The Impact of Project-Based Learning on Collegiate Preparedness

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The Impact of Project-Based Learning on Collegiate Preparedness

A Dissertation by

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Brandman University
Irvine, California
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Submitted in partial fulfillment of the requirements for the degree of
Doctor of Education in Organizational Leadership

April 2017

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To my daughter Eden . . . you have so much to offer. I can’t wait to see what you will bring to the world. You’re smart, kind, and witty. Know that if you work hard, you can overcome even the most challenging obstacles. I will be behind you every step of the way.
ABSTRACT

The Impact of Project-Based Learning on Collegiate Preparedness

by Tanya MacMartin

Purpose: The purpose of this qualitative case study was to explore and describe collegiate PBL high school student graduates’ perceptions of their preparedness for their first year of college and the impact of how the BIE’s eight essential components of PBL (Larmer & Mergendoller, 2015b) contributed to their first year of college preparedness. A secondary purpose was to explore and describe the alignment of the students’ perceptions of the impact of how the BIE’s eight project-based components (Larmer & Mergendoller, 2015b) contributed to their first year of college preparedness as defined by Conley’s (2012) college readiness indicators.

Methodology: This study was a qualitative case study, which focused on students in PBL programs and their perceptions of their own collegiate preparedness as a result. The study explored a bounded case of PBL at High Tech High (HTH), a network of 13 schools located in San Diego County, California.

Findings: The participants in PBL perceived their college preparedness as strong in terms of communication, self-awareness, collaborative learning, and English skills. However, students in this study showed evidence of being unsatisfied with their preparation in terms of adjusting to the instructional style of collegiate programs as well as the pace and rigor of collegiate coursework. They also voiced that they felt unprepared for the math instruction in college.

Conclusions: The current study determined that PBL instruction encourages communication, self-awareness, and collaboration among students. This study also
identified that the eight-component model of PBL has a positive impact on the college preparedness, particularly as it is defined by Conley (2012). Yet it also identified gaps in a student’s college preparation as a result of participating in a PBL high school education, namely in math instruction and the differences in instructional styles of a PBL program and college.

**Recommendations:** This researcher recommends that a study of the effectiveness of PBL in college preparedness be done with a much larger sample to determine if the results of this current study would be confirmed by a larger sample. A comparison study between the perceptions of college preparation of students from a traditional school with those who have gone to a PBL institution should also be conducted. There is also a need of observational studies that compare PBL programs nationwide to determine the scope of variation within PBL programs.
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CHAPTER I: INTRODUCTION

Recently there has been a dramatic increase in the number of schools implementing project-based learning (PBL; Tintocalis, 2015). As schools shift to Common Core State Standards (CCSS), educators are shifting their methodology to meet the new requirements, which not only include content changes, but also stress collaboration and problem solving. In California alone, dozens of districts, including San Jose, Santa Ana, Visalia, Garden Grove, Elk Grove, and countless charter schools, have increased the amount of time students spend in projects as part of their efforts to align to the CCSS (Ellison & Freedberg, 2015).

Regardless of location, population, or focus, many schools are using PBL as a cornerstone of their curriculum in an effort to achieve the rigor of California’s newly adopted CCSS. According to Ellison and Freedberg (2015), “The Common Core standards include explicit expectations that students learn how to work together, acquire skills to solve real-world problems, and persist in doing so—all core components of project-based learning” (para. 8). The skills inherently required in PBL modules are often aligned with the outcomes planned by teachers in classrooms focused on science, technology, engineering, and mathematics (STEM), and therefore, are often recommended and supported by education experts and administrators (Condliffe, 2016; Gorman, 2013).

San Jose Unified School District recently spent nearly $150,000 on training for 70 teachers, so that they could adapt their curriculum to include projects and project-based instruction (Ellison & