and debates during class meetings. Noah describes his favorite class so far:

Mussey: Talk about your favorite class so far.

Noah: Um, political science. Well, I figure that anytime that I get involved in a political discussion with someone in class, it usually turns out to be a success. Well, I really...I wrote a paper last semester, and it was pretty top notch. The topic of the paper eludes me right now, but I was really really proud of it. I remember that for sure. It's just, politics, I mean, I do really good, I feel really good if I do good on something. That is what I want to do.

One structure that exists at his community college which enables Noah to be an active member of a classroom learning community is the small class size. The classes that he has experienced at his institution range in size from 8 to 25 people. These classes are smaller and more intimate than even his high school classes.

Mussey: How many students are in your classes?

Noah: My smallest class is 8 or 9 people. My biggest class is around 20 to 25. I kind of like it because I do well when I can have more connection with the teachers. Rather than in a fat classroom with, you know, 200 people in there, I don't get anytime with the teacher to discuss what needs to be done.

Noah appreciates the small class size because it enables him to connect with and build relationships with his teachers, a practice that he is familiar with from his high school experiences. Noah understands the importance of quality teachers in the classroom, and he carefully selects his teachers for his classes by using an online resource commonly used by college students at his institution, www.ratemyprofessors.com.

S: You have mentioned teachers a few times, and I noticed in your survey you did as well. So, when you choose a teacher, what are you looking for?

Noah: Pretty much what I do, it is very scientific, haha...I go to rate my professors.com. and I look for, clarity is nice to have in a teacher. I look for easiness. I don't pick the easiest teacher. I look for a 3 or 4 rating on the easiness. And everything else, as long as its above then I will look at the comments to see what the teacher is like. It's good information to know.

Noah is developing his college going academic identity in terms of his political ideologies, and mentions how his political ideology impacts his experiences in classes and in his involvement in affinity groups which are not directly associated with his school. Noah selects classes and teachers based on the teachers' compatibility with his own political viewpoints.

Noah: I have been really careful about picking my teachers, and most of my teachers have been pretty fair. Because I know that my brother had a teacher and she was far, far left and we come from a pretty conservative family and uh, generally how its been, the teachers have been pretty fair. They try not to lean, I know it comes out occasionally, but I am pretty much the only one in the class against everybody. I usually don't talk to too many people from my political science class because uh, I would probably just get in an argument with them somewhere along the line, but if I need help they are more than willing to help, so...

Noah is also involved with a political campaign where he is gaining valuable work experience related to his future career goals of becoming a political analyst. His vision for the future is evident as he talks about how what he is doing now prepares him for the future.

S: How is what you are doing now preparing you for what you want to do in the future?

R: Besides studying politics and going throught the history . I am also working on political campaigns. I was an executive assistant for ___ who was running for US Senate. I worked on a campaign for ___. I was executive asst. for the campaign manager. He lost, landslide....we started last minute, pretty much, the party didn't even want him to win the seat...incumbent advantage had us...I learned a lot. There are a lot of things that like, that I kind of I discussed with the people about the republican party being totally not even put together, in disarray, kind of disorganized.... I am going work on ___ campaign probably again in six months.

Noah's theory of action about studying and learning seems more compatible with community college than it was with high school. Even though he did not make

straight A's in high school, he still felt as though he was prepared for the academic experiences. When I asked him how he was most prepared, he eludes to the fact that the rigor of the classes at his high school and the writing lessons that he learned prepared him the most.

S: How were you most prepared?

R: The classes, like, the classes at Preuss made it a lot easier. If I went to a public HS, I wouldn't have learned half the crap I learned Preuss and I think that was a big part, also, I was so, I mean, every year I heard, like, 'you are going to have to write essays, you are gonna need to know how to write one. This is what you should expect. It might be a lot harder, it might not be. That was the biggest thing. I think if I went to another school I would not have been doing as well. I probably wouldn't know what I wanted to do. It was my senior class in government when I found out what I wanted to do.

Although he realizes that he has not mastered what he calls the "perfection of studying," he has realized the need to study and the need to continue to make academic connections with his professors is important. Noah has found success as a college student who is trying to understand how to balance life and academics.

Noah hasn't had many experiences in science and math classes at his institution thus far. The one science class that he has taken is a biological anthropology class which he describes as his most challenging class. He attributes the challenge to the teacher's unnecessary use of vocabulary in class and difficult tests.

S: What is the most challenging class that you have taken?

R: Anthropology by far, anthropology class is probably the craziest class that I have ever taken, I should have just taken AP Chem, I would have done a lot better...the teacher, she teaches at UCSD and then she comes over here, not exactly the same caliber of school, and every chance that she gets, I think she has pretty much read the thesaurus 5 times and looks for the biggest word. Skin, She could've said skin, but she says epidermis, and ya I know what it means, but it just takes that much more time to process it and that plus 10 more big words in a row... The first test, half the class failed, and she was pretty much like, you guys can't study well, there are people in the class if you need to study, and you guys are bad students...She was really shady about it (grading the test). If you went by pure normal grading, I got a D...she said something like a C. I am going to figure out my next test score, coming up on Monday. If it is bad, I might change that class.

Even though Noah recognizes that the teacher often uses content related vocabulary that he doesn't understand, he still seems unprepared when the tests are based on vocabulary. Obviously, the teacher's use of modeling of academic vocabulary is not an effective teaching practice for this student. Also, the teacher's practice of curving

the test grades, common practice at large public universities, is foreign to this community college student.

M: What are the tests like?

Noah: The tests are usually composed of an essay portion, matching portion, where you match words with phrases. That was really messed up because I didn't exactly study the vocabulary, and they were the fat words that she uses. Most of it is matching. There was the difference between diurnal and nocturnal animals and you had to match. On another section, The wrong word was used, you could either put the right word or define the wrong word. There were two ways to answer that question. A lot of people liked it but did bad on that part.

Naomi's Story:

Naomi attends a large comprehensive public university with a commitment to a "learning by doing" approach. She is a mechanical engineering major and is currently on academic probation with a below 2.0 GPA. Naomi's GPA and current academic status has not deterred her goals of becoming a mechanical engineer. She has a fierce devotion to academics, and is intent on overcoming the initial obstacles that she has faced in her classes at her institution.

Naomi has adjusted to the social aspects and academic demands of college by becoming involved in several on-campus organizations including, SHPE (Society of Hispanic Professional Engineers), Movimiento Estudiantil Chicano de Aztlán (MEChA), and a Latino Sorority. All three organizations are affinity groups related both to Naomi's identification with her ethnicity, and her strong commitment to academics. She has developed a social and academic network of peers through participation with these groups, and as a result, her self-efficacy and confidence in her abilities has improved regardless of her academic achievement as measured by her GPA.

Her participation in affinity groups has also helped her adjust to her minority status in terms of both ethnicity and gender in her major, an experience that she refers to as a "culture shock." She speaks of this experience.

Mussey: Historically, women, have been underrepresented in certain fields in college. Do you find yourself, as a woman, to be in the minority at your institution?

Naomi: At Cal Poly, for one woman, there are 10 guys. And so that is a BIG change. I guess for some people it could be intimidating, I guess in my engineering class it was intimidating at first. So as you as a woman or as a minority...I am here to learn. And I am going to make these kind of mistakes, but we are all here to learn, and I will ask someone, "hey I don't get this, can you explain it to me." You know, it makes it easier if you forget about you being a minority and keep participating in class, it makes it easier to think about that we are all just students.

Mussey: Part of the Preuss School mission is to prepare minority students for college because historically black, and Latino students have had less access to college. Do you find yourself to be in the minority at your institution?

Naomi: Definitely, There are mostly Caucasians. There are Latinos here. And, I mean, Preuss prepared me to understand like how much like I can do as far as I am bright student and It doesn't matter if I am Mexican or not. I can do these things. In Preuss there are a lot of Latinos, the majority and when I come here it is kind of a culture shock, the majority is Caucasian. I got involved with SHEP for that reason because they were Latino and they were engineers. And its like you build a family.

Another cultural aspect of the university that Naomi attends that has helped her to remain a mechanical engineering major is the hands-on approach to instruction provided by the teachers at the institution .

Mussey: Tell me about your favorite class in college so far.

Naomi: Mechanical Engineering (ME), Intro to mechanical engineering, last year we did a lot of projects, whether it was building a bridge outta toothpicks to learn about force OR learning about, or making a little go-cart made out of the motor of a lawn motor to learn about how the gear transmission works and all that...it was crazy...can I tell you about my second favorite class?

Mussey: Absolutely.

Naomi: It was IME...it was a machining class and I actually got to build a screwdriver and an air motor in that class. So I got to work with the machines that I will be working with when I graduate.

Mussey: So, do you like the hands-on aspect of those classes?

Mussey: Yes, exactly, that is how I learn best. By doing. We get lectures in the classes but once a week we actually have a three hour lab where we take what we read about and actually apply it to what we are doing.

She has also received support from the teachers in her classes. From her experiences in high school, she values the importance of taking the initiative to build relationships with her instructors.

Mussey: Could you talk about the teachers from those classes? (physics and mechanical engineering)

Naomi: For the most part, the teachers are really friendly, they say come to my office hours and I will help you whether it is homework or a project...if I have time I will stay after with you guys. They are pretty nice, especially my physics teacher. He actually had examples in class to show us more than just the paper. The classes are not that big, the only big class was my history class, which was just a lecture. You just have to take the initiative to talk to the people around you or the teacher, and once you get to know the teacher, well obviously they are not going to know everyone, but if you get your face out

there, it will be easier for them to help you or relate to you and giving you help in certain areas.

Naomi is learning what types of study environments work best for her. She has transferred some of her learning from high school to college, including some time management strategies such as the planner. She also utilizes some of the reading strategies that she was taught at the Preuss school including Cornell note-taking. She values the knowledge that she can gain from her peers through group study, another practice that she was exposed to in high school.

Mussey: What are some things you do when you are studying in a group?

Naomi: When you are with yourself, you tend to study more the things you do. I go over most of the things that I know. You can't get help for what you don't know. I guess when you are in a group it is a better way to learn because they can ask you questions and if you can't answer, then there is your check... You can say, oh, I don't know that...if there is more people, everyone knows their little area, you tend to study more of everything than you do by yourself...Here at Cal Poly there are study groups that you can sign up for. Last year, I did a summer group, we became a family, and a lot of them turned out to be in my classes or...SHEP offers mentoring and tutoring. And we can assign you with a mentor or a place to study.

The most powerful take away that she seems to have internalized from her time at Preuss is the strong sense of self-efficacy and her responsibility to make the world a better place. She has certainly become a “globally aware and responsible student”, part of the learning goals for the school, and she hopes that other Preuss graduates have internalized this awareness as well.

Mussey: Is there anything else that you would like to add that I have not asked you? (This question came immediately after I asked her to give advice to current seniors.)

Naomi: yes (to current Preuss students) stand up for what you want and make sure you are out there changing something, because we are here to change the world. That is one thing I got from Preuss.

Deborah's Story:

Deborah attends a large, highly selective, out-of-state private school. She currently maintains between a 3.0-3.5 GPA, and is majoring in biomedical engineering. Although, she has maintained an B grade point average, she is dissatisfied with her academic achievements thus far, and feels that she has had to lower her academic standards in college. Deborah made straight A's in high school and was recognized for her academic achievements at her high school graduation. She was always at the top of her class, and for the first time in her academic career, she is not. She is certainly

achieving success by most standards, although she doesn't always perceive it that way. Part of the reason is her feeling of anonymity at her large institution.

Mussey: Do you feel like you have been a successful student? Why or why not?

Deborah: Not really, since my grades aren't what they were (and might be getting worse) and I haven't done anything impressive or great. Most of my teachers don't know me. I feel like I'm just another number, another nameless face, sometimes.

Unfortunately, this feeling is resulting in a lowering of confidence in her academics abilities. Deborah also feels that her academic abilities are getting worse, an ironic conclusion, considering the fact that she attends one of the top schools in our nation, and is learning computer programming, linear algebra, genetics, chemistry, Spanish, and expository writing from what she calls "accomplished professors, and teaching fellows," as I am sure they are. As a result of this perceived lowering of abilities, she worries. When asked about the experiences in her courses, she discusses her worries about her performance when compared to her peers:

Deborah: I worry about the students in my classes only when it comes to grading. Scary smart people means there might not be a curve, or I'll be at the lower end of it. Other than that, they're just students.

Deborah is adjusting to college life away from home, and part of this adjustment process for her involved her becoming more socially competent. She was always a shy student, hesitant to interact with peers or become involved in social groups. She interacts most often with two close friends, who are both science majors and therefore on a similar pathway. She studies with them often, and relies on them for both social and academic support. At her university, she has joined several groups including the Vietnamese student association and the Boston Refugee Youth Enrichment program, where she tutors immigrant students as part of a community outreach program. She began to understand the importance of community service through various community service projects at her high school and she has continued to answer this call to service in her college community.

Adjusting to the teacher and learning that is occurring at her institution has been another part of the transition process for Deborah. She recognizes some similarities in teaching methods that occur at her college, and discusses some of the "good teaching" that goes on at her school as being similar to what she experienced in high school.

Mussey: How were you most prepared for college?

Deborah: Preuss is similar to college in its rigorousness. The material we learn, *and how we learn it* at Preuss is similar to the **good** teaching here. I've recognized some of the techniques I learned and practiced at Preuss being

taught here such as the types of hooks for an essay, how to draw Lewis dot structures, partial fractions. There's a lot of thinking to do and the critical thinking skills from Preuss really help such as working backwards from the answer, looking at similar problems.

She also notices differences in teaching methods in high school and at her university and particularly points out the lack of scaffolds at her school.

Deborah: At Preuss, I feel the teachers really aim to have the students succeed, going over things step-by-step and emphasizing the important parts. Here, I think the teachers just review and add onto what's in the book, or rely on other means of teaching to teach the student (e.g. smaller sections, independent reading). The need for self-motivation and initiative is bigger at college; just being in class won't be enough to understand the material. In a way, the teacher seems less invested in the student here. This might be because of the time difference between Preuss and college too.

Deborah has noticed a significant difference in the teaching that is going on in high school and college science. The type of teaching that occurs in her STEM classes directly impacts her perception of this class. For instance, her physics class is the most challenging class that she has taken, due in part to the professors teaching style:

Mussey: Tell me about the most challenging class that you have taken in college.

Deborah: Physics! Ugh! The professor can't teach, or doesn't try to. The demos he does are interesting, but everything else is disorganized, unfocused, and not helpful to learning. It's basically like an independent-study class with homework and tests.

On the other hand, she seems to appreciate and understanding the teaching style that occurs in her favorite class, Computer Science, which she also describes as the most interesting, meaningful, and applicable to life. Even though the class is huge, over 300 people, the professor arranges to meet with students in small groups, by offering to eat lunch with any student on Fridays.

Mussey: Tell me about your favorite class in college so far.

Deborah: My favorite class this semester is Computer Science 50, or CS50. It meets MW from 1 to 2:20pm. It's a lecture hall class of some 300 students with one professor who stands on stage and lectures (he has a blackboard, laptop, and proxima, though). He switches between explaining concepts and actual coding the concepts. We're given handouts on Monday for the week's lecture slides and program codes. The lectures are filmed and all the materials are on the course website. Every Friday, the professor goes out to lunch with whoever RSVPs to the event. For help/support, there are office hours (with the

teaching fellows and course assistants—CAs are like TFs, but they only hold office hours and don't teach section) online and in-person at the computer lab. There is also an anonymized course bulletin board. Everyone also has an additional, optional section, grouped by how comfortable the students feel with programming. This section is headed by TFs, who in this case are students who've taken the class before, and goes over the section notes. Nine students usually show up to my section.

So far, Deborah says that, "I'm not too happy with my math/science classes." She feels that she cannot always follow her math professors, and in her most recent science class, she mentions that "neither the professor nor the TF is very interested in teaching." This fact worries her, as she understands the important relationship between good teaching and learning.

Peter's Story:

Peter attends a large public university in Southern California. He is currently majoring in accounting and has between a 3.6 and 3.9 GPA. Peter has already had opportunities to take courses in his major, and those have been his favorite classes in college, although he says that the textbooks are hard to read.

Peter wasn't always at the top of his class in high school, but he has found success in college. He says that he studies now "because he wants to, not because he has to." He says that "having the option is more than rewarding." Peter has the internal motivation to succeed academically, something that he did not know until he got to his college. Peter feels very successful in school now that he has realized that he can apply some of the study strategies that he learned in high school to college.

Survey Question: Do you feel like you have been successful in college? Why or why not?

Peter: I have been because after a bumpy first year, I realized I only had to do what I was doing in Preuss to do good, and it's working so far. My total GPA is over 3.5 again, better than my Preuss overall, so it's all good.

Peter says that the class that has most impacted his life is Calculus. That is the class that made him realize that he could succeed in college.

Survey Question: What class has impacted your life the most and why?

Peter: Calculus. I realized that I could do good, even in a math class like this one.

Peter describes typical science classes at his school as being large lectures, where the teacher uses PowerPoint slides as the primary instructional tool in the classroom. He says that they "aren't fun. But you learn." He also says that there are few student-teacher interactions in most of his large classes at school, something that he misses

from high school. However, in his science class he has had the most interaction with his teacher. He describes that class as weird and questions the teachers' commitment to teaching when they have Teaching Assistants in class.

Mussey: Describe a typical science class at your college.

Peter: My science class is a bit weird. Some teachers get out of teaching by using TAs, but I learn a lot in biology because the teacher brings in guests and she interacts the most (with students). In bio they have online tests where we can work together and I also study with other Preuss Alumni.

In his large science classes, the teachers use an online system where students can check their grades, get class notes, and even take quizzes. Peter appreciates "knowing where he stands in class so he know how hard to work." Peter is proud of the way that he has matured as a student. He says that he "works hard" and his grades are improving.

Eve's Story:

Eve attends a large private school in southern California. She is currently is a double major in American studies and political science. She has a 3.7 GPA and is on the deans list. She feels very successful and proud of her ability to adjust to the demanding workload and high level courses at her university. In fact, she counts her smooth transition as one of the most significant events in her recent life.

Mussey: What are some of the most significant things that have happened in your life since high school?

Eve: Um, the most significant things would probably be my transition to college, it well it wasn't nearly as daunting as I expected it to be. I take a lot of pride in the way that I was able to learn how to perform in my high level courses and also manage my time. I chose to pick up other extra curricular activities.

During the first years of college, students are searching for the best ways to prepare for classes and exams, Eve has learned to prepare for classes and exams by reading the assignments before coming to class. She also has made connections with one of her professors and is working with him at the program for environmental and regional equity on her campus.

Mussey: What class has impacted you life the most and why?

Eve: That class LA and the American dream is tied to a basic level writing course. The class was taught by a man who has kind of sort of has dedicated his life to environmental racism and environmental justice and just like equalizing disparities, uh, using LA as a microcosm of California and California as a microcosm of the US. So, the class was just really eye opening.

I learned a lot about the city at a basic level, but It was just a really new approach to studying geography and history. That class... I indeed up, I am an American studies and ethnicity Major and double major in poli. sci. It brought in my interest in that field. I am also working with him now at the program for environmental and regional equity here on campus.

Eve's personal connection and attraction to the interdisciplinary nature of the subject matter influenced her decision to major in both American Studies and Ethnicity and Political Science. Eve attributes her successful transition to her positive attitude and her ability to "know what works for her." She is loving being a college student and she says that she really found her "niche."

She feels as though she was prepared academically for the large workload that she would encounter in college. Although, she says that she wishes she would have had more experience with longer writing assignments.

One thing that she was not prepared is for the culture shock that she would experience. She says that she was used to "people like me." She describes the people at her university as "privileged with conservative viewpoints." She says that she "I crave to hear spoken Spanish and eat my Mom's food." Eve describes herself as being very family oriented. She tries to come home often, but as she gets more involved at her campus, she can come home less often.

Eve is extremely involved in her campus. As a students at The Preuss school, Eve was involved in numerous campus leadership positions and community service projects. She continues to be involved in such projects at her university working with a high school outreach program where she tutors low income students in the community. At the time of the interview, she had not taken any math or science classes.

Abigail's Narrative:

Abigail attends a large R-1 University in southern California. She currently is majoring in Psychology and she has between a 2.6 and 2.9 GPA. Although she is doing less well in college than she would like, she feels that she has adjusted to college life well. Through her first year's experience she has found ways to be successful including starting a traveling club for low income students, balancing three jobs, and continuing to work with her mentor from a previous internship. Still she has not achieved the level of success that she would like.

Survey Question: Do you feel like you have been successful in college?

Abigail: I feel like I've succeeded in being able to go to college but I don't feel as successful here as I would like to be. There's a lot of competition and everyone works extra hard and I find that I'm struggling with a lot of my classes.

Even though she says she is struggling with her classes, she feels like she was prepared, particularly for any opportunities that might come her way.

Mussey: In what ways were you most prepared for college?

Abigail: Well, I think the first thing that I would like to say is before I went to Preuss I didn't know anything about college at all, I mean like, just thought that I was going to college, but I didn't know what it was about. So, I mean, Preuss definitely told you all the steps that it takes to go to college and now I am here. Um, And, throughout that experience, throughout all the steps, those steps you learn that there are opportunities out there for you like so many opportunities for what you want to do with your life, what you want to do in school and how to go about that. You learn that there are opportunities for your life and you learn to look for those opportunities.

She seems to have vision for her future, and she plans to major in psychology and minor in health care. She had some experience working with a psychologist during an internship experience in high school, and this experience influenced her decision to pursue this course of study.

Mussey: What is your major?

Abigail: I am psych major, but I am planning to minor in health care. I haven't actually taken any courses yet, I mean I have done some stuff related to it, I mean in high school and stuff, I think so it should be fine. It should be interesting.

Due to the structures in place at her University, she has not been able to take any classes related to her major field of study yet. At the time of the interview, she was enrolled in her fourth academic term at her institution. At the time, her favorite class was a required introductory writing series called, Making of a Modern World (MMW).

Mussey: Could you talk about your favorite course?

Abigail: Surprisingly, my favorite class is MMW, all the series. A lot of people don't like it, it is kind of a hassle when you have a lot of other stuff to do when you have a lot of reading to do, especially when you have the 10-12 pages essays. But, The subject is really interesting because they mix anthropology, they mix writing, and a lot of the teachers actually incorporate art history, and I love it just the history, anthropology, and , sociology it is kind of broad, but it is engaging.

The interdisciplinary nature of the course is engaging, and although the workload in this course is heavy, Abigail loves the content. She also feels connected to the professors in this series. One professor in particular influenced her decision to start a new club on her university campus.

Mussey: Could you talk about the professor in that class? (MMW)

Abigail: Ya, I had Professor Hertz. I am actually taking him again. He is just one of those professors. You hear that professors don't care about you, you are just a number. He actually cares about who you are. You hear that you are just a number like you are one of the hundreds of student in the class. He inspires you. In the fall, I am actually starting a traveling club. I am in the process of registering it now. And it's the little things that he talks about in class. He just talks about traveling and makes it feel like it is a bigger importance than you thought it was.

Abigail's introduction to an interdisciplinary approach to instruction is different from anything that she experienced in high school, and she feels as though her high school could have done a better job preparing her for classes like this.

Mussey: In what ways were you least prepared for college?

Abigail: Ahh...least prepared, well, I feel like the only thing, is that it wasn't as broad. I felt like Preuss was a lot of focus on science sort of math kind of and less focus on liberal art kind of thing, like art and creative writing, and other subject areas that are also important. And, That is the only thing that I can think of right now.

Even though Abigail feels that her high school focused on math and science, she has still struggled with her math and science classes in college.

Mussey: Could you talk about your most challenging class that you took this year?

Abigail: Ummmm...My most challenging class. Well because I am not really a science or math person and everyone at UCSD is competitive, everybody is sort of going through the same thing because it is like science oriented. I actually failed chemistry which I am going to take over again and I actually withdrew out of math twice, so I would say that those are the subjects that I am having trouble with.

Mussey: What is challenging about them?

Abigail: I think, well, just because personal reason, it is not my strongest subject...but, also I think they sort of make the classes harder because they are trying to eliminate people, everyone wants to go to med school or biochem or something like that, so I think they try to eliminate people by making the course harder, and everyone wants to end up on the top, so it just really competitive.

She talks about her abilities in science and math and feels that she is not a "science or math person." She attributes her failures in science and math to her inability and to the "weed-out" nature of the class. She recognizes the competitive climate that exists in her science and math classes. She also recognizes the good teaching that goes on.

Mussey: Could you talk about the professors in your science and math classes?

Abigail: The professors are actually really good, they help you online. A lot of the professors do thing online, so it is easier to connect. They are really open and there are so many opportunities to bring up your grades but still at the same time, it is just a hard subject for me...I could go to office hours and students usually don't take advantage of that, but the very limited numbers of times that I have gone, it has actually been helpful.

Martha's Narrative:

Martha attends a large, highly-selective, private, out-of-state school. In high school, she was confident, independent, and at the top of her class. She loved biology and planned on majoring in biology and chemistry in college. She participated in several biological science related internships in high school, and seemed intent on a science related research career. After two semesters in college, although she has not yet officially declared a major, she has decided to double major in Spanish and French instead. She currently has below a 2.5 GPA.

Martha does not feel as though she has been successful in college. She has faced many challenges, both personal and academic, and she is struggling to overcome the challenges and re-focus on her academic work. She says one of the greatest mental challenges is being below average, a new experience for her. One of the most important life lessons that she says she has learned is that, "Mental health is worth more than any grade, or any class."

Even with this new mantra, she realizes that her poor performance at the beginning of her college experience may affect her future opportunities. When I asked her about the possibility of studying abroad, emphasizing her interest in language, she said that she doubts that will be possible due to her low GPA.

Part of the reason that her GPA is below a 2.5 is the rough start that she had in her first semester freshman classes. At the time, she was planning on majoring in biology and chemistry. The first chemistry classes that she took impacted her life by influencing her decision to both change her major and her career path. She says that these were the most challenging classes that she has taken.

Survey Question: What class has impacted your life the most and why?

Martha: Chemistry 21 and 22 both impacted me because I did so badly, so I was able to change up the course I was setting myself up for.

After taking these classes, she says that she feels as though she was "weeded out," of the sciences. The fast pace and competitive environment of the introductory chemistry classes, coupled with the adjustment of moving far from home left her feeling exhausted and incapable.

Mussey: You started as a Chemistry major, could you talk about why you are changing your major?

Martha: I changed because I was completely weeded out. I couldn't keep up with the pace. I couldn't keep up with anything because I am so far away, and I didn't study well my first year. I didn't really do much work. I was a little disillusioned. I got a C in AP chem., so maybe I should have realized that wasn't the best way to go...I changed a lot because it was really competitive here and I just couldn't do it. I got Ds in my first two chem. classes and if I get anymore (pauses)...I was too exhausted from these intro classes. I felt pretty incapable by myself.

She describes the introductory science lecture classes as being large and “completely useless.” From her discussion of the professor, she seems to think that he is more interested in his own research than teaching, a common feeling among undergraduate students at large universities. One structure at the university, in place to help students learn the content, is a small discussion group called ‘recitation.’ This experience was not helpful to Martha since she had trouble understanding the recitation teachers accent.

Mussey: Describe one of the introductory classes.

Martha: We meet 3 days a week for lecture that lasts a little over an hour. They always schedule those intro classes early pretty early so they can get kids outta bed. And we have an hour and a half lab. Our first professor hadn't taught an undergraduate class in like 20 years and the 2nd was like a crystallography like specialist so he would always talk about his own science. It was just very like, here is the info you have to learn it, and it is just very...I should have taken the initiative and done it myself. The lectures are just completely useless. They don't go over how to do any problems. Or do any questions on exams at all..there is also chem. recitation where they are supposed to teach you and my first chem. recitation prof was a visiting prof who was Russian who wasn't really doing anything. I never went because he just made me more confused. I think that my high school teacher gave me a really good base, but then it got worse. Noone would tell you how to go about solving the problems, so it was just a disparity between what was going on in class and what we were being tested on. There were over 100 people in the class...

Martha's frustration with her academic performance seems to be amplified by her feeling of isolation at this large institution far from home. As a low income student, she feels like she is in the minority, and doesn't understand what she calls the “work-hard/play-hard” mentality of her more privileged peers. The result is that she is left feeling like she is struggling in isolation. She perceives that most of her peers are performing better academically than she is, and even calls this struggle to develop her academic identity in this new context as an “identity crisis.”

Mussey: Part of the Preuss School mission is to prepare URM students for college because historically black, and Latino students have had less access to college. Do you find yourself to be in the minority at your institution?

Martha: Its hard because I have had a huge identity crises. I feel like I can't claim the Latino heritage because of how I look. I may fit in more because I am light skinned. The student population is really diverse and I didn't see it my freshman year. Now, I am really aware of the race issue ad there are tons of people that I have met because I have looked for them. In one sense, I am in the majority because of how I look and the way that white people are stereotyped is as sorority girls and frat guys that have so much money I can't wrap my mind around it. How...I don't even know. I have \$7.00 in my bank account. I can't imagine. The majority isn't white people, it is rich white people. It is not just black people, it is rich black people. It is not just Latino, it is rich Latino. The minorities that are here are wealthy. The financial aid kid is the minority here. I have been trying to identify as the Latino, but even that group is wealthy. I haven't been around "poor minority" kids.

Since changing her major, she has started to feel successful in some areas of her life. She attended a summer language program which positively influenced her perception of herself as a student. This program helped her gain a global perspective on life and has helped her do what she calls, "carve her path."

Mussey: Could you talk about the Middlebury college summer program?

Martha: That was pretty much the best decision that I ever made in my life other than coming to Preuss that really had a huge impact on me. It was for 7 weeks. We couldn't speak English. I wasn't talking to my family or listening to music. There was a huge range of people. I really learned how to study well and to work well. It really opened up my eyes because it wasn't just about taking French classes. It was about how French has an impact on the world. And French speaking countries in Africa,. It gave me more of a global sense than anything in college so far. It is going to shape what I do in the future.

Mussey: You said you want to go into education...

Martha: After I went to Middlebury, I am thinking about teaching English to second language learners, and I found a joint program at Columbia that teaches in inner city schools in NYC. I think it is important to continue my own studies. I feel like that is one of the reasons that I want to go to grad school, especially if I want to teach English or adults. I also know I want to work on myself.

She has already adopted a life-long learner perspective on life and intends to use her education to fully develop this part of herself. She has also had some positive experiences at her University, including building a relationship with a professor, and attending a student organization retreat. Both of these experiences have helped Martha feel more connected and less anonymous at her institution.

Mussey: Tell me about your favorite class.

Martha: The one that had the biggest impact on me was my psychology class. The professor reached out to me when he realized that there was a problem with all my grades. That had a big impact on me in terms of how I felt about my teachers and classes in general because I felt really lost in the crowd before that.

She misses the sense of connection that she had with her teachers in high school. One of the most challenging aspects of transition to college for Martha is the absence of having a small community of learners, with people who know her name.

Mussey: What do you miss most about high school?

Martha: The teachers that know your name. The teachers that have known you since you were 10 or since you were 14. You don't realize the importance of that until you don't have it anymore. You don't realize the teachers at Preuss are more dedicated than we were. And the teachers in college, ya, they are funny, but they are teaching a class because they have to, so they choose the intro class because it is the least amount of work and that is apparent. I miss the smallness and knowing everyone. I used to think that was bad, but now, being unknown is the worse thing ever. I miss the teachers and miss people knowing who I am.

In spite of her struggles, she definitely felt prepared for college in terms of having the basic academic skills to be successful and the basic time management skills to manage her time.

Mussey: How were you most prepared for college life and college academics?

Martha: I think what made me most prepared was the long schedule for the day. I feel like I have enough base like, I can do math, and I can do science, and I can write an essay.

But, she is still adjusting to the social culture that exists at some large campuses in the United States. She describes this culture as the college "hook-up culture" and she sounds shocked as she describes the nature of social relationships that exist at her school. She avoids this culture and surrounds herself with students who are like her in that respect.

Luke's Story:

Luke attends an R-1 University in southern California. He is currently majoring in microbiology and has a 3.3 GPA. He seems confident and calm as he talks about his experience in college so far. He participated in a high school to college transition program called summer bridge. He was invited to participate in that program via an email invitation from the program. This program seemed to help him accept the

initial shock he felt during his first large college lecture, an experience which made him think he wanted to quit college.

Mussey: How do you find college different from high school?

Luke: No one is watching, so you can pretty much do anything you want. Time management. You have to manage your time, not like high school where they give you the planner, they tell you what is going to be on the board.. and um, you know...there is homework assignments everyday in high school. They just want you to read it and expect you to read it so you can talk about it next class. And they may not give you as much time. They expect a lot more from you, and they don't say it. They are just going to say, go ahead. There is no homework, but I want you read this...and you have to read it on your own. They are going to assign the reading you have to self motivate yourself. There is no one to push you. No advisory teacher. You have to self-motivate, motivate yourself. You gotta do it by yourself.

Mussey: Did that surprise you?

Luke: That did surprise you, but Summer Bridge helped you out. If there is any program, that really helped me out. The first day in summer bridge I wanted to quit college because of the lecture, I was like it is so hard, but I just kind of finally got used to it. I looked at everything like the big picture, but if I take like one step at a time, It is pretty easy.

Fortunately, this feeling was short-lived, and as is evident from his interview, Luke has adjusted well, and feels very successful at his University. He has applied some of the time management strategies that he learned in high school, and he understand that even when the professors don't check your homework, or hold you directly accountable for daily readings, the student is still responsible for the assigned readings. Luke seems to understand what is expected of him and he fulfills this expectation by reading before class, and studying in groups and alone for exams. He also attends professors office hours and meets with TAs regularly in order to gain some insight on what will be on the exams. He applies these good study skills and strategies to even his most challenging class, Chemistry.

Mussey: During the first years of college, students are searching for the best ways to prepare for classes and exams. Describe some of the ways that you have prepared for classes and exams during your first year of college.

Luke: For my classes, I would usually read before, usually you have the syllabus and I would read before so you would know what they are going to talk about. This would help me further because I would know what they are going to talk about...Exams, I usually go to TAs and Office hours with the professors. That gives me insight as to what is going to happen on the test.

Mussey: Do you find that a lot of people take advantage of that?

Luke: yes, well no, not the majority, but ya, there are a lot of people in there.

He has internalized his experience in both high school and in the summer bridge program, and often studies in groups.

Mussey: At the Preuss School UCSD, students are arranged in advisory classes. During this class, students have had the opportunity to form study groups, and interact with their peers, and teachers. Have you had the opportunity to form study groups or interact with your peers during your first year in college?

Luke: Ya, cause um, well it was like, I was in summer bridge, so they gave you an option to go to, it was like an advisory class where they helped you out. They would form like a summer bridge group where they would form study groups. It carried into the school years so that was pretty helpful. Like people in the same classes, I would usually study with them, I also go to the library and look around for people to study with.

Mussey: What kinds of things do you do in study groups?

Luke: Problem solving, like I ask questions about concepts that I don't understand.

Mussey: How is that different from what you do when you are studying alone?

Luke: When I am studying alone, uhh, I usually just want to do all of the homework problems that I got wrong. I also review what other students got wrong, and I guess read the book over.

Luke finds his math and science classes challenging. He feels that he was prepared for chemistry, biology, and math. Much of what he learned in the introductory courses were review from his advanced classes in high school. He says that the tests in chemistry were hard, but accepts that as part of a typical college science class. He feels that he is a "math person," and that he acquired the necessary skills in high school to excel in math, so he feels that it is natural to find those classes challenging but manageable.

Mussey: How would you describe a typical science class?

Luke: Its pretty hard. That is the first statement that I would tell them, It is pretty hard, but interesting, because I guess you don't usually talk about science in that kind of depth so it is pretty interesting.

Mussey: Do you think you are going to stick with the major (microbiology)?

Luke: Yes.

Mussey: What about math?

Luke: Depends on the person who is asking, I could say that it is going to be really easy for you, and it could be really hard for you. Depends on if you did good in math in high school, it is going to carry over into college. It's pretty much the same skills in math wherever you go.

Luke successfully passed the chemistry pre-requisites necessary to take his first biology class, where he experienced some innovative teaching in a class of over 300 students. His teacher assigned a group, video project. He enjoyed the experience

where he was able to make a video about AIDS with a group of about 10 students. This project grade served as one of his midterm grades, and he described the experience as fun. Luke intends to graduate with a degree in microbiology and pursue medical school.

John's narrative:

John always wanted to major in science, or so he thought. John attends a large R-1 University in Southern California where he started as a biochemistry and cell biology double major. After completing two quarters, John decided to change his major to Visual Arts with an emphasis in film and cinema. This decision was not easy for John since he felt pressure to major in science, a discipline that he always associated with being successful. In our interview, John talks about the decision to change his major and discusses 2 reasons and 1 major realization that came out of this decision.

John: I am going to switch to visual arts majors.

Mussey: Why?

John: Because, well um, because I really like making movies and I really like art and I know like coming to UCSD, I always felt like pressure to come a science major, so I wanted to try something new, and I took Vis 70, and I really like the class. I could have got an A in it, but it was just my essays, like making movies, I always got an A in making movies. (He got a B+ in the class.)...I decided that sitting in a lab, and I decided that med school is not for me. I really like science, but after chem. It was really hard, Chemistry just turned me off. It is really hard.

John: I thought the other majors were just like taking the easy route. Because UCSD is med. and known for biology, I thought I had to be a bio major and I could maybe do pharmacy. But, I learned that you don't need to be a bio major to be successful. That's what I learned.

John decided to switch from a biochemistry/biology major into a visual arts major because he discovered that both his interests and abilities are more directly aligned with tasks that he was completing in those classes. His perception of science as a major that would lead him to "sit in a lab" or go to medical school was not attractive especially after coming to the realization that he could find success in another discipline. John has become very successful at college by maintaining a 3.18 GPA, becoming involved with the Asian Pacific Islander Student Association, a service fraternity, and a grass roots newspaper. He aspires to make movies for Disney or Pixar.

John's theory of action about learning is similar to other students who attended Preuss. He understands that learning can occur in groups, and that group study can help students "fill in gaps" of missing information. Because he has internalized this theory of action about learning, John participates in study groups often, occasionally initiating groups, through use of online social networks such as www.facebook.com.

He plans “events” on these social networking sites, inviting students from classes to participate and meet at the library for group study. John also studies alone, but he uses that type of study time to practice already acquired knowledge. He has attempted to attend professors’ office hours, but he admittedly made the mistake of waiting until the end of the term to go to the professor’s office. At this point in the term, the office was crowded and he was unable to make a connection with the professor. He says that he has learned from this experience and will attempt to attend office hours earlier in the quarter to attempt to build personal connections with the teaches.

According to John, the interaction and personal connections between teachers and students is one aspect of the high school experience that is missing from the R-1 University experience. He relates this connection with caring, and since this relationship is absent in college, he assumes that the professors don’t care.

Mussey: What advice would you give teachers in high school to better prepare students for college?

John: Well, I like the student and teacher interaction because we are so close to each other, we know, we talk and know each other well. To get the college feel, Ya’ll should be more harder like really harsh.

Mussey: In what ways.

John: In testing...because I swear on, sometimes on exams, I swear we did not go over this questions...oh, and homework does not count in college.

Homework is up to you. You can do whatever you want. You don’t have to do the homework. The class is quizzes test, and participation...attendance is not required. Math they don’t care. Chem. they don’t care. The Prof. doesn’t care. It is like whatever.

John felt prepared for college in terms of the work load. He attributes this preparation to AP courses and scaffolding in high school.

