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Phenomenological Study of Engaging Mindset Development in Authentic, Applied Learning Environments in a Secondary School

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Phenomenological Study of Engaging Mindset Development in Authentic, Applied Learning Environments in a Secondary School

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We certify that we have read this dissertation and approved it as adequate in scope and quality. We have found that it is complete and satisfactory in all respects, and that any and all revisions required by the final examining committee have been made.

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Abstract

This qualitative, phenomenological study investigated the perceptions of 16 adults regarding their learning experiences while enrolled as high school students in journalism or engineering classes. The study focused on students' participation in these applied learning experiences, and the effects on the initial and subsequent development of "engaging mindsets," also known as noncognitive mindsets (self-efficacy, belief in effort-based achievement, sense of belonging, and appreciating the value and meaning of work), in their post-secondary educational and career experiences.

Participants described seven factors of the learning environment positively affecting their learning and future growth: complex, open-ended problem solving; choice and creativity; student independence; real world relevance; products or performances for authentic audiences; relationship and collaboration skill development; and the shifted role of the teacher. Participants conveyed four key enduring effects of applied learning experiences carrying forward into their adulthood: increased autonomy, cognitive freedom, and willingness to take risks; appreciation for collaborative, empowering relationships; meaningful self-discovery; and a greater sense of purpose.

I analyzed the participants' reflections through the lens of three theoretical frameworks: educational theories related to applied learning environment design, self-determination theory regarding universal psychological needs, and theories looking at the importance of authentic, real world experiences.

I discovered applied learning might hold promise for developing engaging mindsets.

Applied learning creates an educational structure teachers can follow, contains elements

that fulfill universal psychological needs, and includes important, authentic, real world connections for students.

Key words: applied learning, authentic learning, noncognitive, self–efficacy, growth mindset, sense of belonging, engaging mindsets.

CHAPTER ONE: INTRODUCTION

My life as a successful student was marked by blind obedience. I did what the teachers told me to do, and the work came easily. I benefitted from a strong support system, and this helped guarantee my accomplishments. Because I enjoyed and found success in school, I decided to become a teacher. I started my career in 1991, and taught my students using the same methods I experienced as a student. I pulled out the physical science textbook and began "teaching," taking cues from my memories as a student. At the time, I understood teaching as largely a rote process; teachers provide the facts and students dutifully parrot back the information.

I taught my students much like I had learned and assumed the methods leading to my success would certainly work for my students. I quickly realized my life as a student was an anomaly compared with the vast variety of students' needs. Faced with the frustrating reality I was not reaching every student, I had a choice: I could blame students, parents, and society for this lack of success, or find new ways to engage my students. During this time, I realized my focus as an educator should be to serve my students more thoughtfully, and to find ways to meet each of their diverse needs. I set out to understand my students one by one.

Over time I came to understand the various elements affecting students' learning success. This included a complex mix of factors including motivation, emotion, physiology, home support, relationships, and brain development. I used this knowledge and gained considerable and varied experiences as an educator. I taught in suburban, urban, and rural areas; in affluent and poor communities; inside and outside the United States. My students

ranged from preschoolers to college graduates. I taught many subjects including science, reading, technology, mathematics, religion, and physical education.

Reflecting on my experiences, I realized three important factors led to student success: engaging activities, student ownership, and positive, supportive relationships. The specific content being taught rarely mattered as much as the process and the educational environment created to engage students. I also realized how changes in society, such as the increasingly sophisticated information resources and the need for learners and workers to be creative, critical thinkers, require teachers to make difficult choices between "covering content" and helping students "learn how to learn."

Today, content has become ubiquitous. Many students have access to laptops or smartphones, giving them virtually unlimited information at their fingertips. There is less need for students (and future workers) to commit to memory the facts I learned in school because knowledge is readily available through the use of powerful, personal, mobile devices. These observations and my experiences led me to think about the changes needed in education. I became interested in designing a classroom environment focused more significantly on problem solving and critical thinking, recognizing this requires a different kind of mindset and learning experience.

My current position requires looking at next generation practices in curriculum and instruction. My role in our school's strategic visioning process is to assist in designing and implementing new academic programs with an eye toward the current and future needs of our students as they enter college, career, and life. Through this research, I learned more about developing mindsets to help students and adults realize success in a world where knowing about something (the content) is no longer enough. I believe students, citizens,

and employees should become more adept at higher order thinking skills beyond simple memorization of the content—critical thinking, problem solving, analysis, and creativity—to live, work, and participate in a rapidly changing world. This research was designed to explore what our schools should look like to help our children become the creative problem solvers that our world needs.

Problem Statement, Significance, and Purpose

School leaders in recent years have been faced with a dilemma: whether to emphasize student achievement based on standardized tests (U.S. Department of Education, 2006) or foster lifelong learning skills, such as investigating real world problems and working successfully with others as 21st century learners (Lombardi, 2007). Accountability measures, such as No Child Left Behind (NCLB) have exerted pressures on educators to ensure learners perform well on standardized tests (Sogunro, Faryniarz, & Rigazio-DigiLio, 2009). Under this accountability regime, curriculum and instruction became targeted at the specific knowledge or skills expected on standardized exams. This often led to "teaching to the test" resulting in diminished student engagement (Roach, 2014).

At the same time, advances in technology and the need for a creative, problem solving workforce have pressured schools to prepare students for higher order thinking skills and aptitudes not easily measured on those same standardized tests (Global Digital Citizen Foundation, 2014). Frameworks supporting 21st century skills promote open-ended problem solving, inquiry, and constructivism—the worldview that learners actively create meaning rather than simply receiving it from the teacher (The Partnership for 21st Century Skills, 2014). Teachers and school leaders are left with the challenge of balancing

these priorities.

Beginning in 2001, under NCLB, all states became accountable for student achievement through a series of high stakes tests administered at certain grade levels and in specific subject areas. Schools not meeting "adequate yearly progress" were subject to corrective actions. The underlying assumption of NCLB as a reform movement involved a simple premise: high stakes testing improves student performance (Nichols, Glass, & Berliner, 2012). While some government reports argued NCLB is working (U.S. Department of Education, 2006), others warned of the unintended negative consequences of the Act (Nichols et al., 2012).

Extra pressure from standardized testing increased the number of students dropping out of school (Clarke, Haney, & Madaus, 2000; Nichols et al., 2012). Students faced with failure on a high stakes tests decided not to continue their education and were often "pushed" to alternative settings (Ryan & Weinstein, 2009). In addition, the problems with high stakes testing disproportionately affected minority students (Nichols et al., 2012). Students dropping out of school report they needed more individualized learning and a supportive culture in school in order to succeed (Iachini, Buettner, Anderson-Butcher, & Reno, 2013). In direct opposition to this need, teachers feeling the pressure of high stakes testing often created more rigid and controlling educational environments, resulting in lower student motivation for learning (Ryan & Weinstein, 2009).

Learner engagement serves as a key to motivation and success in school (Ainley, 2012; Martin & Furr, 2010), especially as it relates to addressing the dropout rate. Engagement may take many forms including relevant, meaningful, challenging, and attainable classroom activities offered by supportive teachers and classroom environments

(Martin & Furr, 2010). Another way of increasing learner engagement involves using technology to enhance education opportunities (Christensen, 2008; Schwahn & McGarvey, 2012; Solomon & Schrum, 2007).

In addition to increasing student achievement based on standardized testing, educators have been encouraged to also address shifts in the skills needed for the 21st century workforce (Wagner, 2010). Changes in society from an agrarian to industrial age, and now, an information age, require different skills and aptitudes (Autor, Levy, & Murnane, 2003). During a 40-year period beginning in 1959, the need for manual tasks and repetitive cognitive tasks declined sharply. In the same period, the need for analytic reasoning and non-repetitive cognitive tasks has increased in the workforce (Autor et al., 2003).

Wagner (2010) based on interviews of top business executives identified some of these higher-order abilities. Wagner's seven survival skills included agility, adaptability, initiative, curiosity, imagination, and critical thinking. Employers seek individuals with well-developed noncognitive skills and mindsets (Wagner, 2010). The term, *noncognitive*, describes the attitudes, behaviors, and psychological states important for achievement (Farrington, Roderick, Allensworth, Nagaoka, Keyes, Johnson, & Beechum, 2012). Cognitive skills, by comparison, delineate content knowledge and application. Noncognitive was a term used to identify everything not grounded in "rational" thought or measured by subjective IQ tests and standardized academic exams (Conley, 2012).

Five noncognitive factors influence academic performance: behaviors, perseverance, learning strategies, social skills, and academic mindsets (Farrington et al., 2012). The focus of my study involved student experiences pertaining to their development of noncognitive,

academic mindsets in applied learning environments. Many researchers advocated for authentic, applied learning environments to develop these skills and mindsets (Callison & Lamb, 2004; Dabbagh & Blijd, 2010; Herrington & Oliver, 2000; Lainema & Nurmi, 2006; Murphy, 2009). Authentic, applied learning focuses on real world, complex problems delivered in an interdisciplinary way (Liljestrom, Enkenberg, & Pollanen, 2013; Lombardi, 2007). Students use academic knowledge and skills to approach problems either simulating real life or within a real life context.

A generation ago, teachers might have expected the content they taught to be sufficient for a student's lifetime; however, today's students may be required to be more agile in their learning as jobs transform to new technological realities (Adams, 2012). Exponential technological and social changes require educators to prepare students for jobs not yet in existence and to solve problems not yet imagined. Already, young adults change jobs an average of seven times from age 20 to 29 (Conley, 2012).

The purpose of my study was to investigate how students experience and make meaning of their education in authentic, applied learning environments, and to explore enduring effects on the development of noncognitive mindsets (Farrington et al., 2012). Instead of focusing on measures of student achievement based on standardized tests, I interviewed students regarding how they assessed their experiences in an authentic, applied learning environment. I learned how a focus on "real work" affected their development during their high school and college years, and later, as they began their careers.

As the world around us changes exponentially, educational leaders should explore how certain methods and environments prepare students for college, career, and life

(Adams, 2012; Packer, 2012; Stobie, 2012). Educators should consider classroom environments conducive to fostering noncognitive mindsets. My study explored how student experiences in authentic, applied learning environments affected their ability to survive and thrive in a changing world—an important question for all stakeholders interested in educating students now and in the future.

Through my research, I found noncognitive mindsets were consistent with the attitudes and psychological states necessary to be a proactive, engaged, life long learner. For this reason, I used the term "engaging mindsets" in place of noncognitive mindsets from this point forward.

Research Question

I adopted the following question for my study on engaging mindsets: How do students experience and make meaning of authentic, applied learning environments? How do students describe the enduring effects of these learning environments on their success in college, career, and life?

Definition of Terms

Ability Derived from Effort: Believing ability is dynamic and dependent on individual effort rather than static and based on innate characteristics (Farrington et al., 2012).

Attribution: The process individuals use to explain events and behaviors (Weiner, 1979).

Authentic, applied learning: Education experiences characterized by experimentation, action, collaboration, and creativity in a real world context (Lombardi, 2007).

Contextual intervention: Interventions designed to modify the educational environment to create improvements in noncognitive mindsets (Hattie, Biggs, & Purdie, 1996).

Dispositional intervention: Interventions designed to modify the individual's belief systems and mindsets independent of the particular educational environment (Dweck & Leggett, 1988).

Mindsets: The psychosocial beliefs and attitudes an individual has about learning (Farrington et al., 2012).

Noncognitive: Individual attributes and skills not considered intellectual or analytical in nature such as motivation, perseverance, self-regulation, and others impacting academic and work success (Rosen, Glennie, Dalton, Lennon, & Bozick, 2010).

Self-efficacy: Having a belief in one's ability to successfully perform a given task or behavior (Lent, Brown & Larkin, 1984).

Self-concept: Beliefs, attitudes, and perceptions about oneself in relation to others, one's behaviors, one's worth, and one's place in their environment (Goodenow, 1992).

Sense of belonging: A feeling whereby members of a group share a belonging to one another, each member matters to the other, and group members have a commitment to one another to have their needs met (Osterman, 2000).

Stereotype threat: The concept whereby negative group stereotypes depress the academic achievement of minority groups through psychological pressures in the academic environment (Walton & Spencer, 2009).

Value and meaning of work: The degree to which a student values or finds meaning in the academic work in front of them (Wigfield & Eccles, 2000).

Overview of Dissertation

In chapter one, I gave an overview of my personal journey leading me to the study of mindsets in applied learning environments. I explained the significance, and purpose of

looking at mindset development given the nature of how the world is changing and the future needs of students as lifelong learners. Additionally, I introduced the research questions and key terms for understanding the literature review, data, and analysis.

I review the relevant literature in chapter two, examining the four mindsets predictive of students' success in school and lifelong learning. I explored the literature to determine how and why these mindsets develop, and educators' and researchers' attempts to intervene when students lack strong mindsets for learning. Finally, I summarize analytical theories used in my analysis, namely the educational theories of Dewey (1919, 1938) and Bruner (1960, 1961, 1966, 1979), as well as self-determination theory (Deci & Ryan, 2008).

In chapter three, I explain the qualitative, phenomenological methods used to study the lived experiences of students enrolled in applied journalism and engineering classes. This includes details regarding my methods of recruiting and interviewing participants as well as the logistical and ethical considerations of handling the data collected. I also describe the setting of the study to help define the limitations on generalizing from this work.

I organized my data in two chapters. I describe the engineering and journalism program's main structures and activities in chapter four. Then, using the participants' words and descriptions, I outline how the teachers designed and delivered the classes—including the assignments, assessments, the collaborative relationships, and the role of the teacher. I summarize seven key elements participants deemed distinctive and necessary to the success of the programs.

In chapter five, I explore the enduring effects of a high school applied learning experience. I created a synopsis of the four lasting impacts the students reported from their learning experiences and the enduring nature of this learning as they continued in college, career, and life. The development of engaging mindsets, through participation in applied learning environments during adolescence, helped shape student, and later adult confidence, approach to problem solving, persistence, and purpose in society.

In chapter six, I present my analysis using a growth analogy to support student mindset development. The growth analogy includes (1) ways to structure the learning environment, (2) understanding and supporting student psychological needs, and (3) creating opportunities for students to authentically engage in the real world to give students the "seeds" for further exploration, engagement, and lifelong learning. I analyze these factors using the lenses of educational and psychological theories, revealing their importance in supporting engaging mindsets.

My recommendations and reflections appear in chapter seven. These include four suggestions for educators regarding how to deliver on the promise of authentic, applied learning environments. I explain the limitations of this study based on the school, students, and other specific contexts. Finally, I make recommendations for future studies to further explore the potential and limitations of authentic, applied learning environments.

CHAPTER TWO: REVIEW OF THE LITERATURE

My research question focused on discovering how students' experiences in authentic, applied learning environments impacted the development of engaging mindsets. Furthermore, my study sought to uncover the enduring effects of learning in these environments on their success in college, career, and life; to find noncognitive elements of their past educational experiences remaining with them as they left high school. Because I was looking for noncognitive growth and development, I began my review of literature by identifying scholarly studies related to all noncognitive factors.

As I discovered the large volume of information available on the topic, I narrowed my search to the study of noncognitive mindsets (or engaging mindsets, as I have chosen to identify them). Mindsets are the sub-category of noncognitive factors most related to students' self-concept—the area most relevant to understanding students' perceived experiences in an educational setting. A few central meta-analyses helped me focus in on noncognitive mindset terminology and key words (Farrington et al., 2012, Vispoel & Austin, 1995; Wang, Haertel, & Walberg, 1994). I gathered research studies, peer-reviewed papers, books, and conference proceedings to create a substantial collection of noncognitive mindset literature and resources.

I reviewed noncognitive mindset literature and divided my findings into four main themes corresponding to the four categories of mindsets. Because mindsets are integrally about a student's self-concept, I expressed them here from the perspective of a student: (1) I achieve through effort, (2) I can do this, (3) I belong here, and (4) I like this. In the analysis of participants' responses, I found these noncognitive mindsets have instilled in them a stronger sense of engagement and confidence with lifelong learning, problem

solving, collaboration, and creativity. Therefore, I adopted the term "engaging mindsets" in place of noncognitive mindsets. In the following sections, I discuss the scholarly literature relevant to each of the four mindsets.

Mindset #1: Ability Derived From Effort (I Achieve Through Effort)

The first engaging mindset discussed in the literature revolves around the degree to which students believe their ability or success is innate versus a function of their effort (Aronson et al., 2002; Blackwell et al., 2007; Butler & Nisan, 1986; Cury, Elliot, Fonseca, & Moller, 2006; Dweck & Leggett, 1988; McCombs, 1991; Ryan & Deci, 2000; Vispoel & Austin, 1995; Weiner, 1985; Wigfield, 1994). In each of the aforementioned studies, the authors explained, students believing ability was malleable had higher persistence and motivation in the classroom. In contrast, those believing ability to be a static part of an individual had lower persistence and motivation. As a result, students attributing their ability or success to effort were more likely to exhibit academic behaviors leading to success in schools.

Perceptions of Success, Failure, and Effort

One of the key ideas researchers used to describe the effort effect is called attribution theory (Dweck & Leggett, 1988; Vispoel & Austin, 1995; Weiner, 1985; Weiner, 1979). Researchers used attribution theory to explain how motivation is heavily dependent upon students' perception of success and failure. When students attributed success and failure to effort, they were more likely to continue working to turn their failures into successes. Blackwell et al. (2007) surveyed seventh grade math students and determined their motivation and academic achievement was directly related to the degree to which they believed their intelligence was malleable. While innate ability and ability

based on effort are most often discussed in the literature, Vispoel and Austin (1995) found sometimes students attribute their successes to teacher influence, family background, or luck. This also draws attention away from students attributing success to their own effort and negatively affects motivation.

Two social cognitive theories described the effort/ability effect—incremental theory and entity theory (Cury et al., 2006; Dweck, 1975). Incremental theorists suggested ability is amenable to change (Dweck, 1975). Entity theorists, by contrast, proposed ability is an immutable part of the individual (Cury et al., 2006). Students subscribing to incremental theory show greater persistence.

Students' attributions of ability not only determined their persistence but also determined their academic goals (Cury et al., 2006; Weiner 1979). Students believing in the importance of performance on summative tests (i.e., getting good grades) more likely viewed ability as static and less likely persisted toward achieving full conceptual understanding. However, students believing in mastery viewed their ability through the effort lens and persisted in working a concept until they had complete understanding (Cury et al., 2006). As such, performance learning tended to lead to extrinsic motivation whereas mastery learning led to intrinsic motivation.

Several researchers studied "stereotype threats," the impact of socially constructed myths about ability or inability to determine the effects of race, gender and other characteristics on effort, success, and failure (Aronson et al., 2002; Cohen & Garcia, 2008; Walton & Spencer, 2009; Weiner, 1979). Individuals believing the stereotype society placed on their social or cultural group (e.g., Blacks lack intelligence, girls are inferior at mathematical reasoning, poor people do not achieve in school) tended to show less

achievement (Walton & Spencer). This mindset led to believing one's inability is an innate function of one's demographic characteristics, stifling an individual from putting forth the effort to achieve (Aronson et al., 2002). While this was mainly found to affect minorities and women, the same effect has been seen in other groups, such as White men in athletics (Cohen & Garcia, 2008).

Interventions Fostering an Effort-Based Mindset

Educators and researchers have attempted to see if specific, targeted interventions may influence students' effort/ability mindset (Aronson et al., 2002; Walton & Spencer, 2009). Some of these interventions, called "dispositional interventions" (Dweck & Leggett, 1988), aimed at changing the attitude of students directly, regardless of the classroom context. Aronson et al. (2012) attempted to mitigate stereotype threat among African American students by directly describing intelligence as a malleable trait instead of one fixed and innate. The students in the intervention group reported greater enjoyment at school, greater engagement, and had higher grade point averages than similar students in two control groups. In another stereotype threat intervention, Walton and Spencer (2009) studied 19,000 students, kindergarten through postsecondary, and found when the psychological threat was reduced, stereotyped students outperformed non-stereotyped students who had the same level of past performance. In a similar study, children identified with significant learned helplessness, attended an attribution-retraining program to learn effort is an important ingredient in achievement and lack of effort causes failure (Dweck & Leggett, 1988). Again, the researchers found students developed greater persistence and academic achievement. Wilson and Linville (1982) applied attributional interventions to college students in three separate studies. Similar to other studies, college

students were trained to believe their low grades were unstable and temporary; in other words, they could be changed. The researchers followed the students' progress over time and found the intervention influenced both short and long term academic performance. In a later study, Wilson and Linville (1985) provided another form of attribution therapy by having college freshmen watch videos and hear testimonials indicating grades generally improve from freshman year onward. The students receiving the intervention saw greater increases in their grades, were less likely to drop out, and achieved higher scores on sample GRE questions than a control group.

Other types of interventions, termed "contextual interventions," focused on students' interactions in the classroom (Brophy, 1981; Butler & Nison, 1986; Crooks, 1988). Researchers proposed any method of connecting a student's performance to past effort and accomplishment helped give the student ownership over the attainment of a specific task (Brophy, 1981). In a study designed to test the effect of different types of task evaluation on student motivation, 261 sixth graders were each given a qualitative and quantitative task three times (Butler & Nisan, 1986). An evaluation intervention was given after the first and second of the three sessions. One group received non-threatening, task-related comments as an evaluation. The second group received normative grades. The third group received no feedback. The researchers found grades fostered extrinsic motivation at the expense of intrinsic motivation (Butler & Nisan, 1986). The grades group scored higher on straight quantitative tasks but lower on tasks requiring divergent thinking. The grades intervention also tended to foster a fear of failure. By contrast, the comments group tended to foster confidence, intrinsically motivated effort, creativity, and divergent thinking (Butler & Nisan, 1986).

In another study focused on the relationship between teacher evaluation and student outcomes, Crooks (1988) determined grading as a summative mechanism produced anxiety, which undermined and depressed intrinsic motivation and effort. Crooks (1988) showed evaluation methods that are timely and provide targeted formative feedback on progress were more effective in giving students a positive self-concept, which led to greater effort and intrinsic motivation. These interventions align with the mastery versus performance discussed earlier, wherein Weiner (1979) and Cury et al. (2006) concluded classroom methods based on mastery used formative, targeted feedback and fostered intrinsic motivation and effort. Conversely, classroom methods based on performance tended to have summative, normed grades, which created extrinsic motivation and feelings of inadequacy in the face of failure.

Several researchers proposed recommendations for the learner-centered classrooms of the 21st century taking the ability/effort mindset into account. McCombs (1991), for instance, promoted the development of affective qualities attending to the whole individual. He argued for creating educational models to help students believe they have the skills for success and with effort could realize academic mastery. Ryan and Deci (2000) emphasized these social learning contexts exert great power in determining students' engagement and motivation, or alienation and passivity. Learner centered environments are strongly correlated with an effort-oriented mindset toward ability (Ryan & Deci, 2000).

Mindset #2: Self-Efficacy (I Can Do This)

The second engaging mindset is self-efficacy. Many researchers found self-efficacy served as the key ingredient in helping students put forth the effort necessary to achieve

(Bandura, 1994; Butler & Nisan, 1986; Cohen & Garcia, 2008; Crooks, 1988; Cury et al., 2006; Kelley, 1973). Knowing and understanding effort affects ability is not sufficient to influence students' behavior—students must also believe they can achieve the task at hand. The mindset giving students this "can do" attitude is self-efficacy. This theme appeared repeatedly in the literature. Students believing in their ability to perform well, both in and out of school, were more likely to persevere at a given task, and therefore more likely to succeed (Lent, Brown & Larkin, 1984; McCombs, 1991; Oyserman et al., 2006; Pajares, 1996; Ryan & Deci, 2000; Schunk & Hanson, 1985; Weiner, 1979). Students with confidence in their ability to perform well were more likely to overcome adversity and challenges in their academic life, and try hard even when tasks proved difficult.

Self-Concept

How students view themselves in general may greatly affect their self-efficacy in particular circumstances (Markus & Nurius, 1986). Based on past experiences and their imagination of the future, self-concept affects an individual's decision-making. Self-concept may be affected by general feelings of optimism and pessimism or may be influenced by specific events (Markus & Nurius, 1986). For example, a runner's sense of self may be improved by watching an Olympic race or squelched by reading about a runner who died of a heart attack.

There are two ways of looking at self-concept. Educational psychologists tended to start with the individual and look for effects of self-concept on motivation and academic goal setting (Bandura & Schunk, 1981; Cohen & Garcia, 2008; Lent et al., 1984; Walton & Cohen, 2007; Wigfield & Eccles, 2000; Wilson & Linville, 1985). Those focusing on this view of self-concept tended to promote and design interventions focused on the psychology

of the individual. Social psychologists, on the other hand, tended to look at social influences on self- concept (Goodenow, 1992). The idea of the "looking-glass self" was introduced over a century ago (Cooley, 1902), and posited individuals shape their self-concept based on how others perceive them. This idea of self-concept suggested looking at the role of social and contextual milieu. Researchers identifying with this view of self-concept discussed and designed interventions related to the educational environment (Brophy, 1981; Butler & Nisan, 1986; Cohen et al., 2006; Crooks, 1988; Cury et al., 2006; Goodenow & Grady, 1993; Harter, 1992; Oyserman et al., 2006; Solomon, Watson, Battistich, Schaps, & Delucchi, 1996; Vispoel & Austin, 1995).

Dispositional Interventions

In addition to the aforementioned studies by Wilson and Linville (1982, 1985), others have attempted to approach the development of self-efficacy from the dispositional angle. Wigfield and Eccles (2000) used before and after student surveys to search for self-efficacy tendencies with questions like, "How well do you expect to do on math today?" Additional studies looked at how stereotype threat (called stigmatization in this study) affects self -efficacy (Walton & Cohen, 2007). In this study, researchers showed how Black students had wide swings in day-to-day self-efficacy about their computer science ability based on the quality of their day. Walton and Cohen (2007) designed and applied an intervention to mitigate the stigmatization, and the students became more confident and were less prone to shifts in self-efficacy.

Another study, focused on students in science and engineering majors, found those who self-reported greater ability in the academic tasks (self-efficacy) had higher grades and were more likely to persist in the program a year later (Lent et al., 1984). In a study of

math classes, researchers asked students in different groups to set proximal or distal goals to see if self -directed goal setting could improve self-efficacy, motivation and interest (Bandura & Schunk, 1981). The researchers found proximal goal setting had a significant positive impact on self-efficacy, while distal goals did not return such positive results. Cohen and Garcia (2008) also suggested self-affirmation interventions appeared to improve self-efficacy.

Contextual Interventions

Researchers also designed self-efficacy interventions to improve the whole academic environment (Brophy, 1981; Butler & Nisan, 1986; Crooks, 1988; Cury et al., 2006). These interventions, known as contextual interventions, rely on believing self-efficacy is socially constructed, influenced by others, and by the relationships developed. The contextual studies discussed in the previous section, which positively affected effort, also correlated to positive impacts on self-efficacy (Brophy, 1981; Butler & Nison, 1986; Crooks, 1988).

Feedback mechanisms may provide contextual interventions, as described by Bouffard -Bouchard (1990) and Harter (1992). These researchers studied positive and negative feedback in college classrooms and found those students receiving positive feedback possessed significantly higher self-efficacy. This boost in self-efficacy created positive academic results: higher numbers of problems completed, efficiency in problem solving, and accuracy of self-evaluation strategies (Bouffard-Bouchard, 1990). Harter (1992) observed and surveyed students as they moved from school to school and found approximately 50% of them experienced significant changes in self-efficacy as they switched environments. Self-efficacy and intrinsic motivation declined as students moved

from grade schools to middle schools. Harter (1992) attributed this to a switch from mastery learning to performance learning as summative grades become more prevalent. In a study of 264 Detroit middle school students over two years, Oyserman et al. (2006) designed and implemented a "positive possible self" intervention, whereby students received frequent reinforcements of their positive self in the classroom context. This sustained effort positively influenced attendance, homework completion, behavior, and grade point average (GPA).

Contextual interventions have also employed metacognitive strategies. Researchers, in two randomized field experiments, used in-class writing assignments designed to boost students' integrity, capability, and virtue (Cohen et al., 2006). Students wrote essays affirming their abilities, personal ethics, and responsibility. This brief intervention reduced the achievement gap in these classes by 40% (Cohen et al., 2006).

In addition to metacognitive strategies, several researchers focused on the effects of the school community and environment. Goodenow and Grady (1993), for instance, discovered interventions focused on school belonging also influenced self-efficacy. They found a student's motivation and self-efficacy were often dependent on the environment and the people involved with the learner. Solomon, Watson, Battistich, Schaps and Delucchi (1996) learned students in elementary schools promoting democratic principles, cooperative learning, self-direction, and student autonomy experienced higher intrinsic motivation, self-efficacy, and empathy.

To explore another type of contextual intervention and modeling, Schunk and Hanson (1985) designed an experiment with four groups of elementary school students. The first group watched other students working math problems with quick mastery. The

second group watched peers who first appeared challenged but with persistence eventually achieved success. The third group watched a teacher work the problems in a straightforward way. The fourth group had no demonstration. Students then rated their self-efficacy at doing similar math problems. The students experiencing peer modeling communicated the greatest self-efficacy (Schunk & Hanson, 1985). Other researchers explained the importance of adult/child interactions and modeling (Masten & Coatsworth, 1998). This form of contextual intervention strengthened self-regulating behaviors and created a stronger sense of self.

Social contexts provided powerful triggers in developing feelings of competence, so much so, some researchers spoke of collective efficacy (Goodenow & Grady, 1993; Goodenow, 1992; Pajeras, 1996; Ryan & Deci, 2000). The shared belief, "we can achieve," is often called a school's culture, atmosphere, or climate. The school's culture was instrumental in developing or suppressing effort, commitment, initiative, and responsibility (Ryan & Deci, 2000). Group identities created by students affected their self-concept and self-efficacy (Goodenow, 1992). The more a school created positive group identities where students felt known, important, and encouraged to be active participants, the stronger the self-concept (Goodenow & Grady, 1993). Masten and Coatsworth (1998) argued each context where group identities formed (school, home, sports teams, religious organizations) represented both a threat and an opportunity for self-efficacy and motivation.

Mindset #3: Academic Community Belonging (I Belong Here)

The feeling of belonging to a school community is the third engaging mindset exerting a strong positive impact on students' academic performance (Furrer & Skinner,

2003; Goodenow, 1992; McMillan & Chavis, 1986; Osterman, 2000; Ryan & Deci, 2000; Solomon et al., 1996; Wentzel & Asher, 1995; Wentzel & Caldwell, 1997). Students with a sense of belonging were more likely to be engaged, feel competent, have a sense of intrinsic motivation, put forth effort, and conform to established school values (Ryan & Deci, 2000). A sense of relatedness promoted motivation, and motivation fostered academic performance. Motivation also mitigated feelings of boredom, anxiety and frustration (Furrer & Skinner, 2003). A caring, inclusive school environment promoted both individual self-concept and positive group identities (Goodenow, 1992).

Classroom and School Relationships

Social cognitive theorists suggested people do not practice new behaviors in isolation (Bandura, 1976). Rather, most often students looked to others for examples of behavior and then replicated them. Schools, through a sense of belonging, offered an opportunity to foster a positive replication of behaviors. In the Schunk and Hanson's (1985) math problem modeling study, students provided a model for other students about how to persist in the face of challenge. Student observers then felt comfortable and confident in trying the math problems themselves. In a study of sixth graders, Wentzel and Caldwell (1997) found positive pressure to conform to peer norms had a concurrent and lasting effect on academic performance. Parent modeling, as part of the academic community, helped reinforce the social pattern of school importance as well (Yan & Lin, 2005). In this study, researchers found three dimensions of parent involvement were linked to student achievement: family obligations, family high expectations, and parent involvement networks.

Some researchers attributed the success of a sense of belonging to a shared emotional connection between students and students, and between students and adults (McMillan & Chavis, 1986; Osterman, 2000; Wentzel & Caldwell, 1997). The power of community came from a feeling of membership and connection when students attended schools with a positive, inclusive academic climate (McMillan & Chavis, 1986). This belongingness and acceptance promoted positive interpersonal relationships both in and out of school, and promoted motivated and engaged learning (Osterman, 2000). Emotional connectedness also mitigated problems related to self-hatred like suicide, depression, and eating disorders (Osterman, 2000). Solomon et al. (1996) and Wentzel and Caldwell (1997) found activities and processes fostering emotional connectedness were also positively correlated to higher academic performance, cooperative learning, pro-social behavior, democratic principles, and peer acceptance.

Student-to-student interactions also affected a sense of belonging (McMillan and Chavis, 1986). McMillan and Chavis (1986) explained how students' influence and reinforcement created a shared commitment to each other. Students experiencing acceptance by their peers were more likely to be motivated and engaged in their learning (Osterman, 2000; Wentzel & Caldwell, 1997). Seeing another student as a positive peer role model in an academic context influenced one's self-efficacy and achievement (Schunk & Hanson, 1985).

Student-to-teacher interactions also had an effect on a student's sense of belonging to the school community (Battistich et al., 1995). Students who experienced school personnel as caring and supportive were more likely to feel a sense of belonging, which in turn positively affected school performance (Battistich et al., 1995). In fact, a positive

relationship with teachers appeared to be the most important social partner for creating a sense of belonging at school (Furrer & Skinner, 2003). In a study of 301 urban students, Goodenow and Grady (1993) recorded similar results. School belonging increased self-efficacy, motivation, and effort, and it appeared to come mostly from relatedness to teachers. Student-to-student relatedness had a diminished impact. In fact, the researchers suggested positive school belonging supported by teachers might override negative relationships with peers (Goodenow & Grady, 1993). Researchers also pointed out the important role teachers played in creating the social norms of the community. In a school with a strong sense of belonging, students were more likely to accept and reinforce the values of the school community (McMillan & Chavis, 1986; Solomon et al., 1996).

As discussed previously, stereotype threat negatively affected a student's self-concept and led to lack of motivation and effort (Aronson et al., 2002; Cohen & Garcia, 2008; Walton & Spencer, 2009; Weiner, 1979). Stereotype threat is sometimes known as belonging uncertainty. If a student felt a lack of belonging or isolation based on any criteria (race, gender, poverty, language, religion, body type), the stigmatization led to a lack of motivation, effort, and achievement (Cohen & Garcia, 2008; Walton & Cohen, 2007). Conversely, if positive school culture increased a sense of belonging among students, it mitigated stereotype threats (Walton & Spencer, 2009).

Classroom Methods

Evaluation methods had an indirect effect on a student's sense of belonging to a school community (Brophy, 1981; Butler & Nisan, 1986; Crooks, 1988). Contextual intervention studies related to teacher feedback and evaluations showed a mastery approach, where students were given formative feedback, tended to foster intrinsic

motivation, self-efficacy, effort, and a positive self-concept. On the other hand, a performance approach, where students were given normed, summative feedback, tended to harm intrinsic motivation, self-efficacy, effort, and a positive self-concept (Brophy, 1981; Butler & Nisan, 1986; Crooks, 1988). When evaluation methods left students feeling a lack of confidence and motivation, it reduced their sense of belonging (Cury et al., 2006; Weiner, 1979).

Pedagogy, like evaluation methods, also affected students' sense of belonging (Battistich et al., 1995; Goodenow & Grady, 1993; Solomon et al., 1996). Opportunities in class for student choice and voice provided an empowering message of the importance of student-centered instruction in school (Battistich et al., 1995). Similarly, cooperative learning instilled both a sense of ownership over academic pursuits and a sense of belonging (Goodenow & Grady, 1993; Solomon et al., 1996). Well-designed programs explicitly used to build community like advisory or homeroom curricula were positive steps in building a sense of belonging (Goodenow & Grady, 1993).

Mindset #4: Value and Meaning of Work (I Like This)

The fourth and final engaging mindset, the value and meaning students place on the academic work in front of them, influenced the students' motivation, effort, and perseverance (Battistich et al., 1995; Butler & Nisan, 1986; Covington & Müeller, 2001; Crooks, 1988; Lee & Anderson, 1993; McCombs, 1991; McCombs, 1993; McKnight & Kashdan, 2009; Stefanou et al., 2004; Tully, 2009; Vispoel & Austin, 1995; Wigfield & Eccles, 2000; Yair, 2000). Using the expectancy-value theory of motivation, Wigfield and Eccles (2000) asked students simple questions such as, "How useful is math?" and "How much do you like math?" If students thought the academic task was worth doing, it affected

their motivation to complete the task. Researchers have suggested several characteristics made a task worth doing, including relevance, applicability to the real world, deep investigation, student ownership, collaboration, and purpose.

Several researchers indicated making learning relevant to students' lives increased motivation and effort (Crooks, 1988; McCombs, 1991; McCombs, 1993; Stefanou et al., 2004; Yair, 2000). Relevance helped students make neural connections to prior knowledge. Relevance created a strong context for their learning, making it real and accessible. Relevance inspired motivation.

Closely associated with relevance, application to real life allowed students to see a potential future use for their skills and knowledge (McCombs, 1993; Vispoel & Austin, 1995). Researchers pointed to the application of learning content as a method for increasing motivation (McCombs, 1993; Vispoel & Austin, 1995). Application gave students an opportunity to imagine future academic and career possibilities and develop a sense of purpose.

Depth of study also has a strong effect on motivation. Surface memorization tended to dampen intrinsic motivation, whereas an in-depth study into a topic enhanced motivation and effort (Crooks, 1998). Students start out intrinsically curious and allowing students to more deeply explore areas of interest is a way to preserve intrinsic motivation (Covington & Müeller, 2001). In many classrooms, students have been forced to focus their attention only on what is being tested rather than digging deeply into what they love (Crooks, 1998).

Fostering student ownership is another goal when trying to develop mindset number four (Battistich et al., 1995; Crooks, 1988; Vispoel & Austin, 1995). There are a

few different forms of ownership affecting motivation, effort, and persistence. At their core, however, all forms share the idea that when products and thoughts originated with students themselves, they were more intrinsically motivated because they owned the idea. Voice and choice were key ingredients to students' ownership by recognizing and valuing each student's contribution (Battistich et al., 1995). Letting students have autonomy in choosing methods of demonstrating conceptual understanding also fostered ownership (Vispoel & Austin, 1995).

Inquiry and higher order thinking opportunities were a great way for students to have cognitive autonomy (Crooks, 1988). When students analyzed, applied, evaluated, and used creativity in an academic task, the thoughts originated within them, giving them a sense of ownership (Stefanou et al., 2004). Butler and Nisan (1986) studied the degree to which different evaluation methods fostered or depressed creativity and divergent thinking as they relate to motivation, again a form of ownership. Fostering reflection and metacognition was another way to cultivate ownership in the classroom (Lee & Anderson, 1993; Stefanou et al., 2004). Metacognition stimulated students to assess their thinking and progress with the academic content.

Allowing students to work with others in collaborative teams and share their thoughts in peer settings is also highly motivating (Lee & Anderson, 1993; Yair, 2000). Cooperative learning created a sense of belonging, encouraging learners and leading to additional effort and perseverance (Goodenow & Grady, 1993; Solomon et al., 1996). When collaborative work was well organized, it produced positive peer pressure predicted by social cognitive theory (Bandura, 1976).

Purpose, defined by McKnight and Kashdan (2009) to describe students' need to have a sense of direction and meaning in their work, motivated them to be goal oriented. Tully (2009) interviewed Stanford education professor William Damon, author of *The Path to Purpose: How Young People Find Their Calling in Life* (2009). In the interview, focused on promoting character education, Damon cited the need to explicitly teach virtues like respect, honesty, diligence, kindness, fair-mindedness, and temperance to give students a higher purpose in their learning (Tully, 2009).

Summary

In this review of literature, I explored scholarly research on the engaging mindsets fundamental to students' future success in college, career, and life. I organized the findings into four key mindsets: ability derived from effort, self-efficacy, sense of belonging, and the value and meaning of work. Fostering these mindsets appeared to increase student persistence, confidence, motivation, and a desire to engage in the educational process (Farrington et al., 2012).

The mindset described as ability derived from effort, rather than an innate characteristic of an individual, helps a student persist in the face of challenges (Aronson et al., 2002; Blackwell et al., 2007; Butler & Nisan, 1986; Cury, Elliot, Fonseca, & Moller, 2006; Dweck & Leggett, 1988; McCombs, 1991; Ryan & Deci, 2000; Vispoel & Austin, 1995; Weiner, 1985; Wigfield, 1994). Students believing anything is attainable given enough effort, time, and grit are less likely to become discouraged (Dweck & Leggett, 1988; Weiner, 1985). Students find failure to be just a necessary and typical part of the journey toward success. If educators design their classroom to value effort and persistence, this mindset may be fostered (Butler & Nisan, 1986).

Self-efficacy is another mindset predicting student success (Bandura, 1976; Lent, Brown & Larkin, 1984; McCombs, 1991; Oyserman et al., 2006; Pajares, 1996; Ryan & Deci, 2000; Schunk & Hanson, 1985; Weiner, 1979). When students believe they are capable of completing a task or producing a quality result, they are more likely to be motivated to engage in the educational process. When educators scaffold and differentiate activities to ensure the appropriate balance of challenge and success, students acquire self-efficacy.

Humans have a basic need to feel accepted by individuals and groups with whom they each engage. The sense of belonging mindset helps students maintain a psychologically healthy disposition allowing them to engage in the educational environment (Furrer & Skinner, 2003; Goodenow, 1992; McMillan & Chavis, 1986; Osterman, 2000; Ryan & Deci, 2000; Solomon et al., 1996; Wentzel & Asher, 1995; Wentzel & Caldwell, 1997). Educators have a role in creating the positive and collaborative learning activities making students feel they belong.

Finally, the fourth mindset is a positive sense of the value and meaning of learning. When students feel the topics and learning activities seem relevant to their past, present, or future needs or interests, they have a reason to care about their work (Battistich et al., 1995; Butler & Nisan, 1986; Covington & Müeller, 2001; Crooks, 1988; Lee & Anderson, 1993; McCombs, 1991; McCombs, 1993; McKnight & Kashdan, 2009; Stefanou et al., 2004; Tully, 2009; Vispoel & Austin, 1995; Wigfield & Eccles, 2000; Yair, 2000). In the next section I outline important gaps in the literature guiding me to my specific research.

Gaps in the Literature

While several gaps appear in the literature, two appeared important for the educational settings arising from the 21st century learning movement. The first gap

concerned the absence of studies focusing on authentic, applied learning environments. The second gap involved the lack of qualitative studies regarding students' self-concept and the development of engaging mindsets in educational settings. Next I explain each of these gaps or tensions and show how my study may advance scholarly literature in these areas.

Gap #1: Authentic, Applied Learning Context

One tension in the literature related to the origin of engaging mindsets: some researchers defined the origin as dispositional (i.e., residing in the individual mind); others concluded the origin was contextual (i.e., ever-changing and dependent on the environment and the people around an individual). Some researchers' methodologies suggested mindsets are purely psychological phenomena (Cohen & Garcia, 2008; Cury et al., 2006; Wilson & Linville, 1985). In contrast, other researchers found mindsets develop through the interaction of the individual within a given context (Goodenow & Grady, 1993; Harter, 1992; Ryan & Deci, 2000). Although researchers focused on looking at context, they generally only investigated traditional or nearly traditional educational settings (Blackwell et al., 2007; Bouffard-Bouchard, 1990; Cohen et al., 2006; Furrer & Skinner, 2003; Oyserman et al., 2006; Yan & Lin, 2005). Traditional settings tend to be more teacher-centered, and more driven by specific, formulaic content and concepts. I did not find engaging mindset studies exploring an authentic, applied learning environment where the learning is more open-ended, student -driven, inherently collaborative, and places the ownership of learning more squarely on the students. My study focused on an authentic, applied learning context and how it affects engaging mindsets.

Gap #2: Qualitative, Metacognitive

The researchers in the literature I reviewed relied on quantitative evidence of mindset development like grades, test performance, or metrics built out of survey questions (Aronson et al., 2002; Blackwell et al., 2007; Walton & Spencer, 2009; Wentzel & Asher, 1995). The quantitative studies failed to shed light on how students understood the metacognitive processes around the development of or challenges with engaging mindsets. Even though engaging mindsets revolve around the importance of self-concept, self-esteem, and self-efficacy, the researchers did not gather deep qualitative data from the students themselves. My study focused on students' self-awareness of how a particular educational environment affected their engaging mindset development as they have entered college and the workplace. My study explored their experiences and the lasting effects on how they viewed learning and approached problem solving.

The gaps revealed a need to understand mindset development from a student point of view, and to focus on environments specifically designed to foster engaging mindsets. I chose to focus my study on the metacognitive aspects of mindset development in a very specific context: two authentic, applied learning environments (i.e., engineering and journalism) in a secondary school. I hoped to advance the literature in this area at a time when educational leaders try to create more effective 21st century learning opportunities for students. In the next section I outline three theories used to interpret my research findings and to analyze the data collected from the students enrolled in one of two programs.

Analytical Theory

I selected three theories to create a framework for understanding how the authentic applied learning environments of the engineering and journalism programs affected the development of my research participants' engaging mindsets. First, I selected two education theorists, Dewey (1919, 1938) and Bruner (1960, 1961, 1966), to analyze key principles of effective learning experiences in the design of authentic, applied learning environments. These theorists described educational environments using several key lenses: democracy (Dewey, 1919), experiential environments (Dewey, 1938), constructivism (Bruner, 1961), and inquiry (Bruner 1966). Next I used "self-determination theory" (Deci & Ryan, 2008) to explore the fulfillment of psychological needs facilitating the development of engaging mindsets.

I first describe Dewey's and Bruner's understanding of optimal educational environments to frame how the applied learning environments may impact engaging mindset development. Then I explore the three universal psychological needs (autonomy, relatedness, and competence) as explained by self-determination theory (Deci & Ryan, 2008), to understand how the development of engaging mindsets aligns with psychological needs.

Dewey's Educational Theories

Dewey described his philosophy of education in two of his main education works, *Democracy and education: An introduction to the philosophy of education* (1919) and *Experience and Education* (1938). For Dewey, an effective learning environment was grounded in connecting prior student experiences to new content and skill development in

a socially empowering environment. Dewey's descriptions of favorable learning environments align with the goals and methods of applied education.

Dewey outlined several recommendations for education leading to the idea of making real world connections (Dewey, 1919). First, real learning happens when things are uncertain. In these uncertain contexts, trial and error and analytical thinking is required. Having students apply their knowledge and understanding to a real world context allows them to test their thinking and make new connections. This gives full meaning and permanent understanding as the students carry their content knowledge forward (Dewey, 1919).

Second, Dewey promoted active instead of passive learning (Dewey, 1919). Dewey suggested giving students first hand intellectual and physical experiences. Having students involved in genuine, complex experiences requiring multiple perspectives may mitigate the danger of equating knowledge with facts (Dewey, 1919). He suggested no study is worthwhile unless it is worthwhile in its own right—the direct experience with the objects and processes of the content one is studying.

Third, Dewey emphasized connected learning (Dewey, 1919). He suggested the best teaching involves making direct interconnections to the world and to other disciplines. He promoted blurring the lines between what is considered academic and "un-academic." Schools should intentionally bring in experiences containing real world contexts (Dewey, 1919). These exposures will make learning more meaningful for students because all of thinking and learning at its core is about discovering new connections. In this study I sought to determine what enduring effect these real world connections in engineering and journalism had on students' engaging mindsets.

Another type of connection Dewey promoted is linking content to something personally understandable and meaningful to the student (Dewey, 1919). He explained that good aims must grow out of existing conditions—only by understanding and connecting to what students already know may new connections in learning take place. Educational activities should present new but familiar material so students may jump from one connection to the next (Dewey, 1919). Therefore, there is also no static or controllable end point in education. Different students will see different results based on prior knowledge and the specific connections they make in the activities. Not only is this acceptable, it is the only result expected.

Student interest should be absorbed into any activity. School should take full advantage of students' natural impulses of curiosity and creativity (Dewey, 1919). When schooling and learning activities grow naturally out of questions students themselves have, education becomes motivational and engaging. The education fits the students' current understandings and inquiries and allows students to deepen their connection to the material (Dewey, 1919). With personal connection comes passion and self-discovery. In my study, one of my goals was to understand how the passion and self-discovery students developed through the engineering and journalism programs impacted their engaging mindset development.

Additionally, Dewey outlined how real world connections to complex problems naturally led to more reflective and analytical learning (Dewey, 1919). He supported creating experiences for students offering no clear answers and intentionally providing a certain level of confusion where tentative interpretations were normal and encouraged. Students would be expected to define the problem, survey the possible results or answers,

and then test their thinking (Dewey, 1919). In an iterative process (i.e., a process repeated to search for increasingly better solutions), students would continue to refine their thinking to come to more precise or consistent conclusions.

In his 1938 publication *Experience and Education*, Dewey described two principles of experience. The first, continuity, explained how each of an individual's experiences are carried forward into and influence other experiences (Dewey, 1938). The second principle, interaction, explained how past experiences interact with one's current situation to define an individual's current experience (Dewey, 1938). These two principles are important as educators attempt to discern what quality experiences to give their students to provide the most effective and worthwhile growth.

When educators make decisions about the activities and the educational environment of their classroom, they affect both students' current experiences, and potentially, students' experiences in the future. The specific designs of authentic, applied learning environments have an effect now and forever on the students' mindset development. In my study I sought to understand the influence, or lack thereof, of an authentic, applied learning environment on students' future success.

Dewey also examined the challenges in education in terms of social control (Dewey, 1938). In its negative extreme, social control may mean an authoritarian environment in which the teacher imposes absolute control over students in a classroom of unquestioned rules and regimented activities. Social control may also be viewed as a jointly established set of standardized expectations for the good of the whole group. Dewey (1938) explained how the educator is responsible for creating a cooperative social control, promoting participation and community activity. Authentic, applied learning environments tend to be

more student-driven and collaborative than traditional classrooms. My study sought to understand what effect a move away from an authoritarian social control might have on engaging mindsets. I searched for evidence of specific social structures in the engineering and journalism programs that might affect the development of engaging mindsets, especially students' sense of belonging, and value and meaning of work.

The most important form of freedom for Dewey (1938) was the freedom of intelligence. Dewey critiqued physical forms of compliance (e.g., rows of desks, students in seats) and connected these to forms of freedom of thought. Dewey promoted movement through hands-on experiences as a means to intellectual freedom. Silent reflection is also important, only as a culminating activity after a collaborative physical activity. Authentic, applied learning environments promote both physical and intellectual freedom in student choice and voice. My study sought to determine the effects of intellectual freedom on engaging mindsets as students took ownership of their learning.

Dewey (1938) also emphasized the importance of developing purpose for students. He argued teachers rarely allow students to develop purpose because any impulses toward purpose are quickly overshadowed by the next academic action scheduled to take place in the classroom. Dewey (1938) suggested teachers should present significant problems motivating learners to seek out information, think critically, and create new, purposeful ideas. Educators are the architects in creating both the purposeful activities to stimulate students, and the intellectually free environment to pursue them.

Often in traditional classrooms teachers develop undemanding questions with pre-packaged answers, and in the process squelch purpose. Authentic, applied classrooms offer an open-ended environment with no clear answers. In my study I sought to determine if

educational environments with an authentic, real-world connection affected the development of purpose, and therefore, the development of the value and meaning engaging mindset.

Dewey (1938) and researchers of engaging mindsets appeared to be consistent in describing elements of the classroom positively affecting engaging mindsets. Self-efficacy, ability derived from effort, sense of belonging, and value and meaning of work are all positively correlated to the Deweyian principles of intellectual freedom, hands-on experience, sense of purpose, collaborative environments, student ownership, and relationships between teachers and students.

I adopted a Deweyian experience lens because it helped me understand how students' participation in journalism and engineering classes shaped their future educational and life experiences. Additionally, it helped me understand how their classroom experiences influenced their choices, their self-efficacy, their motivation, and their sense of purpose in life. In the next section I discuss Bruner's "discovery learning" theory or "constructivist learning" theory.

Bruner's Educational Theories

Bruner created educational theories largely consistent with Dewey's. During the 1960s, Bruner outlined much of his educational theory in three texts, *The Process of Education* (1960), *The Act of Discovery* (1961), and *Toward a Theory of Instruction* (1966). In these texts and others, Bruner supported a learning methodology referred to as discovery learning, inquiry-based learning, or constructivist learning. Bruner (1961) found students learn best and most effectively when they draw from their own experiences and prior knowledge while interacting with and exploring some new concept or experience.

This “discovery learning” promotes student problem solving through manipulating objects, performing experiments, and struggling with tough questions. This method is meant to help students more easily categorize new information based on the similarities and differences with already acquired knowledge (Bruner, 1961).

Learning therefore is an active process. Learners themselves select pertinent information and incorporate it into their cognitive storage (Bruner, 1966). By creating their own hypothesis and testing its validity, learners take ownership of the learning process. Students actively look for connections to things they already understand. This is contrary to the authoritarian classroom where the teacher or textbook delivers pre-packaged facts and knowledge to students. In an active, constructivist classroom, students make meaning for themselves.

The teacher’s role in a constructivist classroom is to curate material and experiences at the proper level and sequence to engage and motivate the students (Bruner, 1966). The instructor encourages learners to discover principles for themselves and engages the students in dialog and experiences to draw out their creation of knowledge (e.g., answering questions with questions). The job of the instructor should not be to ensure students temporarily commit facts to memory so they can regurgitate them back on an evaluation. Rather, it is the job of the educator to make sure the students engage in the learning processes so they permanently gain conceptual understanding and the skills of lifelong learning (Bruner, 1961). Knowing becomes an active process instead of a passive product. Active learning is consistent with the research on the development of engaging mindsets because it transfers ownership to the student.

Jerome Bruner introduced many of today's most often used pedagogical terms. The term instructional scaffolding was first introduced by Bruner (1960), building on Vygotsky's idea of zone of proximal development. The theory explained how students learn best by taking on reasonably sized chunks of information connected to, and built upon, one's prior knowledge (Bruner, 1960). In this way, each new learning activity challenges the student to grow while simultaneously fostering success and confidence. Teachers gradually remove their assistance as it becomes unnecessary.

Bruner (1960) believed even complex concepts could be taught when introduced to learners at the appropriate level and then revisited multiple times to produce deeper and richer understanding. This approach, now known as a spiraling curriculum, takes advantage of scaffolding because a single concept gets re-examined with more complexity building off previous experiences.

Within the scaffolding and spiraling, Bruner (1961) supported the constructivist approach. As students explore and construct deeper meaning with a given concept, they ask more and more complex questions stimulating their curiosity. Teachers expect students to start extrapolating information and filling in the gaps—thereby creating their own scaffolded learning. The ideas of scaffolding and spiraling support an effort-based achievement mindset by showing students how revisiting a topic works to provide continuous growth—a topic is not just mastered once and forever forgotten.

Bruner's (1966) ideas of development supported the theory of constructivist learning. He outlined three stages of development. The enactive stage refers to learning through actions. Individuals, from birth, learn by doing—by trying and trying again until getting it right. Not long after being born, people enter the iconic stage, which refers to the

learner's use of pictures or models. Children are quickly able to equate pictures in a book to their real life equivalents and learn from those pictures. The symbolic stage begins when students can think and learn in abstract terms, for instance through written words (Bruner, 1966).

Each of these stages builds on the other—a student reaching the symbolic stage can operate well in the other two (Bruner, 1966). Learning environments including elements of all three (enactive, iconic, and symbolic) become rich spaces in which students interact with the learning in multiple modes (Bruner, 1966). This framework supports an active, hands-on, constructivist learning environment, meeting the needs of learners by regularly engaging them in enactive, iconic, and symbolic activities.

Bruner proposed the strongest educational environments included students engaging in analytical thinking and intuition (Bruner 1961). Being able to take what is learned in a hands-on way and convert it into something more iconic or symbolic facilitates students showing deep understanding. Reflective learning becomes another form of active, constructivist learning, allowing students to scaffold their knowledge and understanding.

Active learning is student-based, and as a result, the subject of intrinsic and extrinsic motivation is important. Bruner (1961) believed grades and competition damage the learning environment by diminishing the desire of students to be curious and embrace discovery and trial and error as the mode of learning. If success and failure are based on "right answers" on a test, students will want the teacher to give them the answers rather than constructing knowledge for themselves.

With well-designed discovery learning, filled with interesting problems, students maintain natural curiosity and motivation through intrinsic means (Bruner, 1966). The

feedback mechanisms in a discovery-learning environment are focused on growth and new discoveries rather than absolute achievement. Students progress from one learning to the next through their intrinsic ownership of accumulation of knowledge and understanding.

The journalism and engineering programs in MPS are well aligned with Bruner's theories of learning. I used Bruner's theories to better grasp how certain elements of the classroom environment may have affected engaging mindsets in students. Bruner and Dewey's theories helped me connect classroom and curriculum design to the study of engaging mindsets. Next I turn my attention to the field of psychology. Because engaging mindsets are about students' psychosocial beliefs, I adopted Self-Determination Theory to help me understand the psychological components affecting engaging mindsets.

Self-Determination Theory

Self-determination theory (SDT) focuses on the interplay between extrinsic and intrinsic motivations. SDT theorists, building on the work of Maslow (1943), proposed healthy development and functioning were best fostered by positively impacting the individual's basic, universal psychological needs of competence, relatedness, and autonomy (Ryan & Deci, 2000). Conversely, anything detrimentally impacting these key psychological needs will have negative impacts on motivation and engagement. The levels and quality of competence, relatedness, and autonomy students develop are in part determined by the social surroundings and the systems in place to support or thwart their motivations.

Universal psychological needs. The first universal psychological need for all people is the need to feel competent—the sense one can do something successfully or effectively (Ryan & Deci, 2000). Giving people unexpected positive feedback during task completion increases individuals' feelings of competence and the intrinsic motivation to do

the task (Deci, 1971). Conversely, negative feedback makes individuals lose a feeling of competence and therefore decreases their intrinsic motivations (Vallerand & Reid, 1984). The need for competence and its fulfillment lead directly to the development of the engaging mindset of self-efficacy.

The second universal psychological need is autonomy (Deci & Ryan, 2008). Autonomy is the desire or urge to have control and ownership over one's life and to be in harmony with one's interests. In SDT theory, autonomy is not the same as independence from other individuals (Deci & Ryan, 2000); rather, it is about having choice and having increased agency in decision -making and achievement. Situations fostering a sense of autonomy have been shown to increase intrinsic motivations (Deci & Ryan, 2008). Together, competence and autonomy lead to the engaging mindset of effort-based achievement. When people feel they have individual control related to their academic performance, they are more likely to view achievement as a result of their effort rather than as a fixed innate characteristic.

Finally, the third universal psychological need is relatedness (Deci & Ryan, 2008). Relatedness involves the positive connections and attachments made between people. In a classroom setting, this could include student/student relationships as well as student/teacher relationships. The psychological need of relatedness directly aligns with the engaging mindset of sense of belonging. Together, relatedness and autonomy foster the fourth engaging mindset of value and meaning. Relatedness offers a connection to the greater good of not only the peers in the classroom but to the common good of society. Having a sense of autonomy, which includes one's self-knowledge about what content and work is interesting and engaging, helps create the mindset of value and meaning.

Intrinsic and extrinsic motivation. Intrinsic motivation is defined as wanting to do something for the inherent pleasure, satisfaction, or challenge it provides (Ryan & Deci, 2000). People are naturally motivated to be inquisitive, playful, and active because of the positive impact on their social, cognitive, and physical development (Ryan & Deci, 2000). It is both a personal characteristic of an individual as well as a relational characteristic between individuals and various activities. This type of relational, intrinsic motivation is directly connected to the two mindsets of sense of belonging and value of work. Students are motivated by the relatedness stemming from social acceptance and interesting tasks (Ryan & Deci, 2000).

Another aspect of intrinsic motivation in SDT is the degree to which feedback and evaluation methods are capable of being intrinsically motivational. Ryan and Deci (2000) explained that if feedback mechanisms provide *both* a feeling of competence *and* a sense of autonomy, they would be intrinsically motivational. If students feel they internally controlled success, they will have increased self-efficacy and effort-based achievement engaging mindsets.

Extrinsic motivation is when someone performs a task to receive an unrelated reward (Ryan & Deci, 2000). While many view this form of motivation as inferior and even detrimental, SDT proposes extrinsic motivation may vary widely in its degree of autonomy and therefore vary widely in its value (Ryan & Deci, 2000). For instance, if someone complies with a task out of fear of punishment, the motivation to perform is controlled by some outside force (e.g., parents or teachers). If one is extrinsically motivated because of some future reward (e.g., learning Math because it may help a student become a doctor), then the performance on the task is more autonomous. SDT theorists propose since many

educational activities are not inherently interesting for students, teachers would do well to help students internalize the importance of external regulation on their future happiness and success (Ryan & Deci, 2000). In other words, teachers should help students see how extrinsic rewards today may lead to intrinsically rewarding future outcomes.

Autonomous vs. controlled motivation. Deci and Ryan (2008) stated the most central distinction in SDT theory is between autonomous and controlled motivation. Autonomous motivation includes both intrinsic motivation and extrinsic motivation in activities where students have found particular value. Controlled motivation consists of external regulation through rewards and punishments. Controlled motivation pressures individuals to operate or behave in certain ways because of the need for approval, and/or the avoidance of shame.

The universal psychological needs in SDT (competence, autonomy, and relatedness) and motivation theories are seen frequently in the studies of mindsets (Butler & Nisan, 1986; Crooks, 1988; Goodenow, 1992; Goodenow & Grady, 1993; Harter, 1992; Wigfield & Eccles, 2000). Competence aligns well with the mindset of effort and self-efficacy. Autonomy corresponds with the mindsets of self-efficacy, effort and the value of work. Relatedness aligns well with a sense of belonging and value of work. Autonomous motivation is an important ingredient in developing all four of the engaging mindsets because a sense of self-empowerment is critical.

The educational theories of Dewey and Bruner, in conjunction with self-determination theory of Deci and Ryan, helped create a solid framework for analyzing my study participants' reflections. In the next chapter, I outline the methodology I chose in alignment with phenomenological research.

CHAPTER THREE: METHODOLOGY

To explore the essence of authentic, applied learning environments and their effects on engaging mindsets, I used a phenomenological approach within the qualitative research tradition (Bazeley, 2013; Creswell, 2013). In this chapter, I describe qualitative research and the phenomenological approach to understanding the students' experiences. Next, I detail the setting of my study, describe my method for recruiting and interviewing former students, and explain how I protected the confidentiality of my study participants. Then, I summarize my methods for collecting and analyzing the data. Finally, I reveal my methods for ensuring the best possible validity and reliability.

Qualitative Research

I chose qualitative research as the most appropriate approach because I was seeking accuracy within a specific context—to find the actual lived reality of the individuals and the system being studied (Bazeley, 2013). Quantitative studies, by contrast, are designed to make broader generalizations by isolating specific variables and finding correlations between variables being measured. The true experience of any individual participant is hard to depict accurately in a quantitative study; so, I utilized a qualitative study to maintain a targeted focus on the experiences of individuals in applied learning environments.

Qualitative research engages people in their natural settings, trying to understand and describe the reality of individuals as they experience the issues of everyday life (Creswell, 2013), including the authentic voices of individual participants as well as the researcher's own interpretations. Qualitative research takes into account how the researcher influences the research (Bazeley, 2013). In a qualitative study, the researcher is

honest in revealing and depicting how his or her background and experiences filter the data being collected. Merrian (2009) encouraged researchers to recognize inherent bias to get at the participants' "truths" regarding their experiences.

Also, by its nature, qualitative research is more flexible in allowing researchers to make adjustments to the research as they discover new insights through observation, interviews, and historical data. Both inductive and deductive reasoning helps researchers make sense of the data (Creswell, 2013). Creswell (2013) recommended organizing the data in multiple ways to establish themes and subplots, and constantly checking the organizational structure against the data.

Creswell (2013) summarized five approaches to qualitative study: narrative, phenomenology, grounded theory, ethnography, and case study. Each method has defining features and challenges. Each approach has a key purpose. In the next section, I explain phenomenological methodology.

Phenomenology

Phenomenological research is based on finding commonalities with how participants experience a particular phenomenon (Creswell, 2013). The purpose is to ascertain the "nature" or the common "reality" of a system or an experience across multiple people. Moustakas (1994) explained the goal of a phenomenological study is to find out what the participants experienced and how they experienced it.

Phenomenological research has a strong philosophical history on which I focused in my methods. The phenomenological tradition has at its core the belief that objects in the world only exist based on consciousness of individuals (Groenewald, 2004). The focus of a phenomenological study is to explore people's perspectives, perceptions, and

understandings of a particular situation—to look purely at the direct consciousness of their experience (Van Manen, 1990).

One of the key steps within the phenomenological tradition is bracketing—intentionally identifying and processing one's own preconceived beliefs and opinions about the phenomena in order to set them aside, or bracket them (Van Manen, 1990). Researchers using phenomenology suspend their own interpretations of the phenomena, not backed by the data of participants, and continuously watch for and acknowledge when biases enter into the discussion (Creswell, 2013). The purpose of bracketing is to isolate the pure phenomena from what is believed to be known about the phenomena (Van Manen, 1990).

Another key step in a phenomenological study is to use intuition to remain open to the meaning attributed by the participants (Van Manen, 1990). The researcher creatively works with the data until understandings coalesce around common themes (Creswell, 2013). Intuiting requires researchers to fully immerse themselves in the data until the true attributed meaning of the participants becomes clear (Van Manen, 1990).

During the analysis process, the researcher works with the data in multiple ways. During the open coding phase, the researcher scrutinizes the data for commonalities, similarities, and differences (Van Manen, 1990). The researcher creates categories and sub categories that appear to describe the phenomena. In the coding process, researchers look for evidence of patterns, question their own assumptions, and become more responsive to the data (Bazeley, 2013).

Once the first round of coding takes place, the researcher looks at connections among the categories and subcategories to determine if rearrangement or combination is

necessary (Creswell, 2013). Researchers look at specific contexts or conditions influencing the perspective of the participants to ensure the analysis captures the true perspectives of the participants (Van Manen, 1990).

When researchers describe the phenomena, they attempt to create a coherent storyline that captures the experience of the participants with as little interference from the researcher's perspective as possible (Van Manen, 1990). The researcher's goal is to synthesize a comprehensive view of the data and create theories about what the phenomena meant to participants (Bazeley, 2013). In phenomenology, the researcher is attempting to make connections, not to claim causation (Bazeley, 2013).

Van Manen (1990) explained, "To write is to rewrite." In phenomenology, the researcher iteratively rearranges, reconnects, and rewrites the themes and subthemes until the story well represents the participants' lived experiences. Seeking the true meaning of a person's experience is a lengthy process requiring patience, openness, and creativity. Next, I will outline the details of my research plan.

Research Plan Details

As mandated by the Institutional Review Board (IRB) policy, I submitted the appropriate forms to the University of St. Thomas IRB and gained approval for this study in April 2014. The IRB forms help ensure proper care and procedures when working with human research subjects. The IRB Lay Summary (see Appendix A) outlines the background of the study, methods for ensuring confidentiality of participants, recruitment procedures, data collection and analysis methods. The IRB process is designed to protect the welfare of study participants—to ensure that the researcher avoids unethical or damaging research methods.

In the following sections, I explain my research methods and procedures. First, I summarize the setting of the research. Next I detail recruitment of participants, maintenance of confidentiality and other ethical considerations. Finally, I outline my specific methods for collecting data, analyzing the data, and ensuring the study's validity and reliability.

Setting

My study took place at Midwest Private School (MPS). In 2014, MPS was a 7-12th grade school largely serving an upper, middle class demographic. The school's population consisted of about 18% students of color, and about 8% of students used the free/reduced meal program. MPS had a core curriculum mirroring most schools in 2014 but also had a few large, popular authentic, applied learning programs.

I studied two programs within the school. One program was a humanities driven authentic, applied learning environment (i.e., journalism), and the other was a STEM (science, technology, engineering and math) driven authentic, applied learning environment (i.e., engineering). These two programs were optional for 10th, 11th, and 12th graders and had become nationally recognized programs. I felt curious about what aspects of these programs appealed to students and what the lasting effects might be. I sought to understand if these seemingly different settings contained some important commonalities in terms of how they developed students' engaging mindsets, and to see if there were important differences between the two.

Recruitment and Selection of Participants

I first set some goals for my recruitment process. I wanted to recruit a diverse group of participants. First, I wanted students experiencing the engineering or journalism

programs for, ideally, a minimum of two years. I sought a diversity of participants based on graduation year; some with a more recent high school experience, enrolled in college, and others having started their careers after graduating from college. I also aspired to get a representative sample of students based on gender, and race. Finally, I sought to recruit an equal number of engineering and journalism students.

I approached the two teachers of the programs with a prepared script to recruit students (see Appendix B). The script described the purpose of my study and outlined the diversity of students I sought. After reading the script, the teachers created long lists of potential participants.

I made random contacts via phone and email drawing from a pool of 125 potential participants. I attempted to meet my desired goals for a variety of participant age, gender, and race, by strategically shifting whom I contacted based on who had already said yes. In a few cases, a participant recommended talking with another former student, and I added the student to my list of potential participants.

Once I contacted a potential participant, I used a basic recruiting script to introduce the study to them (see Appendix C). I explained how I was looking for their perspective on their high school applied learning experience and how it affected them then and in the future. If a potential participant expressed interest, I then covered issues of confidentiality, risks and benefits, and consent.

Ethical Considerations and Confidentiality

With any research study, maintaining confidentiality and integrity is important to overall trust in research (Creswell, 2013). I made every effort to protect participants' confidentiality, to inform them of the benefits and risks of participation, and to make sure

consent to participate was transparent and well understood before the interview process began. In this section, I outlined my procedures for maintaining confidentiality and ensuring an ethical study.

Protection of participants. The former students in this study are no longer enrolled at the school. This separation helped former students understand and believe their participation would not affect their relationship with the school in any way. I also strongly explained they could opt out of the study at any time for any reason. Confidentiality (see Appendix D) was an important aspect of protecting the participants of the study. I did not reveal participants' real names nor any associated identifying data (address, contact information); I used pseudonyms whenever discussing a specific participant's responses. I kept electronic data on a password-protected computer and on a password-protected qualitative data web-based program called Dedoose. I identified all electronic data only by pseudonym. I kept actual names (connected to pseudonyms) on a paper copy separate from the interview data and on a spreadsheet residing on a password-protected computer. As the principle investigator, I kept the paper copy in a file cabinet in my home.

The paper copy with names and pseudonyms was destroyed upon successful completion of the dissertation. I maintained the interview data and coding on the password-protected computer and password protected web-based program. I was the only one with access to the full data. My research advisors had access to the non-identifiable interview data. Only I knew actual names. The audio files sent to the professional transcription service contained no identifiable information.

I also made sure to detail the voluntary nature of the study. In the initial recruitment process, I told participants their participation was voluntary and would not affect their current or future relations with their high school or the University of St. Thomas. I explained if they decided to participate, they were free to withdraw at any time up to the publication of the results. If they chose to withdraw, the data collected about them would be removed from the study. I also assured the participants they were free to refrain from answering any question during the interview.

Risks and benefits. I was explicit with potential participants about the risks and benefits of being included in the study (see Appendix E). The study had some risks. While the study randomly selected students from many recent graduates, and every effort was made to maintain anonymity, there was still some chance the responses would be recognizable to someone close to the program.

The direct benefit the participants received for participating was the knowledge they were contributing to the improvement of teaching and learning by having shared their insights. Several of the participants expressed gratitude for being asked to contribute. They wanted to tell their stories and felt a desire to "give back" to a program that meant so much in them.

Consent. When getting consent to participate in the study, I asked the potential participants some specific question addressing procedures, risks, benefits, confidentiality, and voluntariness. Through this questioning process, I clarified any details needing to be addressed and/or decided whether or not to include this participant in the study. I guided each participant through an official IRB consent form (see Appendix F) to make sure they understood the full implications of participation in the study. After feeling comfortable

with our conversation about the study's purpose and procedures, the participants signed the form.

At the end of the recruitment process, I had 16 participants with a reasonably desirable mix of program, age, gender, race, and graduation years. The engineering program is a three-year sequence of courses. All former engineering students in this study participated for three years. Students may participate in the journalism program for a maximum of three years. Of the recruited participants, four participated for three years three participated for two years, and one participated for one year.

The gender mix of the study was nearly even. From journalism, I interviewed five female and three male participants. From engineering, I interviewed four female and four male participants. The gender demographics are shown in table 1 using pseudonyms.

Table 1: Participant demographics by gender

Journalism	
Male	Female
Benjamin	Ellie
Roger	Johanna
Matt	Katherine
	Danielle
	Ingrid

Engineering	
Male	Female
Andrew	Lauren
Frank	Sydney
Jack	Caroline
Usher	Ann

I was able to reasonably meet my desired age mix. Nine of the participants were in college and seven of them had started their careers. Of the nine college students, seven of them spoke about jobs and internships allowing them to offer perspectives on work related experiences in addition to their academic work. The number of participants per graduation year is outlined in table 2.

Table 2: Number of participants per graduation year

Graduation Year	# of participants
2006	1
2007	4
2008	1
2009	1
2010	0
2011	2
2012	3
2013	2
2014	2

Data Collection Methods

A typical phenomenological study is best conducted by meeting with the participants in the natural setting (Creswell 2013). I conducted all of my interviews at MPS hoping to stimulate participants to remember aspects of their experience more clearly. I held the interviews in a clean and comfortable conference room or office. Before starting any recording, I conducted a five to ten minute conversation with each participant introducing myself and getting to know a little bit about their most recent educational or career pursuits. We reminisced briefly about their time at MPS in general. I asked them questions about whether they had any friends or family still connected to the school. I chose to use the initial small talk as a way to put the participant at ease.

Once the participant seemed ready, I reiterated the purpose of the study and reminded him or her I would be recording the interview. We briefly discussed the confidentiality of their participation again, and I answered other questions if any were asked. I placed a table microphone in front of the participant and indicated we were starting the official interview. Since this was a phenomenological study, I asked the participants two main questions: (1) what they had experienced in terms of the phenomena and (2) what contexts or situations had typically influenced or affected their

experiences of the phenomena (Creswell, 2013, p.81). These two key questions were stated in more colloquial terms to put the participants at ease (i.e., "Tell me about your time in engineering/journalism. What do you remember about your experience and the impact it had on you then and later in life?").

In addition to these broad starter questions, I had a multitude of questions ready to prompt deeper discussion as needed. The key goal was to ask enough quality open-ended questions to allow the participants to tell their complete story of the experience (see Appendix G). To make the participants feel comfortable in describing their experiences and reflections, I asked participants to describe their memories of relationships they developed both with adults and other students. Some questions helped participants focus on the instructional methods, assessment methods, and the arrangements in the learning environment. I designed other questions to help participants reflect on what effects these learning experiences may have had on their future actions, preparedness, and belief systems in college, career, and/or life.

To ensure participants felt comfortable telling their stories, I encouraged them to take the interview in any direction they felt appropriate. For some participants, this meant I never asked them certain questions, either because they navigated toward those themes on their own or their experience did not lend itself to those topics. In most cases, a single, quality, open-ended question led participants to telling several stories about their experience in the program and/or about current life events, connecting them back to their time in engineering or journalism class. Each interview carved its unique path through the participants' memories. Their stories revealed many consistencies regarding the meaning of their applied learning experience in high school, what they identified as important in

their positive experience, and what the enduring effects were as they continued on to college and started their careers.

I recorded the interviews and transcribed them verbatim, using a professional transcription service. I uploaded each audio file to a secure website and in a few days received the transcription. I uploaded all interview transcriptions to Dedoose, a qualitative analysis software program. In the following section I explained how I used Dedoose to analyze the data.

Data Analysis

Dedoose is a powerful program that allowed me to look at the data in multiple ways. First, I read through each interview transcript twice and created codes, child codes, themes, memos, descriptors, and observer comments. Next, I looked at relationships between codes, memos, and other excerpts to find places where codes could be re-categorized or collapsed into a more succinct structure. Dedoose allowed me to visually and graphically see where overlaps in themes, or code co-occurrences existed, and helped me develop new themes as different patterns emerged.

I performed multiple iterations of organizing my data to try out different theme structures. I then created several concept maps to look for patterns of cause and effect or similarities and differences. Trusted colleagues, keeping full confidentiality of the participants in mind, helped me gain additional insights from alternative points of view in several conversations during my analysis work. I looked at my data metaphorically to determine if a clearer picture would emerge to tell my research story.

Ultimately, spending a lot of time with my data and "purposefully playing" with it in multiple formats, structures, and patterns helped me become more intimately familiar with

it. However, it was also important for me to set it aside once in awhile, come out of the fog of too much closeness, and come back to it with fresh eyes. The 16 interviews revealed an extraordinarily consistent story of what the participants' exposure to engineering or journalism meant to them while in high school and the enduring effects in college, career, and life. I read through all of the transcripts a third time, re-coding all 362 excerpts into central themes. Since many participant descriptions overlapped with multiple themes, I downloaded the excerpts into a spreadsheet to track where I ultimately chose to use each one in describing the data in my study.

I achieved data saturation after analyzing the 16 interviews. I identified multiple recurring patterns, and found no new insights from the data. My analysis yielded seven essential elements that provided participants a meaningful experience while in their respective learning environments. I also identified four enduring effects for the participants as they journeyed into college, career, and life. I organized the data chapters around these themes; chapter four describes aspects of the learning environment and chapter five explains the enduring effects. Next I discuss the ways in which I ensured validity and reliability while I performed the analysis.

Validity and Reliability in Qualitative Research

One of the most important considerations as I used a qualitative research approach was to establish strong methods of ensuring validity and reliability. Since a phenomenological study is not engaged in making broad generalizations, the key consideration was making sure I established strong internal validity by combining and synthesizing the responses of my participants in an objective way (Creswell, 2013). In this

section, I discuss in detail considerations of internal validity, generalizability, and the effects I, the researcher, had on the validity and reliability of this work.

Internal validity. Trying to establish a causal relationship in a qualitative study is difficult at best. The goal in my study, in regards to internal validity, was to do a critical analysis of the data with high quality so my conclusions were trustworthy to my audience. There were several ways I increased the credibility, or validity, of my study.

First, because I was doing a study with a limited scope, I was very specific about the context I was studying and only made claims about that context. My results only directly applied to the setting previously outlined in this chapter. Part of the context was also related to me as the researcher. I was open and honest in stating my very presence and biases affected the results. Other contextual elements—time, space, demographics of the students, culture, and more—affected the study as well. By being transparent, honest, and analytical about how these might affect the study, I lent a degree of validity to the results within this given context.

The strength of my analysis also played a strong role in validity. I spent many hours making various connections between the data, exploring alternative explanations, and making sure I achieved saturation of the ideas explored. I let the evidence from the participants guide the creation of themes, codes, and comments. For each theme I named, multiple excerpts supported its existence. I revealed my critical thinking and communicated it to establish validity in my study.

Additionally, I compared my data and analysis with other studies and theories to increase the validity of my work. Though my study was not an exact duplication of someone else's work, there were comparisons worth making to shed light on my

conclusions. These comparisons to other studies and theories helped me build a new model based on both education and psychology theories. Another strategy I employed to increase validity was peer debriefing. I had some thoughtful colleagues similarly interested in the content of this study. As I shared preliminary analysis and conclusions along the way, they provided second and third opinions to my thinking. They provided a key source of alternative conclusions because they were able to reflect on my data and analysis from a different perspective.

Generalizability. With qualitative research, there are always limits to generalizability. It is typically not the goal of a qualitative researcher to create a sample representative enough to claim generalizability (Bazeley, 2013). This was also true in my phenomenological study. However, some transferability may be gleaned based on my study. One benefit I had was comparing two programs focused on different academic disciplines. This helped me see more clearly (though not conclusively) what effects of an applied learning environment may be reasonably expected across programs and disciplines.

There are other contextual elements I was not able to control: the personality of the specific teacher, the demographics of the students in the program, the culture of the school, and what was happening in the surrounding regional culture to name a few. I was also careful to separate the superficial information of the results from the more substantive discoveries. Every phenomenon has some degree of universality built into it, but each has a larger degree of contextual truth (Creswell, 2013). I was very intentional and explicit in stating my study was looking for truths within the specific two programs I studied and not be too eager to make generalizations to other applied learning experiences.

Researcher bias. There is no hiding the fact I am positively biased toward the implementation and development of authentic, applied learning environments. It probably started with my initial attraction to hands-on science and then becoming a science teacher myself. Most science pedagogy (my primary discipline) has its roots in inquiry and questioning the world around us to develop theories and new understandings. As I became more involved in general professional development and started dabbling in other disciplines, I began to see this as a model with high potential in virtually all academic areas. The empowerment I have witnessed with increased student voice/choice, democracy in the classroom, development of higher order thinking and engaging skills, and incorporating applied, relevant, active assignments and environments is pretty compelling, at least for me. It is exactly this "at least for me" of which I needed to be wary. While doing the data analysis, I developed strong methods for seeing things through others' eyes and questioning my objectivity. I would constantly ask myself if there were other explanations or interpretations of the participants' excerpts I should consider.

In this methodology chapter, I explained my choice to use a phenomenological study in the qualitative tradition. I described the setting of the study and outlined how I recruited and prepared my participants for the interview process. I outlined the data collection and analysis methods I used to ensure validity and reliability. Finally, I explained how I have tried to be honest and transparent about where my biases may have influenced my writing. In the next two chapters I explore the data collected from the participant interviews.

CHAPTER FOUR: THE LEARNING ENVIRONMENT

A key goal of any high school is to prepare students for college, career, and life. Programs of study or registration handbooks clearly detail the content students will study—for example, Biology, World History, Spanish, Algebra and English. Rarely, however, are the processes of the learning environment so easily ascertained despite their impact on college, career, and life readiness. To answer the first part of my research question regarding how students experienced and made meaning of their authentic, applied learning experiences, I both observed students in the applied learning environments and interviewed graduates. I gained a sense for the design of classroom assignments, assessments, and flow of the class through my observations. I learned through my interviews with graduates how they established and maintained their relationships with teachers. Finally, I analyzed how the instructional methods employed in these applied learning environments facilitated student learning.

In this chapter, I introduce each of the applied learning programs and then describe the key elements of applied learning environments based on my participant interviews. I then describe seven essential elements that provided a meaningful student learning experience. I show how these elements serve as a solid preparation for students with regard to their future learning and careers. The design and delivery of applied classes created opportunities for deep learning.

Program Introductions

MPS Journalism: A Brief History and Description of the Program

Journalism at MPS had grown by leaps and bounds over the 10 years leading up to this study under the leadership of teacher Jim Collins. Students and teachers met in four

separate rooms simultaneously; the program included five different classes: Journalistic Writing, Photojournalism, Video Journalism, Graphic Design, and Editorial Leadership. Writers and editors bounced from room to room as they collaborated on stories and recruited partnering photographers, videographers, and graphic artists for their projects. Many students circulated more widely through the school, getting the latest scoop. In fact, the school newspaper journalists and editors became so efficient in their reporting, they frequently outperformed the local papers and the school's marketing and communications department in telling the news of the MPS community.

Student ownership over the process and products was a hallmark of the MPS journalism program. Twenty student editors oversaw the work of 34 writers, eight photographers, seven videographers, and ten graphic designers. Students organized and managed all decision-making and facilitated staff meetings. Students decided the stories worth covering, edited each other's work, and chose what made it to print and what got rejected. The five teachers involved were present to provide guidance and support, but they only peripherally got involved in decisions about the final product. They often coached the editors on leadership strategies but left the complex work of leading to the students.

Over the course of a typical school year, the school newspaper staff produced eleven 18-page newsprint issues, four 32-page glossy themed magazines, and continuously updated content for their on-line newspaper at the rate of about three to four stories per day. The students also maintained four social media accounts, updating them daily. Over the year, students published more than 600 articles, 1000 photographs, and 30 videos. This did not include unpublished draft work. Events and stories occurring at MPS often

appeared in the online student newspaper before word of mouth caught up with the story. Students interviewed me a dozen times over my years at MPS. The students often asked about issues or happenings so current I lacked time to formulate a coherent answer. Many feared and respected the school newspaper staff for their swift and persistent resolve in getting the story.

MPS Engineering Program: A Brief History and Description of the Program

When visitors walked into the engineering program at MPS, they were greeted by a flurry of activity and purposeful noise. Motors whirred, 3D printers and laser cutters pumped out parts, and students engaged in collaborative conversations to figure out how to solve their next challenge. The MPS engineering program, also known as the Competitive Engineering Team (CET) had undergone 20 years of development to make it into an authentic applied learning experience.

Students enrolled in the MPS engineering program, a three-year sequence of courses designed to help students explore mechanical systems, electrical systems, computer-aided design, manufacturing, and the coding of sensor controlled systems. The ultimate goal for students was to create a durable and versatile robot to navigate a simulated disaster area searching for victims. The robot had to negotiate stairs, ramps, obstacles, and uneven surfaces while steering through a maze of rooms.

The learning path to this goal was anything but traditional. Learning was scaffolded through a series of challenges in which there were multiple right answers. Students gathered information from a variety of resources and proceeded through an iterative engineering cycle in which they defined the problem, analyzed potential solution paths, designed, prototyped, tested, and evaluated their solution. Failure and persistence were

expected in the learning process. A group of 10-15 seniors each year were eligible for the MPS Engineering Travel Team. This team spent 2-3 weeks of their summer competing against colleges, universities, and businesses in an international robotics competition.

The teacher's role in the MPS engineering program was strategically hands off. Mr. John Walton was often in his office working on his own research project (the international competition robot). He had designed the student challenges and curated the resources so students became highly independent in their progression through the challenges. Students worked in pairs but often consulted with other teams as well. Getting help from classmates was not considered cheating—rather it was encouraged as simply another resource in the problem solving culture. Students knew if they asked for assistance from Mr. Walton, they were likely to hear their question met with another question. Mr. Walton encouraged students to dig deeper with their problem solving skills and learn through trial and error.

While engineering primarily focused on Math, Science, and Technology and journalism primarily concentrated on the Humanities and the Arts, their similarities were striking. Participants in both programs were consistent in what they identified as important elements of the learning environment and the enduring impacts of the experience. In the following data sections, I collapsed the experience of the journalism students and engineering students into one discussion because of their unified voice. On occasion, I referred to a participant's specific program to provide clarity and context.

Elements of Authentic Applied Learning

In my analysis of the data, I found seven key elements of the learning environment participants consistently identified as most beneficial: (1) complex, open-ended problems, (2) choice and creativity, (3) student independence, (4) real world relevance, (5) product

and performance, (6) collaboration and relationships, and (7) the teacher's role. In the following sections I define each of the seven elements and share the stories and perceptions of engineering and journalism students. I share the participants' stories giving life to these applied learning elements. In each section I provide an explanation and then several example from participants.

Complex, Open-Ended Problems

The first key element of an applied learning environment is related to emphasizing complex problem solving. The path to student learning shifted away from easily repeated facts and the application of memorized formulas. Instead, an applied learning environment requires a sustained effort toward complex, open-ended problem solving. Most students grew up in educational systems with infrequent exposure to such a flexible learning environment. Lauren was at first apprehensive about launching into this environment with new student responsibilities:

> Up to my freshman year with him, … you learn in the class, you read it and you study it, you take a test on it. And when I got to his class and it wasn't that way … I totally freaked out. I was feeling that this is not how I learn.

Lauren and thirteen others expressed their eventual joy in having an experience like this. Learning in an applied environment represented a strict departure from the teacher-centric education format students experienced in a traditional classroom. In traditional classes, participants explained they could succeed by committing to memory the facts, formulas, or steps and promptly restate them on a paper and pencil test. In journalism and engineering, participants faced a new kind of learning—one in which they made choices, accepted responsibilities, and took ownership over the problem-solving process.

Matt indicated, “Lectures can be boring a lot of times so actually going out and doing it is more fun and it’s getting a sense of accomplishment when you actually finish it.” Ann also differentiated her engineering experience from regular classrooms: “There’s not much lecture materials that needed to be discussed in class … the CET [program] is very much built on the foundation that there is barely minimal lecturing and much more doing and guiding and collaborating.” Inspired by his experience in an applied learning environment at MPS, Roger reflected on the overall educational system and the need for fundamental shifts away from rote, factoid-based curriculum to a more current and relevant curriculum:

> Our system lacks the ability to impart more than easily researchable information. I never bought the textbook for [my college class], but I snagged an A thanks to Google and some PowerPoint slides. The system we currently have … is very efficient for filling students with different bits of knowledge and programming them with instructions. Beyond that, its utility is limited.

Journalism and engineering students characterized their learning in these applied classes as continuous improvement and development over time, rather than as static, one-time successes or failures. They came to believe and continue to appreciate that effort is normal and expected to produce achievement and that failure is a natural part of growth and accomplishment. Former students explained how their work in journalism and engineering was an iterative process.

The path to learning for these students had shifted from a set destination to a never-ending exploration. Andrew summarized it this way:

> It’s not an end point; it’s part of the journey. The whole point of school is to learn—to screw up and know you really do know it though. In CET, if I screwed up on something I had time to prove that I knew it.

Sydney and Benjamin related how failure and continuous effort become a natural part of the iterative learning process. Sydney explained:

> You can't be set on what you think the final prototype is going to look like at the end, because it's probably going to look a lot different because you keep learning things throughout the process. I think CET really helped with that … if there was something wrong with your design, Mr. Collins would just take it and would tear it up. He was like, "You just have to start over." This one was a failure.

Matt appreciated this iterative process as compared to his traditional classes: "I would learn things as I went through the process instead of learning things in lecture. I would learn a lesson or like a skill through actually doing it." Andrew emphasized there was no final destination in true learning: "In CET you were never done, you could always keep improving. In [traditional] classes you ace a test and you're done, but in CET you could see how to do better."

Participants specifically described the value and benefits of building failure into a learning environment. Ellie, for instance, talked about the writing and editing process: "Maybe we make a few flubs along the way, but it will only make it that much better in the end." Jack really appreciated failure as an integral part of the classroom, but knew it was a shock to some students as they moved from a traditional classroom setting:

> The whole idea of the class was to not be afraid to try stuff. I think for most students, being in an environment where we're mostly graded on sitting in a classroom and taking tests, it can be hard to do trial and error because a lot of people think that, 'failure is just bad and that affected my grade.' Because that's the assumption, but [applied learning] is a very different way of learning.

For Ellie, breaking away from perfection was a key part of her story:

> I had come from dance team [and] the point of dance team [was]… for everyone to look exactly the same and for everyone to execute something perfectly … I ended up leaving [because I wanted to be with] … people who were creative and had their own voice and wanted to do their own distinctive thing and not be perfect.

Similarly, Sydney made a profound comparison between success and learning: "I would say that one of the big things that they stress a lot is being able to fail … you have to be okay with knowing that it's more important to learn than it is to succeed." She continued by

comparing this experience to her traditional classes, "… because in every other class your grade depends on how well you succeed and in CET your grade depends on how well you learn."

For students, engineering and journalism represented the first time failure was valued and encouraged as part of the learning process. They expressed how happy they were to be in classes emphasizing development over absolute quantitative achievement. Ingrid explained how she could see her development: "You can go back and see what you wrote two months ago and see the progress." Danielle also saw her improvements over time: "Failure was like getting a bunch of red marks all over your paper and just keep redoing it, but ultimately you were successful." Usher emphasized the value of all those cycles of failure:

> Failure is the part of engineering … where the actual learning happens [compared to] … a traditional classroom setting where it's all down to number grades … if you fail and then you learn from that failure … you definitely take that stuff forward.

Frank, too, came to view failure as normal and healthy: "I think it was less seen as failure and more just learning."

While describing the benefits of being allowed to fail, students also connected their experiences to open-ended problems. Caroline spoke in terms of how a class with more open-ended problems felt more authentic: "You have much more ownership over what you create and whether you grow and your overall understanding of the concepts … it's much more stress free and also much more true to how smart you are." Ellie spoke at length of her experience with grading. She explained in a traditional classroom, grades sometimes felt arbitrary and disconnected from her accomplishments and growth: "I'm just following

more directions all the time … and then even this is an A and this is a B? If you get that wrong, your grade is going to go down and [you are] less perfect?"

Although the complex, open-ended problem solving was uncomfortable for some at first, participants welcomed the freedom coming with it. Students embraced failure because they saw the value in learning through continuous improvement. The complex, open-ended problem solving culture opened up opportunities for students to have choices and explore their creativity.

Choice and Creativity

The second key element in an applied learning environment allowed for student choice and creativity. When teachers introduced a complex problem, they did not present formulas and did not stand over the students' shoulders with watchful eyes to see if the work was being done "right." Instead, teachers expected multiple creative solutions, and the students drove the path to a solution. The choices presented to the students in engineering and journalism were not simple ones like choosing between the red worksheet and the blue worksheet. The choices in the applied learning environments were complex and tapped deep into the innovative minds of the students. Fourteen of the participants discussed this kind of personal freedom to be creative in the classroom.

Some students gave specific examples of engineering challenges or journalism events requiring their creativity. Johanna and Danielle remembered how thoroughly every detail of the newspaper rested on their shoulders. Johanna recalled the process of creating titles for stories: "If you're condensing a whole story to five words [for a title], you want to get it across right. … Sometimes we're thinking of a way to be funny but not offensive." Roger remembered times when deadlines loomed and they had to be imaginative about the

writing and the organization of articles: “You are always being forced to start thinking creatively … and leave room for adaptability.” In engineering, Sydney recollected how often they had to make customized modifications to their robot: “And we kind of moved through the design process multiple times and were really allowed to do different innovations to our design.” Andrew remembered being flabbergasted when given a challenge requiring his creative juices: “He said build a robot that fits inside this tube and can navigate this course, and that was all he told us. We were like, ‘that's it?’ We weren't really given anything else.”

Some participants talked more broadly about the atmosphere of creativity in their applied classroom. Jack and Sydney realized individual students were specifically challenged to be imaginative and inventive, and not to rely on the way things have always been done. Jack explained, “The whole point of this class was to test our own ingenuity and not just try and recreate what other people had done.” Benjamin and Ellie said the opportunity to have creative freedom as a high school student was meaningful and fun. Ben explained, “The opportunity to do all these things [and] to figure out how to navigate situations that most people haven't had to … was really cool.” Ann viewed creativity as a positive cognitive challenge sparking her interest: “[We] were able to embrace and apply … problem solving. It’s thinking outside the box and being innovative and really almost like challenging and … building constructive tension.”

The specific engineering challenges in CET often created a need for students to open their minds wide. Lauren remembered one particular challenge, “You could easily do it in ten different ways, but it was the learning and figuring out the best way to do it.” Caroline reminisced about the importance of the divergent thinking coming with being creative: “If

you think through the whole gamut of possible things … one tangent of that thing … might be your solution that you would have never thought of." Participants valued the opportunity to exercise their creative skills and approach problem solving in an anti-formulaic way.

Some students offered comparisons between the creative license their applied courses offered compared with their traditional classes. For instance, Katherine explained, "It was very active and completely different than any of my other traditional classes. I felt that I learned so much more about writing and creative thinking and thinking through problems and challenges." Jack also remembered how his applied learning experience was a distinctive one regarding creative problem solving: "I think part of what the CET system taught me is that you really do have to figure things out yourself and a lot of the hands on experience I think helped."

Creative thinking is an empowering element of the applied learning at MPS. Participants felt liberated from the rote memorization and conventional recipe- driven curriculum. It gave them a sense of maturity and independence as they moved forward into college, career, and life.

Student Independence

The third element of an authentic applied learning environment was student independence. Student independence meant the learning environment allowed students to have responsibility and control over the learning processes and products. For students, this independence included many aspects: finding the resources they need, making choices about their path toward a solution, and having the freedom to divide up their time attending to different aspects of their work. Thirteen participants expressed feeling a

sense of independence in their engineering and journalism classes they had never, or rarely, experienced in traditional settings.

When former students talked about their learning in terms of personal responsibility, they revealed another expression of independence. Jack reveled in the independence:

> We had to work things out for ourselves. The teachers weren't out there to spoon feed us information. We had to do research and try things out. It was more of trial and error. We had to find our own way of doing things.

Roger added, "I learn a lot better when I have no idea what I am doing and I just have to jump in." He appreciated the challenge and benefit of owning his learning. Danielle remembered how the teacher handed the responsibility to her and the feelings it invoked:

> He said that he wanted to change the look of the paper that year and everything was totally up to me … I felt that there was so much ownership that I hadn't really expected… It was "you own this from start to finish" … and so the pride that I felt as a writer was multiplied times ten.

Sydney explained how students not only owned the problem solving but also the questions to be answered, "[You were] defining the problem for yourself before actually starting to come up with design ideas and possible solutions." Katherine explained how the level of ownership built new competencies and self-reliance, "I think the level of autonomy made it so we had to be so creative and trust our instincts." She continued to explain how this translated into a meaningful opportunity to grow: "When you're in high school you still rely on your teachers to tell you when something's due or your parents tell you how to do something. It was really unique and built a lot of skills for us." Frank also was impressed by the level of autonomy: "A lot of what we worked on was self-discovered and self-taught."

Some participants commented on the way these applied classes were designed as independent environments where students could explore their thinking and skills. Andrew explained how engineering was not a complete free-for-all, but there was room for his opinions and self-directed thinking: "A lot of the problem solving in his class was structured but not structured." Ann also felt there was a lot of room for her to own the process and direction: "[I appreciated] not having concrete problems being delivered, [but] having open -ended problems and addressing them in very different ways." Ingrid and Johanna had more practical expressions of their independence. Ingrid stated, "I think it made me confident in an actual skill … like writing."

Caroline and Ben related how the open-ended, independent nature of class impacted their self-perception. Caroline reflected, "It gave me more confidence in my own thinking and saying what I think with this engineering problem and how I want to solve it." Ann remembers her teacher emphasizing the value and the challenges of being independent: "And it was much more like 'You guys are adults, be independent … I'm going to give you the tools that I think you need and then if you don't use them appropriately you may fail.'"

Participants said their confidence was able to flourish in their applied learning classes due to the emphasis on independence. The fatalism coming from thinking one is either good or bad at something was removed, and participants could believe they controlled their success and growth. Caroline was nervous at first:

> I think when I started in the CET program I expected it to be much more guided than it was. When they get you in there as a sophomore, they say, "Here are all of your challenges, go!" Then it's up to you to be proactive about meeting those and asking the right questions. You really have to learn the right questions to ask, which is a lot different than regular learning.

Ellie explained how responsibility was inherent in their desire to improve their stories and their final product:

> What is amazing and I cannot tell you why but everyone in that class … even if they weren't huge fans of journalism, felt responsibility … but a responsibility that they wanted to have—to do well … to hold up their end of the bargain … you are going to go home and work on your journalism and everyone put in their full effort to make sure their story was right.

Independence allowed students to take ownership of their learning. They reported feeling empowered and respected as individuals. Since education is about real life preparation, allowing for independence is a key ingredient. In an applied learning setting, teachers not only prepare students for real life—they bring real life into the classroom.

Real World Relevance

Establishing a connection to the real world is a fourth key element of an applied learning environment. In journalism, students created products for public consumption. Students explored real world community events and issues they cared about and communicated them to the public. Friends, teachers, and family members saw the results of their work daily. In engineering, students were "going to work" every day as a design team. They used the authentic tools of an engineer (3D printer, CAD, circuit boards, sensors) to build a robot with the simulated, profound mission to save survivors from a disaster area.

For fourteen of the participants, a key difference in both engineering and journalism was the expectation for students to apply knowledge to a real life situation rather than memorizing and delivering facts on a paper test. Lauren summarized, "It is much more the application of the knowledge than just actually proving that you can memorize a bunch of names and dates." Roger also expressed satisfaction about the applied format: "I get to

work towards something, actually build something on my own accord. I can get into it, and I can take pride in it instead of regurgitating what I have been fed throughout the semester." Caroline got excited as she explained how complex applications made for interesting, empowering work: "Really, you're dissecting a problem before you start thinking about how you're going to execute solutions ... You have to make sure you define every part of that problem so that you can get to that root cause."

Even if participants did not connect their applied learning to a specific career, many made indirect connections to real life preparation. They viewed the skills and processes they were learning as valuable in real world contexts. Frank pointed out the uniqueness of having a class with a connection to real life:

> It was just such a cool opportunity I think to work on projects that no one else got to play with. I still have not found another high school group, or even a college group, that got to work in that type of format. I think it was a lot closer to a real world application than any class that I had experienced in college.

Likewise, Benjamin gained a new understanding about intelligence and applied knowledge he attributed to his time in journalism: "I like that I wasn't doing it to show that I was smart; it's that there are practical applications. It's a different kind of intelligence … I feel that I've learned something new that goes beyond the classroom."

Jack also emphasized the value of learning in a way more consistent with how one learns in life situations. That was important to him going forward: "It is a lot of trial and error, but I think it really helped me realize that life is a lot more than just sitting in a classroom and listening. You actually have to do things." Benjamin compared his time in an applied learning setting with a more traditional class he was taking in college on the topic of spying: "It's a really interesting class but once I leave the class it doesn't affect me … I

feel like I'm learning stuff there, but I don't feel that I have the same practical applications outside of the classroom."

Some students pointed to specific skills and competencies they will use in their lives and careers. Andrew, for instance, talked about problem solving:

> In CET, you figure out how to solve it [on your own]. In math, it's 'this is how you solve the problem.' It made me better at engineering as a whole and outside of that, problem solving and analyzing problems. You can solve life problems this way. … And it really makes you think critically.

Johanna marveled at the real world skills she was able to engage in at such a young age: "As a high school student, I was applying communications and marketing aspects." When Matt was asked what skills he learned, he focused in on real world competencies: "Definitely the leadership and communication … those are so important in a workplace."

Former students revealed their experience in journalism or engineering felt like being at a real job. The ownership, pride, and freedom they encountered made them feel mature and important. The experience itself either mimicked the real world or was indeed the actual real world. Caroline viewed the learning as pulling together all the pieces of her academic life into a practical application:

> Also having the real life, because I'm a visual person, that comes with engineering, so having the real life examples of what you're learning in this book separately can be applied to a real life situation. For example, physics and calculus, I saw that come up all the time in CET, but no one was telling me. It wasn't someone saying you learned this last year. It was me realizing I learned it already and its putting the pieces together, which bring more meaning to when you are in physics or calculus class and you know you can actually use this. It makes it easier because you can picture it in your head if you're a visual person.

Others talked about how problem solving and creativity made them feel like they were real engineers or journalists. Frank explained, "In the real world that's how it is, right? So I need to make this thingamabob to do 'X' but that could be any number of things, but there

are certain operating parameters that you need to play in." Ann made comparisons to her current job and how CET was the first place where she sharpened her creativity. "There's just no one-size fits all solution or even approach."

In addition to creativity and problem solving, former engineering and journalism students identified specific tools and processes they carried with them into adulthood. "There were very practical applications for everything we learned day to day. It was definitely more of an active learning environment than most of the other classes," Ingrid explained. Lauren was more specific about engineering tools she learned: "I first learned Solidworks [software] which is something that I use every day in my job now." Benjamin too mentioned specific tools he still uses: "Something that's really been a great asset to me that I got out of working on the newspaper is that I have these skills in things like InDesign and WordPress." Danielle remembered the real world skill of balancing the contributions of each of her writers in creating the paper:

> You'd have to navigate that in an interesting way to make sure that people felt they could be heard and that you were writing things that were relevant and interesting. So, learning to prioritize to make sure that everyone is putting their best foot forward so the whole paper can really come across as a cohesive piece of work is challenging.

Some participants talked more about processes and broad learning that felt real to them. Caroline reflected on her current engineering job and remembered key learning from her class that still applied today: "engineering design process where you have to define the problem first and then spend most of your time working to define exactly what's wrong and come up with all the crazy possible solutions to solve that problem." Ellie saw a connection to the real world in the public display of their hard work:

> … just being able to play around with a real website … something that's real that is going out into the world. It's not an assignment that no one besides the English

> teachers are going to read or a worksheet that no one besides my French teacher is going to correct.

In a few cases, students truly did engage in the real world outside of the school. Journalists sat beside other adult journalists covering a game. Engineering students talked to a police department interested in their rescue robot design. Journalists tried to compete with the local paper to get a scoop or to enter the age of digital journalism. Ingrid explained,

> I got the press pass. I got to sit in the press box at the Metrodome with all the real reporters … It was a cool experience where I was doing the same job as the people getting paid to do this for their career. That was the first experience I had where I felt the same thing I did as a student was something people do in practical applications.

Katherine was a journalism student when both the local paper and the school paper were making efforts to post material to the web:

> Digital journalism was very new at the time. When you're starting to look at how to tell stories in a way that we had never really thought about before, when you write a story, it's going into a magazine, newspaper … So if this story can be told in a way that doesn't require words, then it should be told in that way: through video or really cool graphic that we learned to create. This is not how people were doing it at the time. We were looking at these skills of story telling and looking at the whole industry in a very different way. We launched it that fall, and I remember getting a lot of comments that it looked better than what the news was doing, people said it was better than the Star Tribune, which was a big deal.

Establishing real world relevance helped students become motivated and engaged in the learning process. Participants reported the ability to construct meaning from their applied learning experience because they could see connections between themselves and potential future selves. Relevance allows students to bring theory to life. Because real world applications are a key element in applied learning, one will rarely see assessments involving multiple choice and short answer paper tests. Instead, students are expected to

produce real world products and performances to show their knowledge and skills in an applied learning environment.

Product and Performance

A fifth element of an applied learning environment is related to the evidence of learning—the learning in journalism and engineering culminated in the creation of a high quality product, performance, or service. The end goal was not a percentage on a piece of paper. The applied learning at MPS resulted in products and performances that could be touched or experienced in a very hands -on way. In engineering, students produced structures, CAD designs, manufactured parts, and computer programs, and finally brought all those together in a fully functioning robot. In journalism, students produced a collection of stories, pictures, videos, and graphic art to tell a comprehensive and meaningful story, and sometimes emotionally moved people to action.

The product or performance in engineering and journalism was often connected to the participants' feelings of success or competence. For some, especially engineering students, the completion of tasks or challenges was foundational for their feeling positive achievement and development. For instance, for many engineering students, solving the challenge or getting one's robot to complete the task was the ultimate sign of success and growth. For others, especially journalism students, public recognition by getting published in the newspaper (print or online) was the ultimate sign of growth and success. For still others, it was the sense of having a product to show for one's effort or seeing some competitive accomplishment. In subsequent paragraphs I describe eleven students' stories of how products or performances were key in their experience and how they affected their feelings of competence and achievement.

In engineering, one of the distinct motivators was completing the task or solving the puzzle. There may be many creative ways to arrive at a workable solution, but ultimately the design had to accomplish a given task. Solving the problem measured the success and growth of the students. Lauren explained, “It is all about solving. Mr. Collins really gave us a totally open -ended [problem]…like build an arm as long as you can and good luck and come back in a week with your best guess.” Benjamin related his time in CET to a more recent specific achievement that works the way he intended: “I just coded Tetris and there's something really satisfying about making a game and showing my friends—I did this instead of a research paper on Iraq. Both are super interesting to me, but it is a different type of learning.”

Participants recalled the difficulties and joys of completing the challenges along the way to creating their products. Frank remembered the focus on task completion: “We were probably less competitive against each other and more focused on executing the task and being competitive in executing that task.” Caroline also recalled the emphasis on the completion of the challenges:

> It was very much sink or swim. You didn't have a task due at the end of each day. You didn't always have deadlines. Some people could hit the deadlines early and move on to other things and challenge themselves that way, or they could be two months behind.

In journalism, one of the key signs of growth and accomplishment is getting one’s work published and having an audience reinforcing a sense of achievement. Because the newspaper is distributed to 1300 people and the website has thousands of visitors across the world, writers and editors have a true feeling of being in the public eye. Ingrid explained, “People wrote well and cared about it because they were proud to be a part of the newspaper and knew people would read their stuff. It feels good to be congratulated by

your peers for writing a good article." Roger expressed similar sentiments including some colorful language: "I had my own motivation to do well because I did not want to turn in shitty pieces of work. I actually [want] to have good writing and show it to other people." Ellie also measured her achievement by how well she impressed the viewing audience: "I think a lot of the reason why I want to do so well was because I wanted to impress Mr. Collins, I wanted to impress the editor-in-chief, and I wanted to impress my friends." Matt talked about all of the work he was willing to put in to get a final sense of accomplishment:

> Like editing, editing, editing, cutting down a report, cutting down, editing more. [Doing] interviews, photos like we spend a lot of time on that piece. And once it [is finished] and printed, there is almost a relief that it was finally done but it was also pretty cool that, okay, we finally finish this and people responded really well to it. They liked it.

For some participants, their measure of growth and success focused specifically on having a final tangible product. Ingrid stated it explicitly when describing the journalism newspaper:

> Another reason students feel confident and feel they have something to be proud of is that they have a product. Those kids can show those glossy things to their parents or friends. You can show what you've accomplished. You can't do that with a test.

Benjamin expressed a similar feeling: "I enjoy being hands-on and having a final product that is something that is cohesive and is bigger than the sum of its parts."

Ingrid compared the making of a product to the end game in a traditional class: "The other [classes] were run of the mill, lecture, teaching, homework, imitating debate, but in journalism you were actually creating something." She continued, "When you put time and work into something and can see the physical manifestation of that work, it gives meaning."

A few participants saw competition as a motivator and a sign of success and accomplishment. In journalism, Ellie was excited about competitive measures of success: "Maybe [there] was a goal to win an award or maybe [there] was a goal to have a really popular story that really hit the student body … or to get a certain amount of hits on the website. We wanted to beat the local papers to write a story." In engineering, Jack explained how he had his eyes on his peers as he worked to build the best robot: "All three of us were very competitive—not just competitive for the sake of getting on the [international] team, but also competitive with each other."

When the course is set up to produce products and performances, the assessment methods shift. These new types of assessments, while confusing at first, were a welcome authentic change from the traditional classroom for participants. Frank explained his perception of how he was graded in engineering: "It was a different form of assessment [from a regular class]. It was more about, Ok, well how did you contribute to the class throughout the year, have you shown progress, and a commitment to learn." Ann agreed there were grading criteria separate from content knowledge: "And I think … much more of it came down to how hard you worked and how interested [and] engaged you were even if you failed." She went on to explain, "You definitely have to show that you were applying things."

Caroline found learning in an applied setting does not translate well to a traditional paper and pencil test: "That's something you don't get in a textbook. You can't just say that and memorize it and then take a test on it. That was really valuable." Ann compared her knowledge and skill retention in her applied course to her traditional classes: "[In] math class things go in one ear and out the other after the test." Danielle expanded on the idea of

how a collaborative environment also changed the nature of assessment: “As an editor, success was a little bit broadly defined because you're accountable for a team of people so it's not just yourself that's going to be contributing to your success or lack thereof.”

Products and performances allowed students to show what they know in a hands-on and public way. They took pride in their accomplishments because their work resulted in tangible, real world application. A real world focus also allowed students to collaborate in authentic ways.

Collaboration and Relationships

The sixth key element of an applied learning environment is how students were allowed and encouraged to learn and produce results in collaborations with others. In many traditional classrooms, the emphasis is on individual knowledge and skill development. In an applied setting, cooperating with others is often necessary to complete the challenges or produce the final product. In this next section I relate how fourteen participants recalled collaboration and relationship building as a key part of their journalism or engineering experience.

Participants explained they liked the selfless nature of engineering and journalism. There was a sense cooperation and togetherness in their efforts to complete challenges and develop their skills. Caroline viewed the collaborative, interactive environments as being primarily focused on people helping people succeed together:

> Being in an interactive environment really… puts a real life application to what you're learning. It’s not just going through the motions …I've seen what I'm learning physically applied and helps me want to help others; it’s not just for a test.

Frank said, “You naturally ended up focused on helping each other, I think.” Usher concurred, “The engineering environment was so much more collaboration and being able

to get up from the computer and walk over to your friend and say, 'Hey, I'm having trouble with this. Can you come help me?' It's a very open environment to encourage that kind of collaboration and open communication."

In journalism, Ellie appreciated the way students supported each other, "Let's brainstorm and let's work together to make this product the best that it can be." Sydney articulated how students had to overcome the natural tendency to view getting answers or help from someone as wrong: "It's not that big [a deal] if you ask other people what answer they got because not everyone has the same answer ... so it's not cheating, its not copying, it's collaborating." Benjamin summed up his enthusiasm for the collaborative environment with, "I think of it as a giant group project, and you do one every week."

Participants emphasized the pure enjoyment collaborations created. These participants found collaborating fun, engaging, inspiring, and relevant. Danielle said, "You can't run a team where everybody has their own piece and you're in your own lane and that's it. We found that it was a lot more fun when we were collaborative and reading each other's stuff." Roger compared journalism to his experience in traditional classrooms: "I think a lot of the problems with the current system is that students don't care … when you are interacting with your classmates and you are all working on it together, it makes the buy-in a lot more." Ingrid spoke of personal bonds formed in a collaborative environment: "The more time you spend with classmates or teachers or whoever, working towards a goal that you have to complete as a group, it enriches the relationship." Roger alluded to the inspirational and sharing aspects of collaboration:

> It is great to be able to collaborate with people … it is also nice to see what people are doing so you can sort of learn from what they are doing immediately, then sort of base your own work off of what other people's ideas are.

Through collaborations, participants gained a new awareness and appreciation for the unique skills and contributions of their classroom partners. Caroline summarized it well:

> It makes you appreciate teams … everyone can contribute one unique thing and not everyone has to be a master of all trades … it was more than just a group project [where] everyone does something similar … in the engineering project, people have completely different roles that complement each other.

Lauren explained the contributions of her peers more specifically: "I was not a coder and so my friend who used to help me … I remember that it was his strength and that's kind of how it is now because that's how we work as teams now." Ann expressed appreciation for gaining this understanding about individual strengths and challenges in collaborative work: "adapting to the different people that you are working [with and] all the different people, functions and personalities."

Accountability to their peers gave the journalism and engineering students a sense of ownership and responsibility in their collaborative environments. Those experiencing this accountability reported feeling a sense of duty for the end product as well as a need to follow through for the sake of the team. Frank explained,

> We all have to come together for project meetings and core team meetings to understand where everybody is, but at the end of the day you have to break up again and trust that other members of the team are holding up their end of the responsibility.

Lauren concluded, "That was a lot of relying on your teammates and really learning how to work as a team." Benjamin described how groups could succeed together, but he also learned how the collective could fail together as well: "We tend to hold each other accountable in a way you wouldn't [in other classes], even in other group projects. If someone's slacking, it hurts everyone." Ellie expressed a similar feeling:

> Responsibility to other people working on projects is a huge thing … in a traditional classroom if you don't do your homework [then the] only person affected is you … you're only hurting yourself. In journalism if you don't do your work there's a huge chain effect … it's not just about you. Everyone is dependent on you … your laziness won't just affect you. It can affect everybody else.

Matt recognized a phenomenon in his high school applied learning environments—collaborative accountability was a temporary focus, summoned solely for that class: "Everyone has to contribute and everyone has their own role … so we need everyone to be held accountable ... and when class is over we're back to our normal relationships."

Participants recounted the inevitability of collaborations occasionally turning sour or requiring effort. Even in the hard moments of collaboration, participants learned valuable lessons of patience and composure. They learned productive collaboration takes work and attention. Jack explained, "We would get frustrated a lot, but one of the things I learned is sometimes you just have to sit back, relax and keep focusing because ultimately, if you're just sitting around fighting all day you're not getting anything done." Danielle learned about compromise: "So it's all about being flexible and adapting your style to make it work for somebody else." Andrew related this learning to challenging relationships in his current job:

> There are people who don't think the same way. You have to learn with them and work with them … At work, [with my boss] I have to present things to him with patience … That's what I'd do in CET.

Some students also talked about how a collaborative environment required new conversational skills. Danielle linked her learning about collaboration to the specific ability to communicate:

> The other big area that I learned was communication styles. Written communication is just one aspect of what you learn when you're a journalist. You have to be able to have productive conversations when you're interviewing people and trying to learn more about what you want to write. I had to adapt to

> communication styles everyday in the way that you communicated with your team and the way you give them feedback on their work. The communication piece was huge.

Ingrid agreed communication was a skill impacting her ability to be successful in journalism: "I think a big one was interpersonal communication and how to interview someone."

Participants viewed collaboration as important in several ways. It helped them gain diverse insights to complete the tasks in front of them. It cultivated a sense of responsibility and ownership for the group work. And it gave participants another window into real life where they could grow their relationship competencies. One key relationship in the classroom was between teacher and student. In an applied learning environment the teacher's role is unconventional compared to that of teachers in traditional stand and deliver classrooms.

Teacher Role

The seventh element of the applied learning environments in my study is the redefined role of the teacher. Because students had the freedom to apply knowledge to real world, open-ended challenges, the teacher became the "guide on the side" instead of the "sage on the stage." The teacher facilitated the growth and independence of the students through crafting quality questions, curating useful content, and developing meaningful challenges. The teacher designed the classroom processes in such a way as to foster collaboration and persistent, creative problem solving. Some students explained their teacher was intentionally unhelpful and pushed the responsibility for constructing knowledge back on them. Additionally, some delighted in the empowerment they felt being

the teacher's "equal." In the following sections I expand upon eleven participants'

explanations of how they experienced the teacher's role in the class.

Former engineering and journalism students explained their teachers acted as resources for their learning, rather than as the source of all information. Andrew said,

> He was more of a resource along the way. Once a week we'd meet and he'd go over something new. It was more like a business, where we'd work and work, and then here's a workshop where he showed [us] something new … if you had questions you could talk to him about it. It was letting us figure it out instead of throwing it at us and saying, "If you don't get it, too bad." He helped to make sure you'd get it, but at the same time there weren't facts and equations and facts of history that we had to memorize, it was understanding, which was fun.

Lauren appreciated the "guide on the side" approach of her teacher: "When we asked questions, Mr. Collins would give us hints and then kind of lead us in the right direction, but … he was pretty hands off and let us learn from our ideas, and we were doing everything." Caroline pointed out how open-ended problem solving can make a difference in the teacher/student relationship:

> [We learned] those interpersonal skills that don't deal with engineering that you don't necessarily get in a [standard] classroom. Sometimes teachers and students don't get along, but it's in a different way when you're trying to accomplish something together and are self-motivated to solve problems.

Because participants had to rely on their personal resourcefulness in their MPS journalism and engineering classes, they were empowered to become more autonomous.

Participants recounted times when their applied learning teachers appeared to be intentionally, even strategically, unhelpful. Jack explained, "If we would ask him about, 'What's the best design for this robot?' [the teacher would say], 'I'm not going to tell you. You just work.'" Matt remembered appreciating the hands off approach of the teacher: "During the writing process the teachers were not really present—which I like because it gave you a sense of independence." Caroline reflected on how the sometimes seemingly

passive nature of the teacher was designed to draw out student learning and independence:

> When you'd go ask him a question, like how to do this, he'd say, “Go away and come back with a better question.” It had to be specific and something he could actually answer and share his expertise with you rather than tell the answer. There's a difference between giving you the answer and giving you an expert tip.

Roger emphasized how this teaching approach was meant to instill pride and effort in students: “His approach was to [encourage students to] do the work well and if something should be done, it should be done well, and you should get out of it everything that you can and everything that you want to.” While frustrating at times, participants appreciated the teachers’ intentional back seat approach to the students learning.

Participants remembered the teacher’s defined role as specifically pushing the learning and decision making back to the students. Andrew underscored how the teacher/student relationship was premised on student ownership of the learning process: “So the [MPS engineering] program was formed by John Walton and his mindset. The way he sees it as instead of really teaching you, you teach yourself, because you are your own best teacher, which I really liked.” Roger also noted his teacher pushing ownership of the learning products and processes back on the students: “That sort of thing was always encouraged in the classroom. If you had a story idea and you wanted to do something, pitch it to Collins, and make it work.” Ellie was floored when the journalism teacher gave her the keys to the journalism website:

> [The teacher said], “I’ll give you the password to get into the backstage of the website you can play with it and then when we get closer to school we’ll start locking in a design and you get to do the whole design it's all up to you.” He'll approve it, give advice, but its whatever I wanted it to be.

Sydney also found advantages to the teacher/student relationship: “I thought that the way he interacted with the students was very beneficial because he was always willing to come over and help you but was very challenging, because he really wanted you to figure it out by yourself.” She also realized the teacher’s behavior was intentional and part of the pedagogical plan:

> So a lot of times you knew he knew the answer, he knew what you had to do, but he knew that you would learn a lot more from figuring it out yourself. So he would give you hints but he wouldn’t really tell you what to do.

The ownership and independence the journalism and engineering teachers intentionally fostered in their classes made their students feel more grown up, mature, and responsible. Students recalled how they felt a tremendous adult level of respect between teacher and student. Caroline said, “He saw us more as adults than most high school teachers do because he said we could solve our own problems.” Katherine also felt like she was on the verge of adulthood:

> I think in the journalism class, you felt very much like his equal in a way. I think because we were all working together to create the newspaper every week. It had to be done. In a way, that very much empowered you to ... take ownership of your work and it made you feel more passionate about your work.

Johanna pointed to her feelings of maturity the moment she linked herself to her teacher on Facebook:

> Being able to become “friends” with Collins my senior year was such a moment for me. He's not supposed to, but because we had the [journalism] group on Facebook we were the ones able to friend him; it was so cool. For journalism it was working as equals to better the story and make adjustments. I was learning from him, but I was also working with him on the paper.

Benjamin explained how the collaborative nature of the student/teacher relationship spilled over into other areas of his life. Their mentorship and friendship expanded beyond the classroom:

> Mr. Collins wasn't a traditional teacher, because it wasn't a traditional classroom setting … I felt like I was collaborating with him. Having a collaborative environment like that was the only class that I did that … I asked him for advice all the time on things and really trusted him. I also felt like he trusted me. Having that trust of an adult as a young adult who's exiting high school and going to college was definitely unique.

Former engineering and journalism students spoke of how creative freedom was specifically inspired and encouraged by their teacher. Andrew recalled preparing for an international competition: "He taught us to think of every possible thing that could go wrong. Because when you're traveling to Istanbul, and our motors break—you have to bring four motors and think of every possible situation that could arise." Ellie credited her journalism teacher Mr. Collins for fostering her cognitive freedom: "It was just so great to be able to work with him [because he] … let my creativity fly." Lauren similarly credited her engineering teacher Mr. Walton: "He really let us run wild and let us do whatever we thought would get us to that solution."

The teacher's methods and relationship with the students were what make all the other elements of the applied learning environment function properly. Participants outlined how the teacher fostered independence and creativity through the development of complex open-ended problems. The teacher connected the students' learning to the real world through the development of real world products and performances. And, the teacher created the environment where students had to learn to collaborate and communicate with each other to complete the challenges in front of them.

These seven elements of the applied learning environment created an incredibly meaningful experience for the students I interviewed. From their perspective, these classes had a long lasting impact on their future successes in navigating college, career, and life. In

the next chapter I turn my attention to the enduring effects of the MPS engineering and journalism programs.

CHAPTER FIVE: ENDURING EFFECTS OF APPLIED AUTHENTIC LEARNING

Journalism and engineering students emphasized their experiences in applied learning environments were interesting and exciting in their own right, but those learning challenges also had an enduring impact on their formation as lifelong learners and employees. To answer the second part of my research question (i.e., How do students describe the enduring effects of learning in these environments on their success in college, career, and life?), I organized my interview excerpts into themes uncovering common, enduring positive effects of their experience.

In this chapter, I discuss four key enduring effects these applied experiences had on the students: (1) a greater degree of cognitive and personal autonomy, (2) an appreciation for empowering relationships, (3) self-discovery, and (4) a sense of purpose. In the following sections, I define each enduring effect, and then share participant stories reflective of those effects.

Autonomy

Autonomy is the feeling of self-governance and freedom from external control. According to 12 participants, journalism and engineering empowered them in ways their traditional classes could not. In fact, participants described these applied learning environments as increasing their sense of autonomy and ownership over the academic content, and giving them control over the selection and use of various cognitive processes to learn and to engage in activities and projects. Autonomy manifested itself in two main ways. First, students said they felt in control of decisions regarding their learning. They experienced significantly more choice and voice in the minute-by-minute progress and direction of their learning. Second, students experienced for the first time in their

academic career, the teacher and the learning environment allowed and encouraged them to unleash their creativity. Students engaged in applied learning explored ideas with increased intellect and creativity more typical of researchers, inventors, and/or artists engaged in discovery and creation of original work.

Andrew and Jack explained their autonomy in the applied learning environment set them on a path of being more creative. Andrew credited his time in the CET class with future creative endeavors: “I [now] have my own inventions and this entrepreneur mindset. I base it off of CET. Here's a problem. How do we solve it? It’s an open book, and thinking outside the box.” Jack explained how he now embraces and trusts his own creative thinking: “I think part of what the CET system taught me was that you really do have to figure things out yourself.” Participants valued the personal freedom to create something new and the latitude to bring divergent thinking into a classroom setting.

With autonomous success in creative problem solving, confidence soon followed. Journalism and engineering students emphasized the development of confidence in their abilities and in their potential for continued academic advancement because of the embedded sense of autonomy. Confidence is the ability of an individual to believe in one’s capacity to achieve. Applied learning at MPS appears to have given students early exposure to unique opportunities to develop confidence. Ann was amazed and thankful to have been given the opportunity: “It’s very overwhelming … to be exposed to that in high school rather than in college … [It] sets you up for success and gives you … more confidence when you’re thrown into those situations in the future.”

Frank remembers the confidence building as they competed against universities and technical colleges in a robot competition:

> We were by far the youngest group competing with the least experience. I think when we started holding our own, and beating them it may have been one of the first times I realized that you should be able to bring a certain level of confidence to underdog situations. You are not necessarily as outmatched as it may initially seem. I think to a certain level, it may have given me quite a bit more confidence to attack what seems to be impossible.

Benjamin explained how he approaches similar situations now: "I'll go into the newsroom even though I'm not writing stories now, [and] I enter with more confidence. Since I was part of something I felt ownership for, anything I work with [now] I come with that same attitude." Matt remembered one of his first assignments to interview a professional athlete and how he now revels in the opportunity he had to build his confidence: "It was definitely a growing up [experience] … I talk to a 6'5" 250 pound dude who's playing in the NHL. So that was definitely one of the biggest learning experiences for me doing interviews and communicating with people."

For some participants, public acknowledgement of the work they did helped boost their confidence. The collaborative and open environment of engineering and journalism helped make public recognition possible. Roger remembered the feeling of successful autonomy: "That [article] is your own thing, you did that, it was sort of acknowledged as a good idea by your peers and your teacher and the rest of the school. That was definitely cool." Ellie remembered watching the confidence of a shy peer of hers grow over the course of the school year:

> She took control of the whole thing and she really proved herself … and we were like, "You go, girl." I think her confidence really shot up. She was pretty shy … I don't think she had a lot of friends in the class the beginning of the year. As she slowly gained the respect of the editors and of Mr. Collins, she began gaining the respect of the other writers and she became someone who other people started turning to. All of a sudden she was speaking up so much more in class … she was voicing her opinions and throwing out ideas during brainstorming sessions and I think you really could see just a change in her confidence.

Matt remembered the first article he ever had published: “And it is really yours, it really is you.” Likewise, Danielle recalled the satisfaction and confidence in handing out the finished newspaper to her friends and family: “I certainly had a strong sense of pride in the finished product and the process that we took to get there.”

The confidence and autonomy engineering and journalism students felt were different than and distinctive from their traditional classes. Participants made several comparisons to their standard courses. Caroline said,

> I think it gave me more confidence in my own ability to think. In traditional classes, you're very much following the formula. It’s prescribed for you. The way you think is just like everyone else because you have to get the answer the teacher wants, not how you want to answer the question.

Ingrid concurred how confidence building in an applied learning environment is of a different quality: “I think it made me confident in an actual skill. Its one thing to do well on tests and have that be a measure of your performance or give you confidence in that academic department. It’s another thing to have confidence in a skill like writing, and see your progress.”

Confidence often enabled the learner to try new things and take on new challenges. Self-efficacy became cyclically self-fulfilling. Participants offered examples of how their confidence built in high school impacted them later. Benjamin stated, “Even going into job interviews, I'm much better at asking questions. Journalism gave me a sense of confidence.” Jack expressed, “It definitely made [me] more confident to just try new stuff and try new things.” Roger attributed his success at securing a new opportunity to the confidence developed in high school journalism: “Even applying for this internship, I applied in two weeks and I was just like, ‘I'm going to do it’ and it worked out. That was nice.” Benjamin related how the confidence he developed in high school journalism now

allows him to persist when pursuing a goal: "I appreciate it more and am more willing to do the hard work or the trouble shooting or figuring out how to do something."

Many of the journalism and engineering students characterized their learning in these applied classes as continuous improvement and development rather than as static, one-time successes or failures. This sentiment is consistent with developing a sense of autonomy. In a traditional class, once the letter grade is applied to the test or paper, the class moves on to the next topic. In the applied learning environments at MPS, there was an expectation the product wasn't done till it met a standard (e.g., the robot completed the task or the story was publishable). Continuous effort is seen as normal and expected to produce achievement, and failure is a natural part of growth and accomplishment in a setting promoting autonomy.

Former students explained how their work in journalism and engineering was an iterative process. The path to learning for these students had shifted from a set destination to a never-ending, self-paced exploration. Andrew summarized it this way: "It's not an end point, its part of the journey. The whole point of school is to learn. To screw up and know you really do know it though. In CET if I screwed up on something I had time to prove that I knew it." Sydney related how failure become a natural part of the iterative learning process:

> You can't be set on what you think the final prototype is going to look like at the end, because it's probably going to look a lot different because you keep learning things throughout the process. I think CET really helped with that … if there was something wrong with your design Mr. Walton would just take it and would tear it up. He was like, "You just have to start over." This one was a failure.

Matt appreciated this iterative process as compared to his traditional classes and credited it with having an impact on him for life: "I would learn things as I went through

the process instead of learning things in lecture. I would learn a lesson or like a skill

through actually doing it." Andrew emphasized there is no final destination in true learning: "In CET you were never done, you could always keep improving. In [traditional] classes you ace a test and you're done, but in CET you could see how to do better." Usher explained how he has taken the iterative learning philosophy into adulthood while in medical school:

> If I get lesser markings on my final exam or my final grade for how I didn't present my patients in the correct way, I'd take that as a learning experience and move on. I don't get down on myself necessarily or anything like that, so it's helped me. It's been a foundation and continues to be really important. It's worth everything.

Participants talked specifically about the intrinsic value and benefits of building failure into a learning environment. Understanding failure as a necessary, fruitful part of learning was something participants carried forward after high school. For Ellie, failure was part of the writing and editing process: "Maybe we make a few mistakes and problems come up, but it only made the final product better." Usher talked about his current work in the biomedical device field as he remembered valuable lessons learned in CET:

> There is no progress without failure in anything and in any kind of technological advancement or any advancement in medicine or anything. People have tried and failed so many more times than they've succeeded and just to keep that in mind as you're working towards something to understand that maybe it's not going to work this time or maybe it's not going to work the next 99 times, but the 100th time is going to be pretty when it does work.

Jack really appreciated the failure built into the classroom activities but knew it was a shock to some students as they moved from a traditional classroom setting:

> The whole idea of the class was to not be afraid to try stuff. I think for most students, being in an environment where we're mostly graded on sitting in a classroom and taking tests, it can be hard to do trial and error because a lot of people think that, "Failure is just bad and that affected my grade." Because that's the assumption, but it is a very different way of learning."

The autonomy these iterative applied learning challenges created, along with failure, helped students have convictions about how to approach life. Benjamin declared, "It emboldens me to take more risks because I was in this environment."

An important component of autonomy is recognizing one's personal effort and dedication as a key part of the formula for growth and success. Ellie explained her understanding of this concept:

> Dedication over skill because working hard you can learn to get better at something rather than being naturally talented. Some of us can't do math but that doesn't mean that you are the worst … you can still learn to function just as well, maybe better, than anyone who is good at it.

Benjamin explained the independence helped him stay organized, "I have more confidence in my ability now to get things done and make my own schedule and goals."

With a greater sense of autonomy, participants communicated how their personal ownership and responsibility could flourish. Andrew took personal ownership of his learning through quality questioning and defining the problem to be solved: "Part of problem solving is knowing what the problem is … He shot that into us. He said … once you have a good understanding of what the problem is, you can solve it a lot better. He'd say to write down what you did wrong." Andrew went on to explain how this has become a lifelong lesson: "I do that to this day. I write down what I tried and what didn't work, and you never do it again and it saves you frustration from making the same mistake twice. I really like that."

Autonomy was a life long benefit reported by participants in MPS engineering and journalism. They expressed feelings of competence and confidence in college and career. They communicated their increased ability to persist through failure as something cultivated through their applied learning experiences. And, they explained they had a

greater sense of personal ownership and responsibility for the work they do. Next, I describe how MPS high school engineering and journalism affected their sense of positive relationships.

Empowering Relationships

While the empowerment participants communicated was in part based on the curriculum design, it was equally based on the formation of relationships fostering collaboration and ownership. Students outlined several ways in which relationships were key to their positive, empowering experience and the enduring effects they took with them beyond high school. Collaboration and shared responsibility between students were fundamental elements for several. For others, the relationship with the teacher became a key factor in the strength of their experience. The chance to hold leadership positions and hone those skills mattered a great deal for several of the participants. Finally, students perceived there was, by design, a cooperative nature to the way the programs were conceived making the students feel like they were equal, respected individuals in the classroom. In this section I share the stories of twelve participants as they relate how the collaboration and relationships they experienced left a lasting impression on them as they entered college and career.

Engineering and journalism students found value and purpose in the teamwork and a sense of belonging amongst their peers. Ellie explained how the teacher helped create the feeling of belonging: “Mr. Collins was there to encourage brainstorming and to encourage team bonding and to encourage peer learning.” Sydney remembered the energy generated through a sense of belonging and how she now looks at group dynamics as important in her life:

> I think that it was a really cool collaborative environment because a lot of [the problems] were just thrown at you and everyone is learning the same program at the same time … And it really lent itself to helping other people because you would be ahead of them and you would be, "Oh, no, this is really simple. You're overthinking it. This is how you make this piece" or whatever it is. I really like that because everyone was frustrated with it, but everyone was learning it at the same time and I thought it was a really cool way to learn something as a group."

Danielle recalled what it felt like to deliver the newspapers to her classmates: "[I remember being] a part of a team that was delivering these papers. I think there was a lot of [group] pride associated when we distributed papers during homeroom." Benjamin gained a sense of group responsibility he now tries to foster in his new work and school interactions: "I didn't feel like I could leave my team in a lurch like that. That really comes from me valuing the relationships ... with a close group of students at MPS fostered by journalism."

Ellie recalled how the sense of belonging to the group fostered in journalism helped create a respect for the individual: "I think what journalism really lent itself to was that everyone had a voice." Ann reminisced about one of the most important aspects of her experience that became a critical take-away: "I think it comes back to very fundamental things like teamwork and just the [collaborative] environment." Benjamin realized the incredible gift the group environment gave him: "I fostered friendships with people I probably wouldn't have been friends with otherwise."

Participants not only valued the good times related to collaboration and teamwork, they also gained a lifelong appreciation for the work those relationships may require. Participants made connections to the challenge of navigating relationships and communication in the real world. Andrew said, "That's how the real world is, you will work with annoying people, lazy people, and you have to find their skill set and utilize it." Ann

made the connection to how real life is more collaborative than a typical classroom:

"You're just taking tests all the time or you're working independently. There's not as much group activity and like even in my job, I think that's just not, it's just not realistic." Ellie learned the lifelong lesson about how her decisions could impact others: "It really teaches you a lot about responsibility and making decisions that affect everyone."

Participants recounted their realization and appreciation of collaboration as an important real life skill. Frank stated, "You ended up forming natural learning communities I think and natural work groups. I think it was much closer to how you are going to have to learn and work in the outside world." Andrew concurred, "In CET, from day one, you go with a partner and work with them. Till you graduate, you are always working with someone. That's how the real world is, you are always working with other people."

The teacher to student relationships in journalism and engineering also allowed students to experience autonomy and a sense of ownership. Participants absorbed some important lessons about the nature of shared leadership and democratic, cooperative settings. Johanna compared the cooperative nature of her applied learning experience to more traditional classroom:

> But in a normal classroom there's more all-commanding power of the [teacher] making decisions and things … but the big difference is being able not just to learn with your [teacher] but to work alongside them. That's a huge distinction and I think that's the line Collins walks with journalism. He didn't just tell us how to write a story and how to structure it … It wasn't him saying that this is how you have to do it … it was a discussion between me and him as an advisor, not me and him as a [teacher].

Frank sharpened his sense of personal responsibility and accountability over particular engineering concepts. He attributed this to a very intentional teaching strategy in which the relationship was meant to foster independence:

> Walton definitely commanded our attention and commanded our respect, but at the same time I think that he was not always necessarily present with you during your learning. You can look at that as an uninvolved and inattentive teaching style, or you can look at it as an even more interesting teaching style in the sense that it is teaching you to really hold yourself accountable and responsible for your learning.

Participants stated their respect and enthusiasm for their applied learning experiences found roots in the pedagogical methods and the teacher relationship, equal to or greater than their love for the content. Ann talked about her collaborative relationship with her teacher explaining, "He had a unique approach to things that definitely resonated with me and made me interested in the idea of engineering. I don't know if it was the content of the class or more the delivery of it."

Dewey (1938) argued the educator is responsible for creating a cooperative social control, promoting participation and community activity. The learning environment may either leverage authoritarian forms of control (as many traditional classrooms do) or may promote democratic, cooperative forms of social control. Participants in the engineering and journalism programs at MPS indicated the applied learning environments were designed for the latter. This cooperative social control further developed their understanding and appreciation for collaboration and positive relationships.

Former students suggested cooperative social control simply was about establishing a culture of students learning together. Sydney explained how the teacher expected the students to rely on each other:

> [The teacher would say], "Don't ask me what the answer is if you haven't asked the people around you." So I think a lot of it is just the environment. It's not like a quiet class. You don't go in there and people are quietly working with their robots and at the computers. Usually you're talking to people and partners are chatting with each other and talking to people across the room. So part of it is the environment and part of it, I think, was explicitly encouraged by Mr. Walton.

Ellie expressed joy in working in a cooperative, democratic setting: “I loved working with younger kids … ‘what do you guys want to do’ … ‘maybe we could change that a little’ … Thinking critically like that was such a good life skill—working with other people.” Andrew described a “we’re all in this together” sentiment: “Sometimes you have to start over from scratch and maybe collaborate with other teams and make another robot. The end goal is an international robot, so in the end we're all on a team.” He compared this to feelings he had in more traditional classes: “It’s not a class where everyone's fighting for the A; I liked that it wasn't like that.”

Katherine explained her greatest learning in journalism was not writing but navigating her new found independence, leadership, and relationships:

> I was always a little more shy, so being the editor-in-chief of the newspaper and being told that this has to be done every week and these kids are your peers and you have to tell them what to do. That was extremely challenging for me, especially when [Collins] decided he was going to remove himself from the classroom and really only be there if there was an emergency. It was amazing because all these students and juniors and seniors, we go to classes together and we’re friends, but here we had to figure out a hierarchy and tell each other what to do and it was an ambitious thing for us to do. Figuring out how to deal with different people and those relationships was definitely a learning experience.

Many of the participants experienced the thrill and difficulties of real leadership for the first time in their lives. The opportunity was both exhilarating and challenging. Participants spoke about the feeling of being in charge and what it meant for their relationships. Ellie recalled, “So all of that decision-making was really great and I loved the leadership and being able to call my own shots.” Similarly, Ingrid felt a strong sense of leadership:

> Being a writer and then senior year being in a position of leadership, it creates something you're responsible for which contributes more to developing those skills … not just academic skills, [but] those out of the box things like responsibility and accountability and learning to lead people.

Benjamin explained how his leadership in the MPS applied learning environment carried forward into his later experiences: “Anytime now that I have to put my name on something that I do for any other group, I take that more seriously. Because of that, I'm a better part of a team. I'm a better leader or manager.”

Participants realized being a leader isn’t all fun and games; leadership comes with challenges and frustrations as well. Katherine remembered how difficult it was to navigate sometimes, but she nonetheless appreciated learning these life long skills:

> It was a weird experience for me because I had to figure out that I like this person day to day, but she was driving me crazy in this class. We're not working well together. That was a huge learning experience for me because I had to figure out how to talk to her not as a friend but as someone that I needed to work harder for me. That's totally different in high school. I guess on a sports team you rely on a teammate, but we had to go through this back and forth of scolding each other in this professional setting.

Matt also experienced complex feelings about his role as a leader. He took his role as editor very seriously and wasn't always sure how to manage his staff: “So I didn’t want to be like a jerk to her. But at the same time I expected her to get her stuff done.”

The joys and struggles of leadership allowed participants to learn the skill of striking the right balance when working with colleagues and friends—something they have had to do many times since they left high school. Participants recounted moments when they had to develop poise and empathy in their leadership decision-making. Ellie explained, “It really teaches you a lot about responsibility and making decisions that effect everyone.” Matt shared his calculation: “[When] I have a leadership decision where I’m going to need find that balance, I was strict enough where people stay in line but loose enough for them to like me.” Caroline related the balancing act to strategically engaging different colleagues to get the work done in her current job:

> I can find someone who can fulfill that role and do the in depth stuff and I check their work. That's the type of engineering I want to do, where I'm designing processes and I come upon people in their strengths to fulfill small or precise or more defined roles.

Frank also looked at the leadership he learned at MPS through a delegation lens: "In a certain sense, … exposure to delegating project resources and breaking up project tasks … made me more inclined to do project management or leadership on a project with the confidence to delegate." Ingrid felt she learned some important lessons about the nature of strong leadership: "I remember it teaching me valuable experiences about how leadership is less about telling people what to do and more about being a listener and figuring out how to inspire people to do what they're responsible for."

Participants also looked at leadership as an example of servant leadership. They felt their role as leaders was to help the younger students progress and develop. Johanna said, "It wasn't just me feeling that the paper was my baby, but [I] also wanted to get the sophomores ready to be where I was. [I] wanted to prep them and work with them and collaborate with them." Danielle had a similar experience: "It was kind of a feedback system where upper classmen could assist in some of the issues that we are having. As you learn and went forward, you'd kind of pay it back to the people who are learning." Ingrid discovered how leading by example was effective for her: "The way I got people to care about committing to the group was to show my commitment and make it fun and enjoyable for the people there so that they could decide that it was something they cared about."

The creation of empowering relationships was a key enduring effect participants carried with them beyond high school. Participants learned the benefits and challenges of collaborative environments and the complexities of leadership. Participants also discovered ways in which relationships may facilitate learning, growth, and achievement.

Because their engineering and journalism programs offered a departure from traditional learning, participants discovered a great deal not only about relationships but about themselves: their strengths, challenges, and beliefs, in other words, self discovery.

Self Discovery

For high school students, about to head out into the world and take one giant step away from parents, self-discovery may be one of the most important and meaningful contributions an educational environment can give. All sixteen of the study participants expressed learning something important about themselves they have carried with them from their time in the MPS applied learning opportunities. Some found a passion for topics or work they had not realized before. Some discovered personal beliefs about learning, relationships, or personal character that helped shape their identity. All sixteen recognized how previous experiences like journalism and engineering could impact one's approach to future life endeavors. In this section, I explore participants' stories of how they discovered something about their skills, beliefs, or passions.

For some participants, their engineering or journalism class was a direct conduit to a future career. Ann reflected on her time in engineering and realized it was the beginning of her career calling: "And I think that it gave me kind of like that guidance through class, 'Look, I really like this. This is something I'm passionate about. This is something that I could pursue.'" Jack similarly credits his engineering class with giving him direction toward his future: "For those [of us] who were serious, [we tried] to use the building blocks [of class] for potential career field in engineering." Johanna realized later how profound her journalism experience had been: "Looking back, … I think it's cool that as a

high school student, I had the ability to engage in these professional things that I didn't even realize I was engaging in at the time."

Ann saw her high school applied learning class as having the ability to see past college: "I would say it was much more almost real world if you think even beyond college into like the different areas that the people move into." Usher revealed his MPS engineering program was the launching pad for his future career: "[I was] very appreciative of the experience because [as] I look back on the experience and remember things … there's no question that it was a catalyst for what [I] went on to do."

Finding something academic to which to attach the word passion eludes most students in high school. Participants in the MPS engineering and journalism discovered a variety of energy and enthusiasm through their courses. Ellie felt fortunate to have found a strong affinity to her applied class: "I was lucky enough to find my passion in journalism and I know people who are maybe more math and science heavy were lucky enough to find it in engineering. Not everyone finds their passions in high school classes." Katherine explained her passion for journalism was a natural and meaningful fit:

> That was the one class that I really felt passionate about and wanted to go to everyday and felt like I was doing something worthwhile. I always really put myself into my work, I always got good grades in every class and got along with my teachers, but I never felt I was doing something unique to me [except in journalism].

Some participants characterized their passion for journalism and engineering through their expressions of interest for the content or processes they were able to experience. Roger remembered,

> I do not really focus on work that I am not passionate about and a lot [of] that stems from journalism. Once I get interested in something, I become fully invested in it and I really want it to be a great product, this thing that I am creating. Whereas when something uninteresting is provided to me in an uninteresting format, I sort of write it off.