John: I also wanted to add...I really just like the system where at where at Preuss we take APs, and like how, you know, I remember like Mr. Ensberg and you and the advisory teachers they help us with, like you guys help us with prep. And going to college and applying for college, and like financial aid and letting us know about scholarships and stuff like that. And like meeting people like a lot of my friends from here they go to like these big high schools and their counselors don’t care about them, and I am just really thankful that I came from here and I got enough money to go to college and other people are like, oh, I didn’t know about FAFSA and I didn’t know about SATs, and I am like, ‘are you serious?’ you know? So, I am really glad about Preuss, does that.

Hannah’s Story:

Hannah attends a large R-1 University in California. She is currently majoring in economics and environmental studies, and she has between a 3.0-3.5 GPA. She

seems to love college life, and feels like she has adjusted well to living on her own, in a city away from home.

Hannah says that the one of the most significant things that has happened to her since high school is meeting a group of friends that she knows will be friends for a lifetime. Hannah joined a sorority, and is living in the sorority house near her campus. She values the friendships that she has found through this experience, and uses this group for social and academic support. Finding this group helped her make the transition from being a “kid to an adult.”

Mussey: Tell me about the most significant things that have happened to you since you graduated from Preuss.

Hannah: Um, well going to college, I met a lot of like I guess my best friends in college. I joined a sorority and I guess I met some of my best friends that I know I will have forever. I kind of, I guess I fell in love. I got into a really huge relationship. I guess it was really different being on my own. Um, I guess I was sheltered with my parents, like they kind of provide everything for me, I guess being on my own I had to learn how to do everything, even the littlest chores I kind of struggled with, I guess learning to be an adult. Even in school, like in high school with the whole counseling thing. I feel like in college I have to take initiative and go out on my own, I feel like I was running around trying to find how to find my counselor, and I barely spoke to my counselor this year too. I guess the transition from a kid to an adult, that's it.

Hannah was prepared for college, particularly in terms of the workload and rigorous coursework that she would experience. Because of her involvement with the AP program, she also entered college with the confidence and self-efficacy needed to approach rigorous classes without being “afraid.”

Mussey: In what ways were you most prepared for college?

Hannah: I think I was prepared because I feel like AP classes...like in my classes, everyone took AP classes, so I feel like everyone is on the same level. I feel like I am prepared in the sense that AP made me study more, so I feel like I am definitely not afraid when the class is hard.

She does most of her studying on her own, except for in the classes that she struggles with, such as her calculus and other science classes. She sometimes forms study groups for those classes with other members of her sorority.

Mussey: Tell me about the most challenging class that you have taken in college.

Hannah: Probably calculus or the more sciency stuff. I remember that I took it in high school and it was like so much more difficult in college, I remember I was struggling a lot with it and people in that class are less likely to help each other out since it was graded on a curve. I like barely passed that class, and I

spent like a lot of time studying. I probably spent more time studying for that class than for any other class, and I still like passed but I was like a C. I guess I wasn't really interested in it. It was just like a bunch of numbers to me, and I didn't see how to apply it to real life. I just wasn't interested.

She describes calculus as one of her most challenging classes. She attributes this challenge to her lack of interest in the class. One of the reasons that this class is challenging is the lack of personal connection with her instructor, and the competitive culture that exists in this and all math and science classes on her campus.

Mussey: Could you talk about the teacher that you had in your calculus class?

Hannah: Um, I guess he was a good teacher, but he was like this old man and he didn't try to build relationships with students at all, I would get to class and he was like, 'OK class, and he would just start writing on the board.' And he had this rigid schedule and everything went according to planned. So he didn't really have time to talk to the students or kind of like be flexible, its like a 50 minute class so at 50 minutes he would just stop writing, and we just kind of left. so I would look at my notes, and try to pick up everything and have to learn it all over since I felt like the class was going kind of fast. Noone ever asked questions. After class, everyone kind of looked confused and they have to learn it on their own. I felt like he was not a very approachable teacher.

Mussey: Is this typical of the math classes at your school?

Hannah: I think there is a big difference between the science classes...All the science classes are graded on a curve, and people are pretty much pre-med and everyone knows what they want to do, so noone helps each other out. And the North Campus classes, more art, history, social sciences, since it is not graded on a curve, everyone helps each other out.

Hannah provides us with some insight as to why such a competitive environment exists in the science and math classes at her school. More often than not, the science, and math classes are graded on a curve. When professors grade "on a curve," students feel that there are limited numbers of "good grades" to go around. Therefore, competition between students is the result, and a collaborative learning environment cannot exist. This is particularly true when many of the students will be competing for limited positions in medical school in the future.

Hannah contrasts the competitive science and math classes with the more collaborative "North campus classes" where students "help each other out." One of her favorite classes falls into this category.

Mussey: Tell me about your favorite class in college so far.

Hannah: My favorite class.. hmmm...It's like a Global environment seminar, I guess how the environment is effecting diseases and how it is making diseases spread faster in Africa. It is not a very traditional class at all because it is like three hours and you just read a lot and you discuss, and there is only like 20

people in there. And I really like the environment, and I want to do, you know, something outside, like you know outdoorsy in my life and I also love learning about Africa, and it is one of the few classes at UCLA that even though it is over, like half the class is still trying to keep in touch and build wealth in Africa, and I feel like it is one of those rare classes where you actually get to Do something and help out.

In this seminar class, Hannah is experiencing a small collaborative learning environment, where students and teachers can connect. She is also studying content that she can relate to as well as apply to her life, as she helps organize outreach to the part of the world that she was studying. She describes this as “not a very traditional class” and “one of those rare classes where you actually get to DO something.” The structure (class size and seminar format) as well as the teacher in this class engaged Hannah and influenced her to explore possibly changing her major to a social science, where she can attend more classes like this in graduate school.

Mussey: Could you talk about the teacher for that class? (global environmental seminar)

Hannah: My teacher was the most qualified to teach that class. She is amazing. She is like half African and half American and she is from Ghana, so some of her stories are like personal experiences and we learned about AIDS and malaria and she actually used to half malaria because she was living there, so I feel like it is a rare teaching experience because they are personal stories, but she is also very intelligent and I loved going to class because she was very interesting.

She loved interacting with this teacher, and she was prepared for this interaction because of the “one-on-one” relationships that she had with teachers at her high school. Hannah has learned to take responsibility for her own learning. She knows that she struggled at first because there was no one to “tell her what to do,” but she loves her newfound freedom and the life that she has made for herself in college.

Ruth's Narrative:

Ruth attends a large R-1 University in Southern California. She is currently majoring in Sociology and has between a 3.0 and 3.5 GPA. She hopes to one day work in school administration or human resources, a goal that has not changed since her senior year in high school.

Ruth has adjusted to college life well. She feels as though she has maintained good grades while juggling work, and a healthy relationship with her boyfriends. She says that doing good in school is the most significant thing in her life since graduating from high school.

Ruth's favorite classes have been her sociology and communications classes. In both of those classes, she says she is learning about the world around her.

Specifically, in her sociology class, she has learned how people in the world interact. In her communications, she learned how the media influences our thinking. In both classes, she is able to make connection with the real world.

Mussey: Could you talk about your favorite class so far?

Ruth: Um, so far, it is between my Sociology class and my Communication class. In my sociology class, I learned how people interact with each other and how they get influenced by one another. Not just people in America, but people in other countries, I learned about how people in other countries, how they view us, how we view them. In my communication class, I learned how the media influences us and manipulates our thinking. In the class we had to write a paper, about how media stories showed the debates, the good things and the bad things and it forced me to really watch the news everyday and I liked that. (laughs)

The most challenging class that Ruth has experienced is her statistics class. She believes that this class was challenging because the TA in her section was not an effective teacher.

Ruth: (talking about her statistics class) The teacher was good, the book was ok, they were both kind of hard to follow. But, I think that the TA for my section, she really couldn't help us. When we had questions with things, The TA couldn't help us. She didn't/couldn't explain it in a way that we could understand it. That was really hard especially because we were in a really big lecture hall.

Ruth felt most prepared for college in terms of the heavy workload and rigorous classes. She was used to the longer school year, and feels like she internalized the importance of being dedicated to her school work. She is dedicated to her work on campus, and spends long days attending class, working on campus, and participating in extra-curricular dance groups. She does most of her studying in the evenings at home alone.