Similarly Frank expressed his interest in the engineering processes: “I think my passion was probably mostly with the overarching concept that we are going to design/build in here and understand concepts.”

For Danielle, passion came from the topics she was allowed to write about: “For a writer, success is, ‘This is a story that I'm interested in. I feel inspired and I feel passionate about this topic.’” Johanna remembered not only feeling the enthusiasm herself but also seeing it in her classmates: “The ability to take something you'd be genuinely interested [in] outside of the classroom and applying it to a classroom setting. The passion of doing it. You could see it in people.”

Having a passion for something often provides a joy and lightness, keeping the task from feeling like work. Ellie summarized her memory of her enjoyment of journalism: “And [when] following your passions … you work hard at something [and] you want to be working hard [so] it doesn't feel like work.” Roger looked back at his experience and realized how much extra work the program involved, but he remembers not caring about the extra effort: “The journalism program worked because everybody who was a part of it was pretty passionate about it, it was engaging, and it was actual learning.” Jack remembered the effort it took to succeed in building a working robot: “We really worked hard through a lot of the stuff. We did take it seriously. We did have a passion for this and the teacher noticed.”

Participants expressed how journalism and engineering classes provided “ah-ha” moments. They either discovered them when they were engaged in the applied learning environment in high school or later, upon reflection. Some of these self-discoveries were

about one's character and personal growth, and others were about one's beliefs. Jack felt his path to maturity received a significant boost in engineering class:

> You obviously become more independent. The further in life you go, you need to learn to be resourceful and patient, know your strengths. You have to have self-awareness and figure it out for yourself. That's what life is like.

Usher recalled engineering helped him in his relationship skills: "I learned that you can't force other people to operate the way you operate, but you can use certain behavioral things or offer to help them." He elaborated on this cooperative mode of leadership: "You can position yourself more as a peer or someone in a supporting role than a leader so I was able to use that a bit more effectively and I was able to learn from that."

Caroline gained confidence in adult communication skills and expressing her beliefs: "You have to voice and defend your ideas, but also listen and admit when you're wrong … there's a lot [that I learned about] my personality and my character growth and learning to be able to do that." Sydney also developed a deeper understanding of collaboration skills and techniques:

> You really do understand that someone else's idea could be better than yours or someone else's idea could be necessary to your success. I think that is a really helpful thing to understand. Right now I'm in a class that literally is a group project. If you're willing to hear other people's ideas, and if you're willing to delegate, to trust other people with work and to say, "I know that you can do a good job on this and I don't need to be watching you do it the whole time" then you are going to be a lot more successful and you are going to get a lot more done.

Jack spoke of his character growth, reflecting on how CET prepared him for future jobs: "I think almost any job … requires patience and focus because challenges are going to come up and it's just inevitable. You have to have resilience to know that challenges are difficult and you have to get through them."

An applied learning experience in high school brought into sharp focus different ways of looking at the world. Because it differed so starkly from what they had experienced in standard classrooms, many students began to critically examine and reflect on educational systems. Roger talked about his frustrations with typical grading in schools:

> This G.P.A. worship, the compulsion to achieve the highest possible number, rules and subsequently ruins education. It is the pursuit of the number that compels teachers to simplify material to protect student grades, that causes students to cheat in order to dominate their massive course and activity load, and that places creativity and independent, critical thinking behind impressive results.

Caroline also reflected on grading: “School is a game -- if you learn how to play the game you get a good grade. It doesn't really matter what you think as long as you think on paper like the teacher thinks.” She went on to differentiate her applied learning experience: “Whereas in Mr. Walton's class, it gave me more confidence in my own thinking and saying what I think with this engineering problem and how I want to solve it actually works. I can voice my own opinions.” Ellie reflected on traditional classroom methodologies and expressed her belief about how learning environments could improve:

> I think especially in the traditional school environment: teacher, classroom, lecture style, - there's so many rules and this is how you read an essay and this is how your sentences should look and this is the kind of storyline you should follow or even - this is a math problem - this is science - this is right versus wrong. It's so binding I think.

A few participants expressed their initial apprehension to the new way of learning in an applied environment. For Andrew, self-discovery emerged when he got beyond his initial nervousness:

> To be immersed in it very quickly, you're not thinking you really like it; you're thinking it’s not quite right. Where's the structure? You're out of your comfort zone. But then you get it, it really clicks and you realize you can teach yourself

better than a teacher can teach 31 students. I thought it was great that we were able to learn like that and that I realized that's how people really learn.

Dewey (1938) posited a unique aspect of the human species is our ability to make meaning of experiences and carry them forward to inform future decisions. Students in MPS's journalism and engineering programs identified many examples of how their time in the applied learning environments prompted self-discoveries helping define their college, work, and life experiences. They expressed gratitude for how applied learning prepared them for a confident, independent, collaborative future.

One way in which the engineering and journalism students carried their self-discoveries forward is in fostering of relationships. Danielle explained, "[Others] think very differently and you need to be able to relate to them and also that there are other perspectives out there that need to be considered. I think that's something that I put into practice now." Usher talked about how he is much more confident about relying on the strengths of others and not feeling like he has to know all the answers:

> [An important part of] problem solving was if you couldn't figure it out yourself, you could always go to somebody else who may know. That's definitely come through so much with [my] start up activities [now]. The first thing you have to know is that you don't know so much.

Participants also explained how they carried forward self-discoveries about their creativity and persistence. Jack said, "Like last year, our robot crashed three times and we learned from that. The trial and error is part of life. We have to accept that it's not a bad thing." Andrew talked about how current colleagues are impressed with his creativity: "There were lots of times in the class you'd do something outside the norm and it'd work and people would follow you. I do that at work [now] and people say, 'Wow, that works?' Ann could clearly see her innovation skills learned in high school showing through in the

work place: “And I think it’s been that thinking of things differently that’s allowed me to probably be more successful in my two roles that I had since school.”

Some participants carried forward elements of their character, such as work ethic, confidence, and composure uncovered in their applied learning class. Johanna explained, “I feel that I do consider [journalism] to be a formative experience that helped me shape my work ethic.” Benjamin described his applied learning as a testing ground for who he would become: “I trust myself more … Having a structured environment to try that out was really nice and I have more confidence in my ability now to get things done and make my own schedule and goals.” Ingrid also saw her high school journalism experience as a rehearsal for what was to come:

> Its kind of like we had mini jobs. You could almost think of it as your first job in a way—a practice job. You were interviewing people in the real world, not just students but business people and people in the community. It demanded a level of poise and professionalism to be taken seriously. That's something that I've carried through.

Danielle attributed her job proficiency to her independent, empowering experience in high school: “So that sense of accountability and ownership is something that has made me really successful in what I do.” Frank felt the applied learning exposure did not just help him in his career but in other arenas:

> I think that has carried over in every aspect of my life for sure, just from wanting to learn more. It is not with just engineering. I am actually less interested in engineering concepts than I am in a lot of other things, but it certainly carried over into what I want to learn in other aspects of my life.

Katherine thought about several of her friends taking the applied course with her and noticed a pattern worth sharing: “It just happened to turn out that a lot of these people are very motivated to take big risks in their professional life and I think that was something we were doing in that class.”

Participants also reported they felt simply more prepared for the world because of the skills and attitudes gained through journalism and engineering. Ingrid felt the skills she learned prepared her for life beyond high school: “When I say skills I don't mean writing skills, but noncognitive skills like problem skills or creativity or leadership, skills that you see as direct translations from journalism to college.” Katherine connected her learning to a broad sense of preparedness: “This gave us more purpose. We knew we were learning something that would equip us for our futures, regardless if we went into journalism or not.”

Understanding oneself is a lifelong journey. Participants reported benefitting from a strong head start on that journey because of their unique applied learning experiences in high school. A better understanding of their strengths, passions, and beliefs impacted their decisions about future schooling, work, and life. Participants also indicated an enduring effect of their journalism and engineering classes was a sense of purpose.

Sense of Purpose

Participants in the study linked their motivation, effort and persistence to the value they perceived in their applied classes. This value, or purpose, came in three forms: (1) a direct application and connection to the real world, (2) a sense of service to others or benefit to the common good, (3) an interest in the engaging activities and content. In many of the students’ traditional classrooms, a sense of purpose was hard to find. Teachers often hear “this is boring” or “when are we ever going to use this?” Former students in MPS’s engineering and journalism programs identified many ways to find purpose in the programs’ academic work. In this section I share the stories of fourteen participants as

they reveal how they found a sense of purpose as an enduring effect of their engineering or journalism classes.

Participants reported a sense of purpose from just knowing what they were doing would translate to their life outside of school. The question, "when are we going to use this?" was never valid. Ann expressed the realization of how the content and processes of her applied learning class have endured:

> It has been gratifying later on to think of things that you can remember from high school that have stuck with you rather than just like your really basic math class or things that kind of go in one ear and out the other after the test.

Benjamin also compared his applied experience to that of his traditional classes: "In all my classes I read a lot of papers and books and incredible books of academic writing, but I never felt that I got a tangible skill [like in journalism]." Frank explained how having a physical product helped with feeling a sense of purpose: "To a certain extent you are producing something tangible, physical, something that you are actually going to see executed and used and impact other people." Katherine also indicated a sense of purpose through real world application: "You created this little business, and in that way your interactions were very different than in other classrooms and outside of school. I felt it prepared me for post-college and dealing with people in a work setting."

Participants found journalism and engineering gave them purpose through a new understanding and appreciation for making the world a better place through their personal character development and by working for the common good. They felt this purpose through (1) an appreciation for the unique talents and gifts of the people with whom they collaborated, (2) a sense of responsibility to care for creation and the people in it, and (3) a duty to take responsibility toward solving the world's problems.

For some, a sense of purpose was found in their new appreciation for their own and others' gifts. Caroline said, "The first thing I think of is with those teams. You learn to appreciate people and what they're good at, and appreciate yourself and what you're good at and the gifts that God has given you." Matt agreed, "There is a social justice kind of bent to some of that kind of stuff like appreciating each person for who they are individually." Ann reflected on her personal development:

> It has just impacted my personality and my goals, like who I am which sounds cheesy but definitely more so than another class would. And I think that whether it be skills or whether it be personality characteristics that it instilled in me or developed, I mean I think that it just overlaps into my everyday activities and my nature as a person and interactions with other people and my productivity at work and how I get involved with the community.

Caroline focused on the value of teams and working toward common goals. She explained,

> You need to appreciate your team and yourself instead of competing against them. Recognize the good that God has created in that team rather than making them the enemies. When you are not competing and you're in an interactive environment, it makes life so much better for everybody.

Sydney also found a sense of purpose through teamwork: "I think that it goes towards the faith idea of you can accomplish more together than you can alone."

For some participants, a sense of purpose was drawn from a more developed consciousness about stewardship for the broader world. Benjamin explained he watches the news with a keener eye to understand the truths of an event so he can advocate for justice, "I'm even just a better world citizen. I read the news now … [and] I'm more critical of interviews I see. They just did an interview of Wilson from the Ferguson case … I understand what that interviewer feels like." Stemming from Caroline's passion and confidence in engineering developed at MPS, she expressed her personal desire to make a difference: "For me, my dream is to help solve the question of providing for nine billion

people by 2050, both in terms of energy and food." She explained where this goal originated: "I've seen when what I'm learning is physically applied helps me want to help others, it's not just for a test."

For many of the journalism and engineering students, the problem solving emphasized and owned in these courses made them confident and focused on solving world issues. Frank reflected on his engineering experience,

> It probably got me an awful lot more interested in how I can help people. Whether it is from a teaching perspective or whether it is from a creative solutions perspective. Something like Robo Rescue that we were competing in. The whole concept around that was to develop and build a rescue robot … I did not have the opportunity to come up with creative ways to impact people's lives in any other class like that. I could go to an elderly home or a homeless shelter, and I could hand out food. That is fine … I am not belittling that type of activity, but I am just saying that [engineering] offers a very unique opportunity to truly change someone's life down the road.

Andrew also saw his technical skills as a way to change the world for the better: "So being paid to solve problems, save lives, change lives, do something great. Design a well in Africa, do something cool. You can use science and math to change the world. It's taught me to help others." Andrew continued, "I saw in engineering, I could be a teacher and change lives, or a veterinarian or a scientist or a doctor, … [a] love of science and math and designing, [could bring out] the designer in me and the servant leader in me to really do something good."

Usher also found his math and science skills as a way to work toward the common good: "Technology in general is supposed to make life easier in whatever way that is … at its core, its job and its goal is to build something that makes life better." Sydney also articulated MPS's engineering focus as a good fit for developing a sense of responsibility to the world:

> Because in CET we are working with a search and rescue project; so, conceptually it's always for other people. Because the idea is in a disaster situation these are the types of robots that would go in and help the people to get out of it without putting rescue workers in danger. So theoretically what you're working towards is always there, if you chose to keep doing something like this into college … then you would actually be able to work with this technology you're realizing that there are ways that you can help people through design and through building new things.

Frank expressed learning the problem solving cycle in general helps people to find solutions regardless of whether it is technological or not: "I think it is a very different experience and it allows you to come up with a new way to help people and support people. I do not think I could have gotten that many other places."

Journalism also provided opportunities for students to feel a sense of ownership in creating a better world. Johanna explained:

> You're able to reach out and get the story of lesser-heard communities. I think that's incredibly important because getting those stories out there is what sparks involvement. So I think, by nature of that, the idea of journalism as a means of community service, it's completely true.

Johanna pointed out the connection between communication, understanding and social action: "You can open people's eyes to [different] realities … that they don't understand. That's something journalism can do that you can't get from anything else." Danielle reflected the sharing of ideas might help make a better world: "You're making your community stronger or better in some way when you're sharing information."

For engineering and journalism participants, pure enjoyment was another example of the purpose they felt from their engagement in an applied learning environment. Journalism and engineering students found personal value in the experience in several ways. They reported it provided a sense of fun, interest, excitement, recognition, accomplishment, and interactivity.

For Ellie, this enjoyment translated into a willingness to put in disproportionate amounts of time:

> I know I personally spent five times the amount of time I spent working on homework doing journalism—and it was weird because if I was bored doing my other homework, I would do my journalism homework … in my mind that was like a break.

Ingrid also expressed her joy for journalism: "I loved journalism, it really inspired in me a desire, it was fun and felt real and meaningful." Frank was having so much fun in engineering, he felt he was getting away with something: "When we were goofing off in our CET class [we] just happened to be learning about engineering principles, structures, and things like that as we were doing it." Lauren also recalled, "I remember CET being a lot of fun." She then went on to energetically talk about building airplanes, playing with pulleys and building beams.

For some participants, the personal value came from a cognitive challenge, inspiration, or interest. Usher described "getting a sense of wonder with technology and with its capabilities." Matt too remembered his awe about the unique experiences he had on a regular basis: "I think my favorite part about the class is that every day was different." Ann's love for her class was tied to how it compared to other classes: "And I think that looking back it was probably the most unique class that I had—the one that I enjoyed the most." Frank measured his interest in engineering by relating a story about never wanting to leave the lab: "We had quite a few nights where we would be in the CET lab and I remember our parents having to sleep on the floor when they came to pick us up at like 10 o'clock at night and we did not leave until 2 o'clock."

Former students explained the personal value and purpose fostered through a sense of excitement. Katherine was amazed at what they were capable of: "We were on to

something different and unique for people our age and the industry as we saw it through our lens of local news and what not. We're really excited to be a part of it." Andrew remembered the excitement, thinking about his future potential: "In CET it was really cool to be solving problems and like I said earlier, you could be saving lives. I could use my science and math and that to save lives." The sense of excitement fed the motivations and persistence of participants to want to learn the content and apply it.

Some participants found personal value in specific recognitions and accomplishments. Matt remembered one of his articles being honored: "It ended up winning state for Best Feature which was pretty cool—getting recognized for your work especially when you put so much into it as it's an amazing feeling." Johanna remembered how writing about something of importance and starting the conversation in the community gave her a rush of personal purpose: "The paper becomes so much more important. You're in control of your section and what is published there, but as a writer, if you're able to talk about something you're invested in, it's so awesome. I felt emotionally connected." Usher described the feeling he got when something he personally engineered performed the task flawlessly: "Wow, I'd programmed it to do that."

Engineering and journalism students valued the interactivity they found in their applied experiences. Ann commented on interactive relationships: "There's no question I love the social aspect, the collaborative aspect and knowing that if you're sitting in [traditional] class all day, you're going to have a more interactive class coming up." Danielle said, "I liked that I could write about whatever I wanted and it got me moving around the school and talking to different people."

Roger saw the interdisciplinary connections created by an applied learning environment:

> The concept of blending subjects [together] instead of treating them as if they are separate is important, because honestly if we are engaged in real learning and higher level learning, they are not separate. Everything has elements [of other subjects] and they can work together to create something really cool.

For Caroline, the interactivity and real application of her MPS engineering experience helped her muddle through her lecture-based college engineering courses: “CET gave me a good idea of what engineering was and made me fall in love with it so that I knew to stick through the [boring] classes because I'd regret it two years from now if I don't.”

A sense of purpose was valuable to participants as they forged ahead in their lives. It gave them direction as they decided which careers to pursue. It gave them a greater understanding of what would engage them personally. Engineering and journalism at MPS also gave students a window into how learning may be put into practice to work toward the common good. A sense of purpose provided inspiration to help motivate students in their learning.

In chapter four, I outlined the key elements of the applied learning environment participants reported as important for a successful experience. In chapter five, I summarized key enduring effects for the participants as they advance to college, career, and life. In chapter six, I analyze my data using educational and psychological theories.

CHAPTER SIX: ANALYSIS

Students in MPS engineering and journalism programs clearly outlined elements of the classroom they felt not only differentiated those experiences from their traditional classrooms, but also gave them a unique set of positive enduring effects on their lives beyond high school. In my analysis, I explain how both educational theory and psychological theory support each other in defining how the authentic, applied learning environments in this study developed the four engaging mindsets in former students.

As I analyzed the participants' stories in light of educational and psychological theories, I found there were three theoretical lenses worth exploring, leading to the most successful and meaningful applied educational experience for students: (1) the establishment of foundational educational elements theorists John Dewey (1919, 1938) and Jerome Bruner (1960, 1961, 1966, 1979) proposed, (2) the fulfillment of universal psychological needs as explained by Self Determination Theory (Deci & Ryan, 2008), and (3) the inclusion of "real world" products and performances to create what theorists call authentic experiences (Lombardi, 2007; Newmann, 1993; Van Oers & Wardekker, 1999), autotelic activities (Csikszentmihalyi, 1990), and deep practice (Coyle, 2009).

The seven elements of authentic, applied learning environments and the four enduring effects participants revealed in the data chapters are intertwined within these three ingredients. As I outline the three ingredients leading to the growth of engaging mindsets, I will weave in the data categories and themes. I first set the stage with a growth metaphor outlining the three key ingredients for initial development and lifelong learning success. Then I elaborate on how each of these three ingredients lead to nourishing the

student so engaging mindsets may flourish and become permanently ingrained in a confident, collaborative, life long learner.

Growth Analogy

A tree, as a young seedling, relies on the external environment for proper growth and development. The nutrients in the soil, appropriate amounts of moisture, sunshine, and carbon dioxide are critical for the initial growth of the tree.

Similarly, students initially rely on the external environment, as established by teachers and parents, to begin their growth and development in schools. Adults create inputs of structured learning in the way they set up problem solving opportunities, collaborative activities, and connections to prior knowledge.

As the tree develops, internal mechanisms kick in to boost and accelerate the growth of the tree. The roots reach deep and wide to seek out their own sources of moisture and nutrients. The leaves unfurl and the canopy widens to allow the chlorophyll to capture maximum sunlight. The tree itself now has a substantial and critical role in its own energy production, maximizing its own future development.

Students also reach a junction in their life when their personal agency becomes the driving force behind their growth. The development of key internal psychological strengths such as competency, autonomy, and relatedness (like effective roots and leaves) become the key determinant in an individual's future maximum potential.

The definition of a living thing includes, among other characteristics, the ability to reproduce. A tree doesn't become its full authentic self until it bears fruit. When the tree creates this new product that can be separately experienced by the world (e.g., tasted by other animals or falling off and forming a new tree), it becomes a full and continuing

member of the larger ecosystem. The fruit is not just a sign of previous growth—it is essential for continued growth of the tree species in the world.

Students, too, experience self-actualization when allowed to use their knowledge and skills in deep practice to create products or performances—ones connected to the students' own experiences and/or the real world. Students become their true authentic selves when they are able to pursue their passions and share talents within the culture of the human family. The products students create are not only signs of their previous growth, but also drive their ability to create new growth and engage in life long learning. The confidence students gain applying their knowledge and skills in the real world help boost their ability to reproduce competence in the future.

Each of these stages of growth is connected to each another. If the initial external inputs are not applied strategically and with high quality, it will be hard for the "trees," or students, to acquire and expand their internal mechanisms to become independent in their growth and development. These internal mechanisms help create the conditions to produce. A tree matures enough to bear fruit. A student gains the psychological resources like competency, autonomy, and relatedness to apply knowledge and skills in the real world. This cycle helps students build the engaging mindsets helping them tackle new challenges in the future. Students, having been given the environment, the psychological supports, and the opportunity to creatively produce something in the past, are well situated to become lifelong learners and creative producers in multiple situations as they enter college and career (see Figure 1). They have the engaging mindset "seeds" helping them produce again in the future.

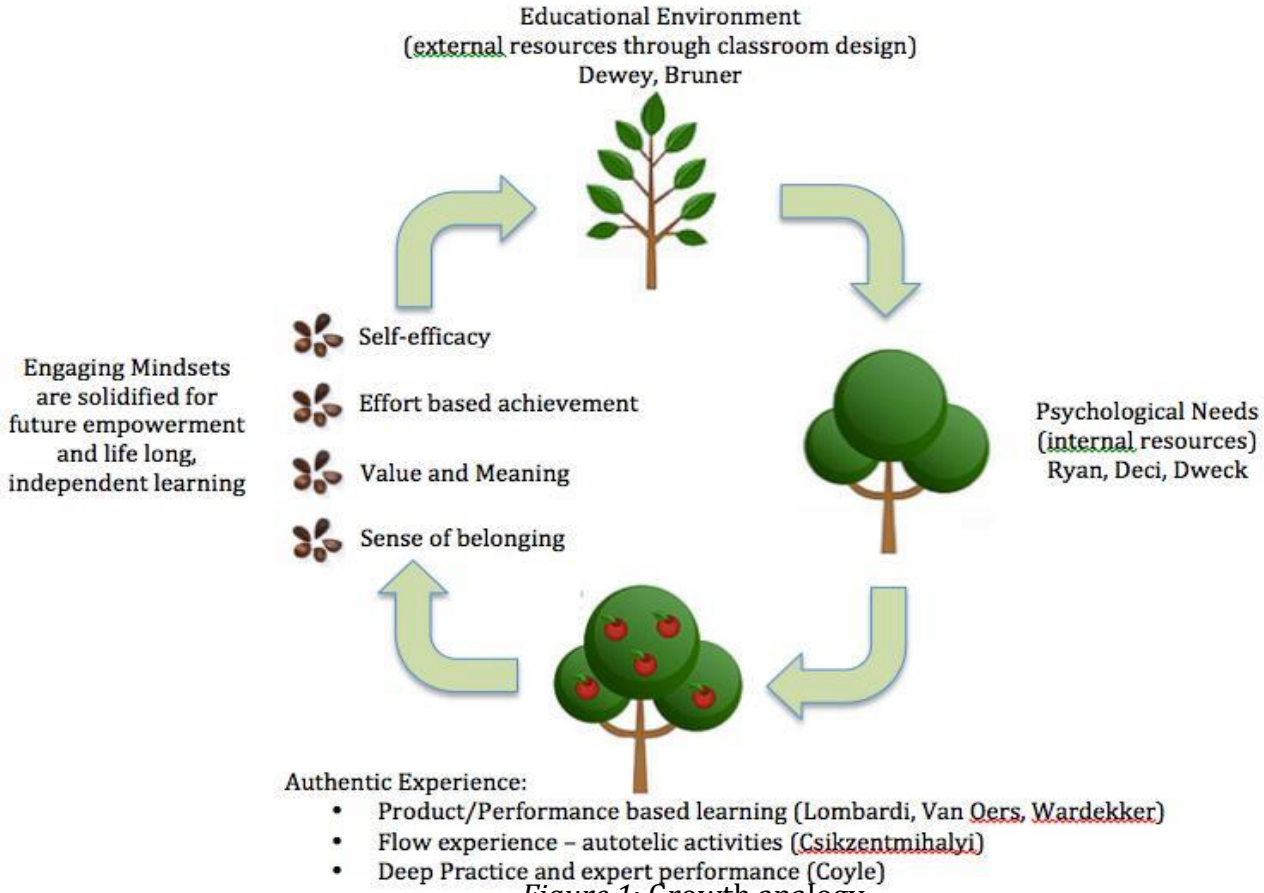

Figure 1: Growth analogy.

Educational Environment

Participants in this authentic, applied learning study revealed several key elements they felt differentiated and elevated their experiences in journalism and engineering. These elements stood out as pivotal features creating both a positive experience while in the class and an enduring positive effect on their engaging mindsets. Participants identified the following four core classroom elements: (1) choice and creativity, (2) student independence, (3) sense of purpose, and (4) complex, open-ended problems. I looked at each of these elements using education theory lenses from John Dewey and Jerome Bruner.

In John Dewey's *Democracy and Education: An Introduction to the Philosophy of Education* (1919) and *Experience and Education* (1938), he presented a vision of what an ideal learning environment should look like to promote intellectual stimulation and skill building. He argued fundamental elements of democratic processes and direct experiences should be infused in the classroom to foster curiosity and ownership of the learning. In the following sections, I outline some of the key elements of a "democratic" classroom according to Dewey and link them to the experiences participants have had with the journalism and engineering programs at MPS. Along the way I overlay Jerome Bruner's ideas, building on Dewey, promoting classrooms of discovery and constructivism as found in his key writings, *The Process of Education (1960), The Act of Discovery (1961), Toward a Theory of Instruction (1966)* and *On knowing: Essays for the left hand* (1979).

Choice and Creativity

In engineering and journalism, participants reported many examples of freedom in their learning. In journalism students expressed the joy of having choices in what to write, how to do the layout, and whom to interview. In engineering, there were few restrictions on robot designs—as long as they could complete the task, they could try anything. Students reported feeling their teachers respected them like adults. Teachers gave students full cognitive freedom and responsibility.

Dewey (1938) believed the nature of freedom in a classroom was not only about physical movement (i.e., hands-on activities, desk and chair arrangements, sitting and standing) but also about cognitive self-determination. Dewey (1938) outlined many benefits of the freedom of thought. First, allowing students to freely engage intellectually gave the teacher a window into their thought processes, better enabling the teacher to

make adjustments to the learning. Second, allowing students cognitive freedom increased collaborative learning and creativity. Finally, cognitive freedom fostered autonomy and self-efficacy. Likewise, Bruner (1961) outlined his preference for discovery learning. Bruner believed a constructivist, inquiry based environment promoted creativity, independence, and active engagement in the learning process. When students were given the freedom to think critically and not just spit back what the teacher delivered, they were able to become better problem solvers and analytical thinkers.

Student Independence

In both journalism and engineering, former students reported high levels of independent action and independent, higher order thinking. In journalism class, students constantly evaluated their own, and peers' choices. One of Mr. Collins's main goals, as evidenced by the data, was letting students create their own content, become critical of their content, and understand how their content interacted with the world—deciding when it was relevant and when it was not. He wanted students to make those calls. For him, the reflective process was a stepping-stone to independence. In a traditional classroom, students often despised or resisted reflective assignments. They felt the assignment was done and it was time to move on. In an authentic applied learning environment, based on students' responses, students came to realize the cyclical nature of continuous improvement—reflecting on previous work made future work more effective and engaging.

Unlike in journalism where completion of an article is somewhat subjective, in engineering the robot either successfully completed the task or it did not. Analytical reasoning and reflection came into play through the processing of a failed attempt at completing the mission. Because students came to embrace the cyclical nature of the trial

and error environment, they naturally accepted reflection and analysis as part of their work. Rather than reflection being an end point evaluation of success or failure, it became only one more step in an environment where "what should we try next?" is the norm. Growth was emphasized over achievement, and evaluations and reflections became non-judgmental.

Reflective thinking is one of the highest levels of thinking. When done properly, students not only grapple with the academic concepts inherent in the experience, but they also reflect on their intellectual development. Metacognitive processing produces the greatest amount of cognitive development and sets a student up for positive lifelong learning (Dewey, 1919). The higher order thinking categories of analysis, evaluation, and synthesis are triggered when allowing students to reflect on what they have seen, heard, smelled, and touched (Dewey, 1938). Bruner (1961) believed intuition and analytical thinking were essential features of productive thinking. Experts in any field have a knack for exploring multiple interpretations of an event or data. Bruner (1969) believed finding ways for teachers to create learning environments within which students could practice this skill would be critical.

Sense of Purpose

Students in the applied learning environments at MPS felt what they were doing had a real connection to their lives both now and in the future. Students in the journalism program had significant latitude in choosing their topics. Their primary audience was their peers; so, the material they chose to cover was relevant to their demographic. One might assume students were only concerned with sports, fashion, video games, and movies. However, when left to their own devices, students were incredibly thoughtful and

insightful on very complicated, important themes of the day. When adults valued students' voices and their choices, they became extremely motivated and engaged. Giving students true ownership over the newspaper allowed them to rise to the occasion and produce something they were proud of and connected to them personally. It inspired deeper critical thinking on the part of the students and required them to be partners in their learning as they took on issues that mattered to them.

Engineering students described how the open-ended engineering design and building process intrigued and inspired them. The course itself represented a particular interest of theirs. In addition, as the teacher fostered the idea of multiple paths to answers, students approached challenges in their own subjective ways. Students' autonomy in their choices strengthened a sense of personal interest.

Many brain studies have been conducted recently about the physiological connection between emotion and learning (Albin, 2008; Immordino-Yang & Faeth, 2010). Dewey had proposed this connection long before brain scans and neurological imaging. Dewey believed allowing students to pursue topics of personal interest would allow students to engage more deeply in the material (Dewey, 1919). Whether choosing a book to read or developing a unique, personal science laboratory investigation, having a personal connection to the learning fosters ownership and therefore deeper thinking. Bruner (1961) also explained, in ideal circumstances, the material to be learned should arouse natural interest and connection to students. He promoted stimulating and engaging material to create the greatest motivation to learn (Bruner, 1966).

Dewey emphasized the importance of developing purpose for students (Dewey, 1938). He explained how curriculum design and delivery could thwart or encourage

meaning and purpose for students. In engineering and journalism, students reported a sense of purpose in three ways: (1) a direct application and connection to the real world, (2) a sense they were doing a service to others or benefitting the common good, (3) an interest in engaging activities and content. This sense of purpose develops the value and meaning engaging mindset.

Complex, Open-Ended Problems

At MPS, the applied learning environments provided ample opportunities for students to tackle complex, open-ended problems. In the journalism class, the teacher created an environment in which the students had to figure out the complex work of getting from idea to finished product mostly on their own. Students ran the show exhibiting multiple layers of leadership: students helped other students; writers, editors, photographers, and layout people worked together to create articles, pages, and sections of the newspaper. Rarely did the teacher get up and "lecture" or even give instructions. Students explained the teacher acted more as their leadership coach and helped them as an equal in the process of putting out the final product. In this active class, students learned to take great ownership over their learning and their production of the paper. Creating an active, student-centered environment promoted higher order thinking and love of learning.

In the engineering class, Mr. Walton created the engineering challenges and curated the research materials and then he got out of the way, retreating to his office to wait for intelligent questions while he modeled independent thinking working on his own design problems. The teacher expected students, from start to finish, to be independent and to actively collaborate. The rule in engineering, for instance, was when the school bell rang to

start class, students should have all of their materials out and be working together to solve the current challenge.

Dewey (1938) emphasized the importance of an active educational experience—one in which students would actively engage in complex problems in the physical world. By doing so, students would learn to apply academic knowledge and understand the nuances between theory and real life (Dewey, 1919). Bruner (1966), too, insisted the main purpose of education was to design experiences within which students could construct meaning for themselves. He promoted the idea teachers should avoid having students passively absorb facts bestowed by the teacher, but rather have students take an active role in the exercise of finding and processing knowledge. Students able to creatively process problems using higher order thinking are more likely to continue that propensity as lifelong learners (Bruner, 1961).

Classroom and instructional design considerations Dewey and Bruner helped establish decades ago might create the conditions to facilitate student growth and development. These adult-constructed environments provide the critical initial ingredients, setting a student on the path to engaging mindsets and leading to creative, competent, independent, life long learning.

In the following section, I analyze how psychological needs are met in an authentic, applied learning environment like those at MPS. Using Self Determination Theory (SDT), I connect what students reported regarding the fulfillment of the universal needs of competency, autonomy, and relatedness. I weave in Carol Dweck's work on "growth mindset" and some aspects of Deweyian educational theory as appropriate.

Psychological Needs

Students in the engineering and journalism programs related the development of key psychological factors as meaningful and helpful both while they were in the high school class as well as during their progression into college and career. They attributed their psychological growth to several features of the authentic, applied learning environments: (1) collaborative, empowering relationships, (2) the teacher's role and student independence, and (3) complex problem solving in an environment allowing for trial and error. In this section, I analyze each of these features through the lens of Self Determination Theory (SDT). According to SDT, there are three universal psychological needs: competence, autonomy, and relatedness (Deci & Ryan, 2008). The journalism and engineering programs at MPS appear to fulfill these needs. In the following sections, I analyze how the study participants identified the fulfillment of each of these needs.

Collaborative, Empowering Relationships

Students in engineering and journalism told many stories of open communication between peers and with the teacher. Helping each other figure out difficult problems was a natural part of the class, compared with traditional classes where students were expected to do their own work, or "not cheat." Student participants conveyed a strong sense that the teachers designed the student-to-student relationships to be supportive and joy producing.

Students also expressed how the team approach of these classes allowed them to appreciate each others' contributions to the projects and make everyone feel part of something important as a collective, not as individuals. The collaborative relationships, while fun, also produced a sense of responsibility to the group. Some even expressed this in terms of responsibility to the community outside of the school.

According to Ryan and Deci (2000), social environments have a profound impact on intrinsic motivation and overall well-being. In SDT, the term *relatedness* is used to describe one of the three universal psychological needs all people require for maximizing development and psychological well-being (Deci & Ryan, 2008). Relatedness develops in environments where there are either close personal bonds (e.g., best friends or romantic partners) or where there is sense of belonging to a group. Engineering and journalism students frequently mentioned this sense of belonging.

Researchers showed relatedness is key for allowing individuals to internalize a new value, belief, or behavior (Ryan & Deci, 2000). A feeling of relatedness fosters and supports the other psychological needs of competence and autonomy. Strong personal or group relationships make individuals gain self-efficacy and a sense of independence in their abilities (Ryan & Deci, 2000). The highest quality relationships occur when they support all three psychological needs of relatedness, autonomy, and competence. In the engineering and journalism program, students left school with confidence in their abilities, a willingness to take on new challenges, and a sense of connectedness to others in their programs.

The Teacher's Role and Student Independence

The teacher in the MPS authentic, applied learning programs performed an altered role from the traditional teaching approach. The teacher intentionally stepped away from being directly involved in the problem solving and instead turned the ownership over to collaborative student teams. Many students expressed surprise and pride at the responsibility bestowed upon them. Some even felt as though they were collaborating with the teacher as an equal.

Teachers gave students in engineering and journalism the freedom to explore their competence and autonomy. This freedom came partly from the open-ended problems and tasks, but also from the distance the teacher put between himself or herself and the students' decision-making process.

In SDT, the psychological needs of competence and autonomy often go hand in hand. When individuals are able to achieve success on their own, both their sense of autonomy and competence is bolstered (Deci & Ryan, 2008). When, on the other hand, success is achieved in a controlling environment, individuals are less likely to internalize this success. They are more likely to see their success as simply a requirement imposed by someone else, thereby squelching their feelings of both competence and autonomy (Deci & Ryan, 2008). When students believed they were personally responsible for their success (i.e., autonomous), they inevitably sustained the long-term increased feelings of competence.

Dewey (1938) talked about the role of the teacher in terms of positive social control. He explained the role of the educator as creating classroom activities promoting a social organization around the completion of the task. In such an environment, teachers remove themselves from the role of authoritarian figure because the activity itself engages students to collaboratively focus on the project. Bruner (1966) emphasized the role of the teacher as avoiding rote learning, and instead, stepping aside and facilitating the learning process. The teacher should allow students to collaboratively discover concepts and connections by themselves.

In both engineering and journalism, the teachers have embraced this concept of positive social control. In journalism, the leadership structure facilitated students holding each other accountable for the work of the newspaper. In engineering, students worked in

collaborative teams and across teams to try and meet the latest challenge. Participants expressed a sense of responsibility to their peers in each of these environments. Students only went to the teacher for help if they could not get the answers from each other. The teachers spent more effort setting up the experience before class and less effort "instructing." Choice and opportunities for self-direction cause greater positive feelings of autonomy (Ryan & Deci, 2000). The teachers in these programs, through the shifted definition of their role, created an environment in which the universal psychological needs of autonomy, competence and relatedness could proliferate.

Complex Problem Solving with Trial and Error

Engineering and journalism students reported an incredible appreciation for their teachers allowing an iterative process in their problem solving. Participants said they now see task failure not as a comment on their innate abilities but as a stepping-stone to continuous improvement and success. The former students respected how these applied learning environments focused on the learning process rather than on content retrieval.

In journalism class students wrote and re-wrote stories continuously. A story would be peer reviewed and edited multiple times before going to press. Students saw failure as a necessary component of continuous improvement and became more accepting of not getting it right the first time. With built in trial and error, students spoke of learning the lifelong lesson of persistence. They were able to articulate and see clearly that life is full of complicated tasks, rarely done right the first time. With an iterative process, students practiced reflection and higher order thinking. Not only did they experience persistence in their writings but also in managing their collaborative human connections. Students

reported learning leadership and relationship skills through this trial and error environment.

In engineering, failure was also a staple of the challenges with which students were tasked. Many of the students drew parallels with real world engineering challenges where improvements to products and processes are constantly being discovered or created. Students lost their fear of getting it wrong and gained confidence in trying something, anything, knowing there would be no judgment about their multiple attempts. Students, freed from the apprehension of getting it right the first time, willingly engaged in solving more complex problems.

Students communicated they could tangibly grasp their development and growth as they progressed through engineering and journalism. They had responsibilities, choice, and ownership like never before; and they came to appreciate their agency in their successes and achievement. The problems were difficult and complex, but the participants found they were up to the task in part because they were given the time and freedom to produce their personal accomplishments.

According to SDT, the manner of communicating and evaluating competence may have a profound impact on self-efficacy (Ryan & Deci, 2000). Competence measured in demeaning evaluations with no opportunity for improvement, negatively affects confidence. Feedback providing specific recommendations for performance and allowing for cyclical attempts at the task supports and fosters self-efficacy (Ryan & Deci, 2000). In both engineering and journalism, the iterative process assumed everyone could ultimately succeed at the task. By allowing every student to try and try again until he or she met the

objective, the teacher communicated the philosophy of every student being capable of achieving competence.

According to Ryan & Deci (2000), feelings of competence may not strengthen intrinsic motivation unless it is developed in tandem with autonomy. If someone successfully completed a task because of a fear of punishment or losing some external reward (such as grades), then the person may not be motivated to ever pursue such a behavior again. However, if individuals felt ownership in their success and believed they were the cause of the achievement, independent of external reward or consequence, the feelings of competence were reinforced (Ryan & Deci, 2000). Autonomy and competence, working in partnership, create a growth mindset.

Carol Dweck (2006) outlined the differences between a fixed mindset and a growth mindset. People with a fixed mindset believe intelligence is innate and static. Such individuals become focused on showing competence at all costs. Challenges are to be avoided, effort is fruitless, and criticism is unwelcome because it reveals weaknesses. People with a growth mindset believe intelligence may be developed. Such individuals welcome challenges, persist when confronted with obstacles, and see effort as a path to growth and mastery (Dweck, 2006).

The collaborative, trial and error environment of engineering and journalism created the perfect ingredients for students to develop a growth mindset. They were given the opportunity to see themselves as failing on the road to success in a safe and non-judgmental atmosphere. Not only did engineering and journalism students develop their growth mindset related to the academic material, they also saw their successful relationships with their peers and teachers through a growth mindset lens (Dweck, 2006).

They entered college and career with a strong understanding of the importance of developing relationships and teams, not just accepting existing relationships as fixed and unchanging.

The importance of building failure into the learning environment is also important in the theories of Dewey (1919) and Bruner (1961). Dewey promoted educational experiences involving multiple iterations of exploration, reflection, and then further exploration on the road to getting it right. It is precisely in the failure students have the opportunity to think about the concepts and come to a deeper understanding of the phenomena they are experiencing (Dewey, 1919). Bruner (1961) also advocated for discovery learning or a constructivist approach to learning. He believed the most effective way for students to grow was for them to categorize, code, and create meaning for themselves rather than have the teacher produce the answers for them. The most important outcomes of learning for Bruner were not the concepts themselves but the trial and error process students go through to construct meaning for themselves.

The collaborative relationships, the teacher's role in fostering student independence, and the complex problem solving in a trial and error environment are key features in strengthening student psychological needs in the classroom. Competence, autonomy, and relatedness were essential benefits engineering and journalism classes provided for students as they entered college and career. As Ryan and Deci (2000) predicted, participants not only reported feeling these essential qualities while they were in these programs, these qualities also became internalized parts of their personalities as they tackled new problems beyond the high school classroom.

Once students internalize competence, autonomy, and relatedness, they can take on greater ownership of their future growth and development. They have personal strengths they can use to further develop their engaging mindsets. In the next section, I analyze a unique aspect of an applied classroom—the way in which applied experiences give students the opportunity to authentically and creatively produce something in the real world.

Authentic Practice

A key differentiator in engineering and journalism was the opportunity students had to use authentic, real world processes and create authentic, real world products. In other more traditional classes, participants reported good relationships with their teachers, success on complex academic tasks, and moments for creativity and independence. However, these participants, in their more traditional classes, rarely felt they did something that translated directly to a life they imagined for their future.

For participants, three key aspects of their experience in journalism and engineering spoke to this authenticity. First, participants felt class activities were purposeful beyond academia—they could see a true authentic connection to the world beyond school. Second, students felt a concrete manifestation of the knowledge and skills, useful and meaningful beyond taking a test. Journalism students had newspapers and websites they could point to as the products of their creativity and hard work. Engineering students had robots, computer programs, and their performance at a competition as evidence of their innovation and effort. Third, students reported finding something within them connected deeply with their experience. They discovered aspects about themselves that translated into decisions about their future career, helped them understand their strengths and

challenges, and revealed characteristics of future pursuits that might be most engaging and enjoyable to them.

In the following sections, I analyze these three aspects of the engineering and journalism programs using theories supporting project based learning (Dewey, 1919; Bruner, 1960), authentic learning (Lombardi, 2007; Newmann, 1993; Van Oers & Wardekker, 1999), deep practice (Coyle, 2009), and flow (Csikszentmihalyi, 1990). Together, these theories paint a picture of how powerful an applied learning experience might be in preparing students for a lifetime of confident, competent, independent learning.

Real World

The teacher of the journalism program believed creating a newspaper and online news publication achieved an authentic, real world experience inspiring higher order thinking. Similarly, the engineering teacher chose to diminish the amount of content knowledge students had to memorize in favor of applying their knowledge to a real world product and engaging them in the real world process of the engineering cycle.

Both the engineering and journalism teachers entrusted the students with incredible opportunities to learn real world, adult content and processes. Students used real world software and hardware (e.g., computer aided design, website development, 3D printing, social media) to produce real world products. Students also used real world processes. The engineering peer teams used the engineering design/build cycle, standard in the industry. The journalism students worked within the simultaneously hierarchical and collaborative system of editors, writers, photographers, and graphic designers.

Project based learning ideas have existed for centuries but were solidified into our modern educational system by John Dewey, Jerome Bruner and others. Dewey's (1919)

notion of the best learning environment was one where students experienced something "un-academically." By this he meant students should not just work with ideas as abstractions of the real world. Instead, students should work with ideas in the context of the real world. He felt this would produce the highest levels of inquiry and thought (Dewey, 1919).

Bruner (1960) argued teachers and schools unnecessarily postpone challenging topics and processes with the justification that they are too "difficult." He believed with proper planning and scaffolding, students would be able grasp more complex concepts and tasks at very young ages. Bruner (1960) posited a relevant education should allow students to participate in the society's cultural activities including corresponding real world activities that connect to academic content. The former students realized how learning in a real world context positively influenced the learning environment. Learning through experience creates an authentic space where students are allowed to use their higher order thinking skills to solve problems.

Participants explained how much they grew in their higher order thinking because of the complexity of the real world problems they tried to solve. In more recent years, "authentic learning" represents a broader set of characteristics enhancing a student's learning experience. Newmann (1993) introduced a set of criteria for an educational environment to be authentic for the student. Among them is the idea students should use higher order thinking skills in the context of real world problems and challenges. In doing so, students construct meaning for themselves and can more easily generalize their learning to other situations (Newmann, 1993). The uncertainty and unpredictability in real world processes create circumstances for higher order thinking to thrive.

Participants expressed they felt they were “going to work” and they were more mature and part of the real world. Van Oers and Wardekker (1999) spoke of authenticity as making academic content connections with both personal interests and cultural values. By participating in cultural practices (e.g., engineering design and journalistic writing), individuals were inspired to improve their capacity for critical thinking, independent learning, and responsible participation in society (Van Oers & Wardekker, 1999). All individuals should eventually develop a sense of participation in cultural practices. In engineering and journalism, the authentic connection to real world disciplines helped students experience this at a younger age (Van Oers and Wardekker, 1999).

Other educational leaders have similarly created frameworks for authentic learning mirroring students’ experiences in engineering and journalism. Lombardi (2007) created a list of characteristics making a learning experience authentic including real world relevance, ill-defined problems, sustained investigation, collaboration, polished products, and multiple possible outcomes. Student participants reported their complex challenges in engineering and journalism replicated these characteristics.

Engineering and journalism students recalled having more clarity about their college and career choices. They explained how they were more likely to be able to get past the rigors (and boredom) of their college classes because they saw what the real world has to offer on the other side. Authentic learning experiences create perseverance, motivation, and a sense of purpose and relevance (Lombardi, 2007). They give students an ability to see themselves as full, contributing members of the culture. Students in an authentic learning environment become primary authors of their future (Lombardi, 2007).

Product and Performance

Participants expressed great pride in the product and performances they created in engineering and journalism. These tangible creations ultimately manifested the growth and achievement of the students and gave them a sense of competence and connectedness to the real world. As previously explained, these products and performances provided an authentic experience mirroring the real world (Bruner, 1960; Dewey, 1919; Lombardi, 2007; Newmann, 1993; Van Oers & Wardekker, 1999).

These creations also allowed students to deeply engage in something in which they had not previously gained competence. Daniel Coyle (2009) discusses what he calls deep practice or targeted practice in his book *The Talent Code.* Coyle explains that practice becomes significant and important in producing results by targeting skill areas with which someone struggles and then devoting considerable time and effort perfectly practicing those skills.

Journalism and engineering students frequently remarked how these experiences challenged them in new ways. The critical thinking, independent learning, meaningful collaborations, and creative problem solving skills presented significant new challenges for them in their applied learning environments. They also said they failed on the way to succeeding in each of these areas.

Learning environments such as these are opportunities for students to engage in deep practice (Coyle, 2009). The more individuals challenge themselves to do activities requiring a stretch (not just practicing things one already knows), the more cognitive and physical development will accelerate efficiently (Coyle, 2009). The earlier in life teachers help students engage in specific skills and give them the opportunities to deeply practice

them, the more "muscle memory" they have for the chosen skill (Coyle, 2009). Whether one is learning Spanish, playing a guitar, or kicking a soccer ball, early and repeated targeted practice will help solidify competence in the long run.

Participants recalled significant gains in higher order thinking skills, relationship skills, and creative skills—the very competencies that were a stretch for the students coming into the program. Engineering and journalism students mentioned they felt better prepared and skilled than their peers in the work place in things like creative thought, collaboration and complex problem solving. Just as with Spanish, guitar, and soccer, giving students a head start on developing these skills at a younger age may establish greater permanent competence (Coyle, 2009).

Collaborative, complex problem solving with a product or performance as the end result gives students the opportunity for deep practice in skill areas not fully developed, and are a stretch challenge for high school students. This fosters an efficient pathway to greater cognitive skills in these areas (Coyle, 2009). By developing these skills early, individuals are able to call upon them as they enter their career when they are essential for success.

Self-Discovery

All participants articulated they discovered something about themselves that helped shape future decision-making in college and career. Some discovered a passion for certain content or career path. Some discovered skills they enjoyed employing in the problem solving process. And some discovered what kind of work made them engaged and happy. All engineering and journalism participants reported their experience in applied learning

environments gave them more clarity about what would give them optimal experiences in the future.

Participants made claims about how enjoyable and rewarding their experiences were in engineering and journalism. Engineering and journalism students looked forward to their work in these classes and would even seek out opportunities to do more of it, late at night or on the weekends. According to Csikszentmihalyi (1990), this type of intrinsically motivating and rewarding experience is termed autotelic, or a "flow" activity. Individuals having an autotelic experience reported they would continue the activity even if they did not have to, and time passes very quickly while they are engaged in it. A person pays attention to the experience for its own sake (Csikszentmihalyi, 1990).

There were several examples of participant responses indicating they were engaged in an autotelic experience. Participants reported not really knowing, or caring, how they were being graded. The activity itself was reward enough. Students also reported spending much more time than was required on their applied work, designing and building their robot late into the night or writing newspaper stories while bored in other classes.

Participants enjoyed these applied experiences in an atmosphere wherein someone else established the rules and goals of the activity. They enjoyed them nonetheless. On the surface, one might sense a contradiction—the most enjoyable experiences should be the ones in which the individuals make their own rules. On the contrary, Csikszentmihalyi (1990) explained it is exactly the well-established structure that helps create the optimal flow experience. The rules, requirements to develop skills, specific goals, and built in feedback allow an individual to feel success and progress. Typical flow experiences (e.g., Spanish, guitar, soccer) have structure and feedback directing one's accomplishment

toward established goals. The structure of a flow experience facilitates engagement, involvement, and concentration because they are distinct and memorable in relation to everyday existence (Csikszentmihalyi, 1990).

Every engineering and journalism student I interviewed appeared to have a flow experience to a lesser or greater degree. According to Csikszentmihalyi (1990), this is likely related to these activities having the proper balance of skill and challenge. For a flow experience to occur, individuals continuously advance both their skill level and the degree of challenge to create optimal joy as they progressively develop in the experience. Too much skill and not enough challenge leads to boredom while too much challenge and not enough skill leads to anxiety. The journalism and engineering classes were designed to be self paced so the balance between challenge and skill was maintained, keeping students in a flow experience.

Journalism students with advanced skills, ready for a challenge beyond basic story writing, took on the role of editor or tried their hand at more challenging pieces—or maybe they moved on to graphic design or website creation. Engineering students needing more challenge had infinite options for exploring the design of more sophisticated and complex robots and computer programs. Self-paced, applied learning opportunities are ideal for creating the possibility of a flow experience.

For most of the participants, their experience in engineering or journalism inspired them to look at their future careers with a lens of finding work that would be enjoyable and make them happy. When one is engaged in a flow experience, what is typically characterized as work, is also characterized as enjoyable at the same time (Csikszentmihalyi, 1990). These former students discovered a key to their future

happiness lies in finding work as both useful and enjoyable. They first realized this was possible in their applied learning at MPS.

Just as the apple tree becomes its authentic self in the bearing of fruit, students fulfilled their cultural identity when they produced something authentic in the context of the real world. The creative production of something tangible, deeply practicing skills in an authentic way, and the pursuit of autotelic/flow experiences allowed students to discover their true, unique assets and talents, giving them the engaging mindsets to enter the adult world.

Analysis Conclusion

Applied learning environments play a significant role in helping students develop engaging mindsets allowing them to become competent, confident, life long learners. According to my study, for our students to feel self-efficacy, achievement as a function of effort, a sense of belonging, and value and meaning in their work, educators should first create an environment in which students have choice, opportunities for creativity, independence in their learning, a sense of purpose, and the opportunity to tackle developmentally appropriate complex problems (Bruner, 1961; Bruner, 1979; Dewey, 1919; Dewey, 1938).

Second, educators should develop ways to allow the students' psychological needs of competence, autonomy, and relatedness to flourish (Ryan & Deci, 2000; Deci & Ryan, 2008). Giving students ownership in decision making by altering the teacher's role, allowing for collaborative, empowering relationships (Bruner, 1966; Dewey, 1938), and promoting trial and error processes to support a growth mindset (Dweck, 2006), help to give students the internal mechanisms to engage in their own growth and development.

Third, authentic, real world experiences allow students to fully engage in connecting their thinking and their skills to the surrounding culture leading to greater empowerment. Teachers should develop problem solving opportunities for students to connect with the real world (Bruner, 1960; Dewey 1919; Newmann, 1993, Lombardi, 2007; Van Oers & Wardekker, 1999), create activities promoting deep, targeted practice with higher order thinking and collaborative skills (Coyle, 2009), and design self-paced intrinsically motivating opportunities to create flow (Csikszentmihalyi, 1990).

When students are given empowering applied opportunities such as in the journalism and engineering classes, they produce the "seeds" of self-efficacy, persistence, belonging, and purpose helping them when approaching other challenges in the future. They become independent, lifelong learners with engaging mindsets—able to seize opportunities and navigate obstructions.

CHAPTER SEVEN: SUMMARY, IMPLICATIONS AND RECOMMENDATIONS

In this study, former applied learning students had many common understandings regarding the value of their high school journalism and engineering experiences as they continued in college and career. In the analysis, I outlined the three main ingredients for a successful authentic, applied educational experience: (1) the establishment of strong experiential and constructivist educational design, (2) the development of experiences fostering the fulfillment of universal psychological needs, making the learner more confident and independent, and (3) the inclusion of "real world," authentic products and performances creating a genuine connection to students' personal interests and the broader culture.

The participants' reflections helped shape important insights into how engaging mindsets may be developed through authentic, applied learning environments. The participants' reflections and subsequent analysis have helped me conceptualize recommendations for educators as the world continues moving to a more complex and technologically infused future. In this chapter I review some of the key findings in my analysis to make recommendations for educators. I also look at the limitations of my study and make suggestions for future research.

Suggestions for Educators

To prepare students for a modern life with complex work, civic, and social problems, educators need to create the conditions for student independence, purposeful collaboration, and ownership of lifelong learning. Educators should design learning environments assisting students in developing engaging mindsets. To this end, I offer four

suggestions for educators, (1) mimic real life, (2) be strategically unhelpful, (3) build in failure, and (4) embed collaboration.

Mimic Real Life

One of the key benefits of the journalism and engineering programs, according to participants, was being engaged in something important and real. They expressed having a greater sense of purpose as they created products or worked on problems useful in the "real world." These learners appeared to be looking to their next level of being in the world and felt empowered when they achieved something beyond their current existence.

One key way educators might achieve my first recommendation is to look at curriculum development in a new way. Rather than designing what students should learn *about* math, science, history, writing, music and other subjects, educators should design classroom activities to allow students to *be* mathematicians, scientists, historians, writers, musicians, etc. Educators might create authentic experiences allowing students to act as professionals using disciplinary content for a specific real life purpose.

Another way to execute this recommendation is to design activities starting with the top of Bloom's taxonomy and working down. The top of the new Bloom's taxonomy includes creating, evaluating, analyzing, and applying. Deciding what the students will create first helps determine the authentic context for students to get hooked on the topic. From there, students determine what they need to know and understand to tackle the authentic problem. Engineering students knew they had to create a robot that could complete certain tasks. Within this context, they went about gaining the conceptual understanding of gear ratios, component fabrication, and programming. Journalism students knew they had to create a print and online newspaper. Within this context, they

proceeded to learn what was required to write for a specific audience, ask meaningful interview questions, and create an engaging layout.

By mimicking real life, educators set up the conditions for students to be creative, complex problem solvers. This will in turn allow students to develop strategies to fulfill two of the universal psychological needs of competence and autonomy. When learners feel empowered beyond their role as traditional students, their confidence and independence burgeons.

Be Strategically Unhelpful

Many former students conveyed the importance of the teacher's role in shifting the responsibility for effort and learning onto the students. While this shift initially intimidated some of the journalism and engineering students, they explained it was incredibly empowering and set them up for future confidence and success in college and career.

Educators might incorporate several methods to design learning opportunities to be strategically less helpful. First, teachers should create complex problems in which there could be multiple right answers. When students are looking for the one "right" answer, their tendency is to want the formula or memorized steps. When teachers strip away the pressure to get a specific answer, students think more critically about what makes an answer to a problem more or less appropriate or applicable in a specific context.

Math is arguably a subject where multiple right answers would be difficult to achieve. However, I offer a possible way in which being strategically unhelpful would work for a subject like math. If a teacher wants students to learn calculations related to surface areas and volumes, the typical assignment would be to learn the appropriate formulas for

circles, spheres, cylinders, rectangles, cubes, and other shapes and then practice 30-50 problems using the formulas. Students would not have to use much mental capacity to apply known formulas to new numbers as they work the problems.

Instead, the teacher might ask the students to design a recreation room within some broad criteria and include in the design the use of circles, spheres, cylinders, rectangles, cubes, and other shapes. The design requires them to calculate the costs to carpet, paint, tile, and fill spaces. Every student will have different answers. Students will have to critically analyze their design and define their assumptions about where paint or tile coverage is needed, and which sides and spaces do and do not need carpet, paint or tile. In this authentic example, students act as architects, carpet layers, and painters. Every design will be different and depending on the students' assumptions, even an individual student could come up with multiple reasonable answers.