When she studies, she reads and highlights the book, makes flashcards, and does practice problems. Occasionally, she will study in a group, especially if she knows there are discussion questions that she will need to respond to. In the group, she will get other people's insights as to how to answer the questions.

One thing that Ruth misses about her high school experience is the sense of community that she shared both with her teachers and with peers from similar backgrounds. Ruth describes the same kind of "culture shock" described by some of the other students upon entering college.

Mussey: What do you miss about the Preuss school?

Ruth: I guess The sense of community is different – I guess racially too because there is a big racial difference in ethnicity and stuff and I guess the

teachers because in college the teachers will not know your name if it is a big lecture, the interaction one on one with the teachers because they care more and they care if you learn more.

Mussey: Could you say more about the racial difference? How do you feel about it and what do you do?

Mussey: Preuss was very diverse I guess, there was more like Hispanic, it was very heavily Hispanic, and I guess at UCSD, its just whites and Asians are the most dominant ones and everyone else falls underneath, about 14% or less. And but, well here, my roommates, the people that I live with are very diverse. There is another Mexican girl, and 2 Asian girls and one Caucasian girl. So what I have done about it is join a Mexican Dance group and I am also pledging a Latina Sorority so that I will have a community of girls who come from a familiar cultural background.

She misses the feeling of being connected with the teacher through one-on-one interaction, an experience that is direct contrast to the large anonymity that one can experience on a college campus. She also misses having a “community of girls who come from a familiar cultural background,” something that she has sought out by participating in two student affinity groups on campus.

Elizabeth’s Narrative:

Elizabeth attends a community college in southern California where she has been admitted to a transfer program, guaranteeing admission to the four year school of her choice, upon successful completion of a series of courses at the community college. She is currently on track to transfer at the end of her second year. She intends to transfer to a large R-1 university in the same city, where she will major in biochemistry, and pursue a career as an OB/GYN. She has a 4.0 GPA.

After graduating from high school, Elizabeth attended a recruitment training program for the Navy. At the end of that 6 week boot camp program, she decided that the military “wasn’t the best solution.” She had the option to enlist or go to college, and she promptly enrolled in community college in her home town. Over the course of the year, Elizabeth has developed into a successful college student. She says that the biggest ways that she has changed is by becoming more studious, a characteristic that she did not feel she had in high school.

Elizabeth seems to have adjusted easily to college academics. Her class sizes are small and range from 15 to 45 people. She has been to professor’s office hours where she was surprised to learn that she could get academic help.

Mussey: Have you had the opportunity to form study groups or interact with your peers during your first year in college?

Elizabeth: Ya, I had a lot of study groups because there were a lot of freshman. We would help each other out. Like tell each other, ‘oh ya – you should go to this professor’s office hours. Because I thought the office hours was just sitting

talking to the teacher about something, but it is actually them sitting there helping you . It's a one-on-one. It is the closest you can get for a one-on-one.

She has also learned that she is accountable for keeping up with the assigned course reading. She even called her biology textbook her "best friend."

Mussey: During the first years of college, students are searching for the best ways to prepare for classes and exams. Describe some of the ways that you have prepared for classes and exams during your first year of college.

Elizabeth: Basically, you have to do the reading. I learned that the hard way for uh, what was it, my bio class. For, uh, it was chapter one. I decided to skip chapter one and go straight to chapter 2 because it was longer, but oh, on the test, oh geez, I was like a C. But, the whole section on chapter one, I didn't know what they were talking about. It was horrible, it was horrible. So, you actually have to do the reading and take notes. I do the Cornell Notes, write a question and an answer, and I do the key terms. You have to read along. Whenever you are assigned the reading, I read it.

She is also able to apply the skills that she learned in high school to college, such as Cornell Note taking and studying in groups. She utilizes the resources offered by her professors, including accessing study guides that are available in the library and notes that are on-line.

Her favorite classes have been her psychology and Japanese classes, since she has been able to directly apply this knowledge to her life. She has struggled most with her English classes, and the writing that is required in college. She describes her typical science class.

Mussey: Describe a typical science class at your college.

Elizabeth: It was actually so similar to high school, like our AP Bio classes, we dissected a class too, we also dissected a cat in that class. Two days a week you have a lecture, and one day you spend in the lab. It was like here is your set of procedures, read it, do it, turn in your work, go home.

Mussey: Could you talk about the teacher in that class.

Elizabeth: The teacher, It was horrible, he was just like read the book, read the book, and it was just like lecture, lecture, lecture. No PowerPoint. He was just lecturing out of the book, so the book was your best friend, so I did the reviews out of the book.

Elizabeth is excited about her academic success and her future aspirations. She says that the biggest adjustment that she has had to make is the social transition.

Mussey: Some students find the transition from the Preuss School to college difficult. Talk about some of the ways that The Preuss School is different from college. In what ways is Preuss similar to college.

Elizabeth: The biggest one would be social. Because you are so used to preuss you know everybody but then you go to college and everybody is on there own, so basically you sit alone. That is why I study alone. I mean, you do make friends, but It is more of a social transition. Academically, it is not that bad, its not that different from high school, from what we had here.

Lydia's Story:

Lydia attends a large public school in southern California were she is a liberal studies major. She plans to get her teaching certificate and teach either kindergarten or 4th grade. Lydia feels very successful in college. She is proud of her academic accomplishments and feels like she has adjusted to college life well.

Mussey: Tell me about the most significant things that have happened to you since you graduated from Preuss.

Lydia: Well, uh, I was really proud of myself for finishing the first semester of college. It was personally hard for me because I was going through a lot of changes. One of my best friends had passed away, and I was re-thinking everything. The second semester, I was really proud of myself, my GPA went up a whole point, I even got on the Dean's list or something like that.

As you can see from her interview, Lydia gained some renewed pride in her academic accomplishments when she was recognized at her institution for good grades.

Lydia has been influenced positively by some of the interactions with her professors at her institution. Even in her most challenging class, the relationship that she built with her professor helped her to see this as a positive learning experience.

Mussey: Tell me about the most challenging class that you have taken in college.

Lydia: Hmm, challenging, let me think, well, I'm thinking math, 211, um that was a class I took, spring '08. The material itself was hard for me because I had a really hard time during elementary school, and I just I don't remember a lot of basics overall, so the class was to teach us how to teach those basics, and so I felt like I was one step behind. It was just harder for me, so I would give like 150% and I would make sure I was there early and I would stay late. the teacher, it was hard because of the material we were covering, but the teacher was really good even though she had just like transferred from China, and she had problems communicating what she was trying to say but I actually worked with her, and I ended up getting to know her very well, I even ended up interpreting for her in class. So, that class ended up being a positive experience for me even though it was really hard. At one point I had a D, and then it went up to a C, and then a B, and that is where I stayed.

Through the interaction with her professor, she gained a renewed sense of her capabilities in math, a subject that has produced anxiety for Lydia since elementary school. Lydia has also had positive experiences in some of her science classes. One class, her geology class has impacted her so much, that she plans to specialize in science for her liberal studies degree. She says that:

Survey Question: What class has impacted your life the most and why?
 Lydia: Geology. It has taught me how wonderful learning about this earth can be and has renewed my interest in science. I used to hate it and now I have decided to specialize in science for the liberal studies major.

A positive learning experience in science has renewed her interest in science. She goes so far as to say that she used to “hate it.” When I asked her in the interview to tell me about her favorite class, she talks about this geology class again.

Mussey: Tell me about your favorite class in college so far.

Lydia: (She talks about a PE class first.) The other class is geology, and I have learned a lot, just a lot. She jokes with us about that we are going to talk about this at home with our friends and I actually do that because it is so interesting.

Mussey: Could you talk about the teacher in that class?

Lydia: She usually lectures to a PowerPoint, but um, she does, what I like about it is that it is not a usual PowerPoint, very little writing on the PowerPoint, just mostly images, and figures, and maps, and very beautiful images too. And that is how she captures our attention with amazing facts, like she will tell us how right by where we live there is a transform boundary right by where we live, and she will show a picture of it actually moving and that is when the whole class starts paying attention, we are like, what? And um, and its just really an interesting class because of what we can see there and she has amazing images, amazing videos, and the material itself is just like really cool. That is one thing I wanted to mention. For attendance she has a little apparatus, and just by answering, she counts you as there. I have done 80% or above on every test. Most of the material on the test, she does in class.

Lydia likes this class because the teacher makes the content interesting and relevant to the student’s lives. By using images on PowerPoint, the teacher captures the attention of the visual learners, which Lydia claims to be. By teaching all of the material in class, she lowers the affective filter for students and they feel like they can be successful on tests. Lydia tells me that the teacher uses the textbook as a reference.

Lydia has adjusted to college academics well. She says that the hardest part of the transition process for her was getting used to a different accountability system. In high school, teachers hold students accountable for every piece of work that they do. In college, students are accountable for learning the material and displaying this knowledge on exams. For Lydia, this was an adjustment, as you can see from the following quote:

Mussey: Some students find the transition from the Preuss School to college difficult. Talk about some of the ways that The Preuss School is different from college. In what ways is Preuss similar to college.

Lydia: Ya um, well one of the main things that I found difficult is that I was very homework oriented. I would always do my homework always, always and I would always do a top notch job on it because I had the resources, because homework is homework, you could take it at home and just go crazy. So I would rely on my that homework grade to get an A. So, my test average would be a B or C and I would never worry about it because I would still have As. So I would be like, its cool, I have a good average. So went I went ot college I realized I had a problem, because I would read on every syllabus didn't say anything about homework, just 75% exams and tests, 20% finals, and 10% attendance, so that was kind of scary and I was really, really scared the firsts semester. I was sure that I would fail at least one class...but, I didn't. I was just really scared because it was just me alone with my brain. It wasn't like I didn't know about it. I was told, just getting there to college and seeing it,that was scary.

Lydia advises high school teachers to adjust their workload to reflect the accountability system in college. Specifically, she says:

Survey Question: What advice would you give Preuss Teachers about how to better prepare students for college?

Lydia: Workload needs to be reduced....A LOT. There's no reason to master bookwork/classwork. There is NONE in college, if hardly any. Concentrate on tests and essays. Critical thinking, reading. I know Preuss does this already but I just think the amount of homework was un-necessary. Most kids were burnt out after graduation and in my opinion, that caused a lot not to finish/go to college. college has no work except reading, LOTS of it and 3 exams that make up your one grade. At preuss, mostly 50% of grade was HW and classwork and the other 50% was attendance and tests. Make it at least 75% tests.

Moses - Narrative:

Moses attends a small private university in southern California. He is majoring in architecture and plans on becoming either an architect or starting his own business when he graduates. He feels that he is excelling academically. He has a 3.4 GPA.

Moses successfully manages his time in college and is very proud of the fact that he spends 30-40 hours a week in the design studio, while still managing to work part time on campus. In his free time, he de-stresses with classmates from his studio class, a tight-knit group of friends, one of the results of the cohort model that exists at

his school. Moses loves his studio classes describing them as both his favorite and most challenging classes.

Mussey: Could you talk about your favorite class?

Moses: My favorite class was that studio 1A, the first semester, that is the main class that architecture students take. I enjoyed it because I got As and the thing was that not many, two or three other students got As too. It made me realize that we could have done so much more, I guess that the analytic process came naturally to me, but I think that Preuss could have done better in offering more about architecture, since it concentrates so much on politics, science, and engineering. If Preuss, had something more, I could have performed better in that class.

Even though he got As in the class, he feels like he could have been more prepared for the analytic and critical thinking that would be required of him in college. He is learning how to think in different ways, problem solve, and successfully complete design projects. One of the biggest factors that has helped him to be successful is the teaching that is going on at his university. When I asked him about his studio teacher, he says,

“The teacher, you would have to meet him. He would work and then come to this class. He just brings, he just opens everyone’s mind. Even as an analytic person that I considered myself. He just opened my eyes, and I could see more in a abstract way. He just opened my mind to a new way of thinking.”

Moses had an ‘eye-opening’ experience in this class, an experience that both engaged and challenged him and solidified his commitment to his major and career choice, architecture. He has developed personal relationships with many of the faculty members at his school and keeps in communication with them via email, by going to office hours, and by staying after class to talk.

Mussey: What has been your most challenging class?

Moses: Studio or Design Com. 2. They asked for a lot of money for everything. Every project I had to at least spend like \$100 on every project and we had like 5 of them, so the financial and what they asked for in the project was challenging.

Mussey: What did you find challenging about those classes?

Moses: Oh, it was something that I was never asked to do at Preuss, like build a certain model out of wood using certain criteria and you couldn’t go off of this point and you have to build within this limit. Things I never encountered at Preuss.

Moses describes the challenge as being twofold: 1) It is a financial challenge to come up with the extra money necessary to build projects throughout the semester, and 2)

Academic challenge, because it is something he has never had to do before, authentic problem solving. The first problem may deter low income students from participating in this major. There are few low income students at the expensive private school where Moses attends college.

Moses has not encountered any academic problems in his math courses in college. In fact, he works as a math tutor for the office of academic support and instructional services (OASIS) program, and has been asked to solve problems in front of his math class. His math classes come easy to him and much of it is review from high school.

Mussey: Could you talk about a typical math class at your school?

Moses: All the classes are very small, maybe 20 students. The second semester 10-15. Woodbury is a private school and the classes are very small. I guess I was the most prepared one there. Everything they were teaching us, I found to be review. The teacher, he was nice. He would even ask me to do the problems, because sometimes he would get confused. But, he would work around it and show us different ways to work the problems.

Moses is not ‘just a number’ at his institution. He has been able to meet and make an impression on his teachers due to both the small class size and his academic abilities. Moses does most of his studying alone, and finds group study to be distracting and unnecessary.

Eden’s Story:

Eden attends a large R-1 University in central California. She is adjusting well to college life and academics. She is currently majoring in linguistics and has a 2.6 GPA. Eden chose to major in linguistics because she has a natural aptitude and interest in language. She is already fluent in Spanish.

Eden realizes that she needs to improve her GPA and she attributes the low grades to the fact that she could not afford to buy books the first quarter. After the first quarter, she learned to budget her financial aid more effectively and was able to purchase books for the subsequent quarters.

Eden has formed a close network of peers that support her both in her academic and social adjustment to college. She met most of this group, which she refers to as her “friend group” in her dorm.

Mussey: What kinds of things do you do when you are studying in a group?

Eden: When we study in a group, we don’t always study the same things. Sometimes I’ll be studying and then another friend will be studying math and then someone else will be studying maybe the same thing that I am studying, or maybe math, but we all study together, so we are all being productive. When we notice that somebody is getting off task or being distracted, we let them know. We are like, yo, yo, yo let’s get back to work, your class is tomorrow,

you can't be messing up. I like studying in a group, they keep me on track, kind of. It's more like we are going to get more work done. We are going to focus more if we are studying in a group. And sometimes we would stay up all night.

Eden has also joined some student groups on campus that help her focus on academics and stay connected to the university. One such group, the African Student Alliance (ASA) is very influential in her life. All the members of her friend group who are also African American have joined this group as well. She says that the ASA reminds her how important it is for African Americans to do well in school. Eden's favorite class was her philosophy class because it has helped her think about things that she has never thought about before.

Mussey: Could you talk about your favorite class so far?

Eden: My philosophy class, My philosophy class was ethics and the meaning of life. I thought it was pretty cool because I learned a lot of things I had never learned before. I never thought my thought process was philosophical. I used to think in a utilitarian way and I learned in class that utilitarianism is not as plausible as it seems.

Mussey: How has your view of life changed?

Eden: They talked about ethical egoism and psychological egoism, and that people usually do what is in their own best interest. I started to think about that and how it is true and it made me think about my life.

She tried out her new ideas on me, utilizing her new vocabulary and applying what she has learned to explain some things that are going on in her life.

Eden has only taken one science class, a planetary science class. Her perception of these classes is that they are boring and that the teacher did not care about the students.

Eden felt prepared for college in terms of the workload and the ability to form relationships with peers. She feels a responsibility to be successful so that she can positively impact her younger siblings.