Teachers may also be strategically unhelpful in the way they interact with the students. Often students look for easy answers to get the problem completed. Like most of us, they seek the path of least resistance from point A to point B. When educators offer prescriptive or specific answers to students' questions, they often let them off the critical thinking hook.

I recommend teachers employ a few key approaches. First, answer student questions with another question. By doing so, teachers require students to verbalize their thinking before the teacher provides help. Making students verbalize their thinking facilitates students' constructing meaning for themselves. Students become more metacognitive and more independent while solving problems.

Second, have students ask each other for help when they struggle to understand something. This gives another student the opportunity to teach. Students will retain concepts and skills when given the occasion to demonstrate their understanding to others.

Third, start with concepts, not formulas. Whether it is teaching five paragraph essays or quadratic equations, start with the conceptual idea and let students develop the formulas. When educators teach with pre-determined steps and paths to the right answer, they bypass students' natural curiosity about the way things work. Start with a real life challenge compelling students to figure out what is needed from an essay or mathematical formula. If a teacher is teaching the quadratic formula, for instance, a teacher could ask students to program a crash test car to accelerate to a certain speed into a wall. Let the students figure out for themselves they will need a squared term. By having students struggle with a challenging problem in which they construct personal meaning, they gain two things: (1) the confidence of knowing they can succeed through difficult tasks and (2) greater retention of the concepts.

Build in Failure

The engineering and journalism students I interviewed for this study explained how they came to appreciate and embrace failure as a key take away from their experience in their high school applied learning environments. They related how their learned persistence has helped them in college and career settings when circumstances require additional effort, time, and perspiration. Essentially, they learned the lifelong attitude of never giving up.

Some students never fail. Teachers tell them what to do. They do it. Teachers give them an A and the class moves on. Teachers do these students a disservice by allowing

them to get it right the first time; they never experience what is required to overcome a difficult challenge. All students should have the chance to experience something complex enough to challenge their mental fortitude. Educators should find ways to challenge every student and require effort to get past the failure.

Other students experience failure on a regular basis. Teachers tell them what to do. Students try it, or often, do not try very hard. They get a D or F and the class moves on. The disservice teachers do to these students is very different than what the "A" student experiences. These students have the failure part mastered. What these students need is the feeling of success that comes from persisting through the failure. When teachers serve up the D or F and go on to the next concept, they let these students off the hook in a very different way.

The message teachers give these students is; when failure happens the class will just move on to the next concept or task and students never have to revisit the topic with which they struggled. Educators should not only allow students failing on a given assessment to improve their failing marks; educators should require it. The lesson of persisting through failure is more important than the specific content being learned, the timing of when students understand the concept, and more important than our notion of fairness in grading (i.e., the idea a student got the F they deserved because they failed to get it while studying it the first time).

Failure alone is not enough to help students gain self-efficacy and a growth mindset. It is the success after failing that empowers students with confidence and the sense their effort produces favorable outcomes. To implement this in the classroom, educators should keep the grade book open and available to adjustments far beyond the due date of a specific

assignment or test. Students should complete outcomes to a certain level of conceptual understanding and skill achievement. Teachers should not allow students to get a D or F on something and move on.

Embed Collaboration

Working together in teams created several benefits for students in engineering and journalism classes. Because of the open-ended problem solving nature of the classes and the expectation of students working together to solve problems, students developed strong connections with each other. These connections led to increased relatedness and fed feelings of autonomy and competence. Students learned to appreciate and value one another for the skills, knowledge, and creativity each brought to the table. Though some participants talked about the challenges of collaboration, they always explained how valuable collaborative learning was for their current understanding of negotiating relationships and collaborations in their work today.

To maximize students' understanding, appreciation, and skill in collaboration, educators might make cooperative learning an integral part of the classroom experience. Similar to building in cognitive failure and success, educators should also build in opportunities for students to experience mistakes and triumphs within relationships. These opportunities need to be set up so it is not simply a matter of one student completing section A and another student completing section B. Rather, students need to experience genuine joint decision-making, reflect upon and edit each other's work, and rely on each other to accomplish delegated tasks with quality.

Educators might integrate meaningful collaboration by incorporating the following methods. Students should have opportunities to solve complex problems together where

building on each other's ideas creates a product better than any one student could have achieved alone. Students should critically examine and constructively assess the quality of each other's work, improving the knowledge and skills of both students in the process. In groups, student should be given tasks demanding and intense enough for them to learn to delegate and rely on each other. In all of these examples, students learn the skills necessary to navigate relationships, making them better employees, family members, and civic leaders in the future.

Another aspect of collaboration engineering and journalism students mentioned was the shifted relationship between student and teacher. Over time students felt as though they were collaborating with the teacher as an equal. This sense of ownership and responsibility is something teachers wish for all students as they head off to college and career.

Educators may release responsibility and ownership to the students from very early ages. Students may take turns leading small group or whole class discussions. Students may collaborate with teachers in deciding what evidence will be proof of understanding. Giving students the opportunity and responsibility to collaboratively lead the classroom in structured ways makes them more proactive members of the class. They take ownership of their learning and advocate for their own and others' learning needs.

Allowing students to collaborate more is especially essential as students near the date when they head off into the world, separated from their parents. Beginning with younger grades, educators should be gradually releasing responsibility to the students for every aspect of learning and life. Collaboration is no different. When some students arrive at college, their newly found freedom is overwhelming since they have never had the

opportunity to practice independence and collaboration. Educators need to allow time to practice these skills so students develop the engaging mindsets necessary for success in college, work, and life before they get there. Next I review limitations of my study and make suggestions for further research.

Limitations of this Study and Recommendations for Further Research

I conducted this study in a narrowly defined environment. The engineering and journalism programs at MPS were choice based programs for 10^{th}, 11^{th}, and 12^{th} grade students. They likely drew students having a predisposition for valuing the content. In addition, I only interviewed students enrolled in the program for at least two and, at most, three years. These students presumably enjoyed enough success to want to continue in the program. MPS generally enrolls a high number of socio-economically advantaged students, further narrowing the types of students in this study. Finally, since I am an employee of the school, one has to wonder if there was an underlying pressure on the participants to speak of engineering and journalism in a positive light, even though I was specific about the high level of confidentiality. In the following section, I recommend several future studies that might shed light on the value of applied learning in developing engaging mindsets.

First, a variety of student demographics should be included in further research. Seeing how applied learning impacts students coming from different socio-economic and cultural backgrounds could help determine how universal my findings may be. Further research could also focus on the age of the student to see if applied learning has limitations or benefits when started at various ages from preschool through college.

Another area of future research would be to expand into other disciplines to detect similarities and differences. This study revealed many common elements and enduring

impacts between journalism and engineering. Further research could reveal whether these similarities hold true when other disciplines are the primary focus. Continued research could help identify subject areas in which applied learning would be more or less successful (e.g., world language, social studies, math, and others).

Further research might also focus on aspects of choice. In this study, students made the choice to participate, the choice to continue participating, and the choice between engineering, journalism, or some other electives. Further research might determine what happens when applied learning is not a choice. There may be significant differences in the benefits to students when choice is taken out of the process.

Time is another factor deserving further research. Does the amount of time spent in applied learning environments have an accumulating effect on developing engaging mindsets? Also, it would be valuable to interview my participants over time to see how their perspective changes. I found the act of interviewing the students helped them reflect on their current situations in light of their past applied learning experiences. One could also study the metacognitive process itself and how it impacts their engaging mindsets.

Finally, because of my employment with the school, the relationship between my participants and myself cannot be ignored. One might see different results from interviews conducted by someone detached from the school being studied. Future studies would be well advised to take this into account.

As society continues to redefine what it means to be human in an age when technology supplants tasks we used to perform, engaging mindsets are going to be critical to our ability to adapt to an ever-changing world. Educators have the responsibility to

study and design the best learning environments for our students to become confident, creative problem solvers, and lifelong learners.

Conclusion

Both education and the world of work are rapidly changing in response to new technological and social shifts. As different needs and expectations arise in our society, there is a shift in how teachers and students view themselves and their roles in society. It has become clear over the last century jobs requiring repetitive physical or mental processes are becoming automated through technology or outsourced to lower wage markets. These societal changes have forced educators to shift their attention to help students develop skills and aptitudes marketable in the future work environment and applicable to forming positive contributing citizens and lifelong learners. Persistence, creativity, analytical and critical thinking, communication, and application may represent the primary skills needed for students to be successful in life. Engaging mindsets are the gateway for such skill development.

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APPENDICES

LAY SUMMARY Appendix A: Lay Summary

Project Name	Noncognitive mindsets		
Researcher Name	Steve Pohlen	**IRB Tracking Number**	573628-1

Lay Summary

Please complete each section in clear, easy-to-read language that can be understood by a person unfamiliar with your research and your field. Written correctly, sections of this summary can be used in your consent form.

Background

Provide ONE paragraph to explain the importance of the research and how it fits with previous research in the field.

Research in neuroscience, education, social psychology, and economics has indicated the importance of noncognitive mindsets for success in school and life. As educational leaders, we need to focus on developing experiences and environments that promote these mindsets. Most of the past research has been conducted in typical, traditional classrooms using mostly quantitative academic assessments and/or survey results. My study explores applied learning environments to determine what characteristics in these environments develop or hinder noncognitive mindset development. My focus will be on understanding these environments through the eyes and reflections of the students themselves.

Research Methods and Questions

Specify the overall research question(s), hypothesis, methods you will use to address the research question(s) .

Be sure to attach copies of ALL materials to be used in the study to your project (such as surveys, interview questions, dependent measures, and so forth) .

Overall Research questions: How do authentic, applied learning experiences and environments affect the development of noncognitive mindsets? How do students experience these environments as they reflect on their own mindset development? Specific interview questions can be found in a separate document, "Interview Questions."

My study will examine how participants' applied learning experiences affect the four key mindsets identified by Farrington et al.,2012: self- efficacy, sense of belonging, value and meaning of work, and ability derived from effort. I plan to conduct in-depth interviews of former students in two Midwest Private School high school authentic applied learning programs, journalism and engineering. I will explore their recollections of what those programs meant to them.

Participant Recruitment

After applying for and gaining permission to conduct my study from the University of St. Thomas Institutional Review Board, I will use teacher recommendations to find students who have graduated in the last five years. I will also use a snowball method of asking students to recommend

other students. I will contact the recommended students at random by phone or email until I have

8-10 from each program (journalism and engineering) that are willing to participate.

The script is a simple:
"I am conducting a study about students' development in applied learning environments in secondary school programs. I invite you to participate in this research. You were selected as a possible participant because you have experienced a mature applied learning program first hand. The purpose of this research is to determine how applied experience and environments shape students' views of learning, teaching, and college and life preparation. I will be studying how Midwest Private School's engineering and journalism programs affect the development of students. Would you be willing to be interviewed about your experiences? Your participation is voluntary and your responses would be anonymous."
If they say yes to this initial enquiry, I will walk them through the consent form to make sure they understand the full implications of participation in the study. I plan to interview 8 -10 participants from each program (16-20 total) or until saturation occurs. I will also monitor the recruiting process to ensure that I end up with a representative sample in terms of race and gender.
I will be very specific about the voluntary nature of the study and the confidentiality. I will explicitly tell them the following:

Confidentiality:
The records of this study will be kept confidential. In any report I publish, I will not include information that will identify you in any way. The types of records I will create include a transcript and an audio recording of the interview. It will be stored on my personal hard drive and will be password protected. Steve Pohlen will be the only one that has access to the data. Any report beyond the raw data will also be password protected. Participants will be able to review the data and reports created from the data at any time upon request. If at any time you would like to remove yourself (and the data associated with you) from the study, you may do so by request.
Voluntary Nature of the Study:
Your participation in this study is entirely voluntary. Your decision whether or not to participate will not affect your current or future relations with your high school or the University of St. Thomas. If you decide to participate, you are free to withdraw at any time up to the publication of the results. You may also review the data and reports at any time upon request. Should you decide to withdraw, data collected about you will be removed from the study. You are also free to skip any questions I may ask during the interview process.

Expectations of Participants
State precisely what you will have participants do.
Identify the location of data collection and the expected time commitment of participants.

The participants will each participate in a one-hour interview that will be taped. Ideally, the interview will take place in the engineering lab or journalism room at the school (the location of the authentic applied learning experience). In the interview process, I will ask partcipants to share recollections of their experiences in the program. I will use broad questions (see Interview Questions) to pull out stories from their expereince. Listening carefully for expereinces that seem to be most meaningful to the participant, I will customize each interview to create as rich a picture of their experience as possible.

Following the interviews, I will produce a transcript and later analyze the data looking for codes and themes. I will likely organize the data in multiple iterations as new patterns emerge. I will also likely conduct follow up interviews or have additional correspondence with some or all of the interviewees to get clarifications or a more in-depth understanding of their experience. Partcipants will be allowed to review their own interview transcript to provide further insights upon reflection.

Participant Data:

Electronic data will be kept on a password protected computer and on a password protected qualitative data web based program called Dedoose. All electronic data will be identified only by pseudonym. Actual names (connected to pseudonyms) will be kept on a paper copy separate from the interview data. The paper copy will be kept in a file cabinet in the researcher's home. The data will be part of the principal investigator's dissertation, planned for completion in Spring 2015. The dissertation will only use pseudonyms.

The paper copy with names and pseudonyms will be destroyed after successful completion of the dissertation (May 2015) . The interview data and coding will be maintained on the password protected computer and password protected web based program.

Only the principal investigator will have access to the full data. The research advisors will have access to the non-identifiable interview data (actual names are known by the researcher only).

The researcher will personally transcribe all interview data.

Analysis of Existing Data

If you are analyzing existing data, records or specimens, explain the source and type, as well as your means of access to them.

N/A

Appendix B: Script to Engineering and Journalism Teachers

Dear Teacher,

I am conducting a study about students' development in applied learning environments in secondary school programs. The purpose of this research is to determine how applied experiences and environments shape students' views of learning, teaching, and college and life preparation. I will be studying how Midwest Private School's engineering and journalism programs affect the development of students' motivational mindsets. Could you recommend a diverse group of 30-40 students who participated in your program over the past five years. From this list, I will randomly select students to contact and set up an interview.
Thank you for your assistance.

Steve Pohlen

Appendix C: Participant Information

PARTICIPANT INFORMATION

Project Name	Noncognitive mindsets		
Researcher Name	Steve Pohlen	**IRB Tracking Number**	573628-1

Participant Information
Please completely answer each question in clear, easy to read language. Reminder, it is extremely important that all information obtained from your participants be kept as confidential as possible.

Target Population
You described and selected your target population in your application.
Provide your rationale for purposefully selecting your target population(s).

The target population is anyone that participated in the journalism or engineering programs at Midwest Private School. I will be seeking students who graduated in the last 1-5 years in an effort to get students who experienced the program when it was similar to the current program.

If you are purposefully excluding women or minorities in your study, explain why.

N/A

If you are conducting research on school children during class time, please answer the following two questions:

Describe in detail the activity planned for children not participating in your research.

N/A

Who will supervise non-participants? Include this information in the consent form.

N/A

Anticipated Participants
Explain if you anticipate in your study a sample of gender, race or ethnicity that is not proportionate to the general population.

I anticipate a population that is less racially diverse than the general population because the current Midwest Private School population is less racially diverse.

Recruitment of Participants
If subjects are recruited or research is conducted through an agency or institution other than UST, submit written documentation of approval and/or cooperation. This document should use the agency or institution's letterhead and contain enough information to demonstrate the agency or institution understands of their role in your research.
Please be advised that you will need a letter of permission from any organization (printed on letterhead) where you will be recruiting.
Please answer the following:

Identify the locations where participants will be recruited (name, city and state).

N/A

~~Who will make the initial recruitment contact (full name)?~~

Stephen Michael Pohlen

If the principle investigator is not the recruiter, describe how contact will be made with those who will be doing the recruitment. Describe what will be said to potential recruiters.

N/A

Describe how participants will be recruited. Include a script or other recruitment materials.

After applying for and gaining permission to conduct my study from the University of St. Thomas Institutional Review Board, I will use teacher recommendations to find students who have graduated in the last five years. I will also use a snowball method of asking students to recommend other students. I will contact the recommended students at random by phone or email until I have 8-10 from each program (Journalism and Engineering) that are willing to participate.

The script is a simple:

SCRIPT: I am conducting a study about students' development in applied learning environments in secondary school programs. I invite you to participate in this research. You were selected as a possible participant because you have experienced a mature applied learning program first hand. The purpose of this research is to determine how applied experience and environments shape students' views of learning, teaching, and college and life preparation. I will be studying how Midwest Private School's engineering and journalism programs affect the development of students. Would you be willing to be interviewed about your experiences? Your participation is voluntary and your responses would be anonymous."

If they say yes to this initial enquiry, I will walk them through the consent form to make sure they understand the full implications of participation in the study. I plan to interview 8 -10 participants from each program (16-20 total) or until saturation occurs. I will also monitor the recruiting process to ensure that I end up with a representative sample in terms of race and gender.

Specify what measures you will take to eliminate potential coercion. *Be specific*

I will be very specific about the voluntary nature of the study and the confidentiality. I will explicitly tell them the following:

Confidentiality:

The records of this study will be kept confidential. In any report I publish, I will not include information that will identify you in any way. The types of records I will create include a transcript and an audio recording of the interview. It will be stored on my personal hard drive and will be password protected. Steve Pohlen will be the only one that has access to the data. Any report beyond the raw data will also be password protected. Participants will be able to review the data and reports created from the data at any time upon request. If at any time you would like to remove yourself (and the data associated with you) from the study, you may do so by request.

Voluntary Nature of the Study:

Your participation in this study is entirely voluntary. Your decision whether or not to participate will not affect your current or future relations with your high school or the University of St. Thomas. If you decide to participate, you are free to withdraw at any time up to the publication of the results. You may also review the data and reports at any time upon request. Should you decide

to withdraw, data collected about you will be removed from the study. You are also free to skip any

questions I may ask during the interview process.				
Will you have access to existing records in order to recruit?	Yes	■	No	■
If **YES**, indicate who gave approval to use the records. Approval must be given by an individual who has the authority to release the records. Attach a signed letter of approval from that individual, preferably on letterhead from their organization. List the name of the person who has given approval to release the records.				
N/A				
Will the participants receive incentives before and/or rewards after the study?	Yes	■	No	■
If **YES**, describe these incentives and/or rewards. Include this information in your consent form.				
N/A				

Appendix D: Confidentiality of Data

CONFIDENTIALITY OF DATA

Project Name	Noncognitive mindsets		
Researcher Name	Steve Pohlen	**IRB Tracking Number**	573628-1

Confidentiality of Data

Please completely answer each question in clear, easy to read language. As with the lay summary, the information in this section should be used in your consent form. It is extremely important that all information obtained from your participants be kept as confidential as possible.

Data formats

In what format(s) will the data be created? *Check all that apply*

☒	Consent Forms	☒	Audio Recordings
☒	Video Recordings	☒	Photographs
☒	Surveys	☒	Transcripts
☒	Written Notes	☒	Other

Data storage

Where will each form of data you create and records be kept?
Specify the setting where the data will be kept (e.g., home, work, school, etc.), and indicate how the data will be made secure (e.g., kept in a locked file in a locked room, secured password computer. etc.).

Electronic data will be kept on a password protected computer and on a password protected qualitative data web based program called Dedoose. All electronic data will be identified only by pseudonym. Actual names (connected to pseudonyms) will be kept on a paper copy separate from the interviewee's data. The paper copy will be kept in a file cabinet in the researcher's home. The data will be part of the principal investigator's dissertation, planned for completion in Spring 2015. The dissertation will only use pseudonyms.

Data Retention

How long will the data and records be kept? Specify the exact date when the data and records will be destroyed. If the data and records are to be kept indefinitely, specify how they will be de-identified.
The paper copy with names and pseudonyms will be destroyed after successful defense of the dissertation (May 2015). The interview data and coding will be maintained on the password protected computer and password protected web based program.

Data Access

Who will have access to the data and records? Will data identifying the subjects be available to anyone other than the principal investigator (e.g., school officials, research advisors, etc.)? List these people in the Consent Form as well.
Only the principal investigator will have access to the full data. The research advisors will have access to the non-identifiable interview data (actual names are known by the researcher only).

Data transcription				
Will information from the data be transcribed?	Yes	■	No	■
If **YES** , please explain who will transcribe any information from this media and where it will be stored. If the researcher is not the person transcribing the media, attach a Statement of Confidentiality from the transcriber to your project.				
The researcher will be transcribing all data.				
Will the data be recorded in any permanent record, such as a medical chart or student file?	Yes	■	No	■
If **YES**, please explain				
N/A				

Appendix E: Risks and Benefits

RISKS AND BENEFITS

Project Name	Noncognitive mindsets		
Researcher Name	Steve Pohlen	**IRB Tracking Number**	573628-1

Risks and Benefits

Please complete each section in clear, easy-to -read language that can be understood by a person unfamiliar with your research and your field.

Minimize risk

Describe the precautions used to minimize risks. This information must be listed here and on the consent form.

Although every effort will be made to maintain anonymity, there is still some chance that the responses from the partcipants will be recognizable to someone close to the program.

Electronic data from the interviews will be kept on a password protected computer and on a password protected qualitative data web based program called Dedoose. All electronic data will be identified only by pseudonym. Actual names (connected to pseudonyms) will be kept on a paper copy separate from the interview data. The paper copy will be kept in a file cabinet in the researcher's home. The data will be part of the principal investigator's dissertation, planned for completion in Spring 2015. The dissertation will only use pseudonyms.

The paper copy with names and pseudonyms will be destroyed after successful completion of the dissertation (May 2015) . The interview data and coding will be maintained on the password protected computer and password protected web based program.

Only the principal investigator will have access to the full data. The research advisors will have access to the non-identifiable interview data (actual names are known by the researcher only).

The researcher will personally transcribe all interview data.

Use of Deception

If this research involves the use of deception as part of the experimental method, the method **MUST** include a "debriefing procedure" which will be followed upon completion of the study or subject's withdrawal from the study. Specify the method here.

N/A

Benefits to participation

List any anticipated <u>direct</u> benefits for subjects that participate in this research project. This does not include statements like "add to the existing knowledge" or "assisting your school/agency/company, etc." If there are no benefits, state "None". List this information here and in the consent form.

None

Appendix F: Consent Form and Informed Consent Process

CONSENT FORM: UNIVERSITY OF ST. THOMAS

Phenomenological study of noncognitive mindset development in applied learning environments in a secondary school

IRB Tracking Number: 573628-1

I am conducting a study about *noncognitive mindset development in applied learning environments in secondary school*. I invite you to participate in this research. You were selected as a possible participant because you have experienced a mature applied learning program first hand. Please read this form and ask any questions you may have before agreeing to be in the study.

This study is being conducted by: Steve Pohlen, supervised by University of St. Thomas instructor Dr. Sarah Noonan from the College of Education, Leadership and Counseling.

Background Information:

The purpose of this research is to determine how participating in a mature, authentic, applied learning experience affects the development of students and their views of learning, teaching, and college and life preparation. I will be interviewing past participants in Midwest Private School's engineering and journalism programs. With the data, I will explore the alignment between student development and learning environment design.

Procedures:

If you agree to be in this study, I will ask you to do the following things: Each participant will participate in a one- hour interview that will be taped (audio only) . Ideally, the interview will take place in the Engineering lab or Journalism room at the school (the location of the authentic applied learning experience). Follow up questions or discussions may occur as needed to clarify and/or explore answers more deeply. Names of participants will not be used in the study. Participation is anonymous and voluntary.

Risks and Benefits of Being in the Study:

The study has some minimal risks. While the study will randomly select students from many recent graduates, and every effort will be made to maintain anonymity, there is still some chance that your responses will be recognizable to someone close to the program.

Electronic data from the interviews will be kept on a password protected computer and on a password protected qualitative data web based program called Dedoose. All electronic data will be identified only by pseudonym. Actual names (connected to pseudonyms) will be kept on a paper copy separate from the interview data. The paper copy will be kept in a file cabinet in the researcher's home.

The only benefit to participating in this study is the knowledge that you are contributing to the improvement of teaching and learning by sharing your insights.

There are no "direct" benefits.

Compensation:

There will be no compensation for the participants.

Confidentiality:

The records of this study will be kept confidential. In any report I publish, I will not include information that will identify you in any way. The types of records I will create include a transcript and an audio recording of the interview. It will be stored on my personal hard drive and will be password protected. It will be marked by pseudonym only (no actual names connected to the data). Steve Pohlen (principle investigator) will be the only one that has access to participant names. Any report beyond the raw data will also be password protected. The data will be part of the principal investigator's dissertation, planned for completion in Spring 2015. The dissertation will only use pseudonyms. Participants will be able to review the data and reports created from the data at any time upon request. If at any time you would like to remove yourself (and the data associated with you) from the study, you may do so by request.

Voluntary Nature of the Study:

Your participation in this study is entirely voluntary. Your decision whether or not to participate will not affect your current or future relations with your high school or the University of St. Thomas. If you decide to participate, you are free to withdraw at any time up to the publication of the results in Spring 2015. You may also review the data and reports at any time upon request. Should you decide to withdraw, data collected about you will be removed from the study. You are also free to skip any questions I may ask during the interview process.

Contacts and Questions

My name is Steve Pohlen. You may ask any questions you have now. If you have questions later, you may contact me at 612-618-2419. You may also contact my dissertation chair, Dr. Sarah Noonan, at 651-962-4379. The University of St. Thomas Institutional Review Board can be reached at 651-962 - 5341 with any questions or concerns you may have.

You will be given a copy of this form to keep for your records.

Statement of Consent:

I have read the above information. My questions have been answered to my satisfaction. I consent to participate in the study. I am at least 18 years of age.

_____ _____

Signature of Study Participant **Date**

_____

Print Name of Study Participant

_____ _____

Signature of Researcher **Date**

Informed Consent Process

Project Name	Noncognitive mindsets		
Researcher Name	Steve Pohlen	**IRB Tracking Number**	573628-1

Informed Consent

- Simply giving a consent form to a subject does not constitute informed consent. Consent itself is a process of communication.
- Be sure all required consent forms are attached to your project.
- In addition to consent forms, assent forms are required if your subjects are children ages 10 and older.
- All forms are located in the document library.

Describe Study

In a script, state what you will say to the prospective participant describing your study. The script is a simple:

"I am conducting a study about students' development in applied learning environments in secondary school programs. I invite you to participate in this research. You were selected as a possible participant because you have experienced a mature applied learning program first hand. The purpose of this research is to determine how applied experience and environments shape students' views of learning, teaching, and college and life preparation. I will be studying how Midwest Private School's engineering and journalism programs affect the development of students. Would you be willing to be interviewed about your experiences? Your participation is voluntary and your responses would be anonymous."

Participant Questions

What questions will be asked to assess the participant's understanding of his/her participation in your research? Identify 3- 5 open-ended questions (not "yes/no" questions) that address procedures, risks (if any), confidentiality and voluntariness.

- "What do you see as the types and level of risk associated with participation in this study?"
- "What level of confidentiality do you expect from this study regarding both the interview data and the report produced with the data?"
- "Participation is completely voluntary. What do you understand by this and what are your rights regarding participation in this study?"

Obtaining Consent

At what point in the research process will consent be obtained? Be specific.

I will describe the risks, confidentiality, and voluntariness when I initially ask the interviewees to participate. Right before performing the interview, I will ask them for their understanding of these issues and get the consent at that time.

Will the investigator(s) personally secure informed consent for all subjects?	Yes	■	No	■

NO

If , identify below the individuals who will obtain consent (include job title/credentials):

Appendix G: Interview Questions

Interview Questions

Project Name	Noncognitive mindsets		
Researcher Name	Steve Pohlen	**IRB Tracking Number**	573628-1

The interview will be a fluid process. I will start with general questions to encourage the students to give a full narrative of their own experience (impressions of the assignments, the teacher's methods, the general environment, the other students in the class, etc.). The questions below represent starter questions that I will use as needed to prompt deeper discussions in areas that aren't fully explored in the initial narrative. I plan on using the interviewee responses to direct the flow of the interview.

Starter questions:

- Tell me about your experience in Journalism/Engineering class? What did you do? How long were you involved?
- Describe 2-3 projects or assignments in detail. What is memorable about them? What made them enjoyable or challenging or both?
- Besides the content that you learned, were there skills or attitudes that you had to learn or develop in this class? Describe.
- Describe your experience in this class over time. What adjustments did you have to make? Did your attitudes or beliefs about learning change over time? Explain.
- Describe 2-3 interactions with the teacher. How was this the same or different than other classes? How did you feel about the interactions with your teacher? How would you describe the teachers teaching methods? Compared to other teachers?
- How were you assessed in this class? Describe in detail. What did you think about this form or assessment?
- What did Journalism/Engineering mean to you in general. How does it fit in terms of how it prepared or didn't prepare you for college and/or life?
- How do you view the role of the teacher in this class compared with other classes?
- How do you view the role of each student in this class compared with other classes?
- How were the interactions/relationships between students in this class compared with other classes?
- What do you think were the most important skills to be able to succeed in this class? How does that align with what you need to succeed in college or in a job?
- What did you find enjoyable about this experience? What did you find frustrating?
- Tell me about a time when you overcame an obstacle in this class. How did it make you feel? What did you learn from this?
- Would you recommend this experience to other students in high school? Why or why not?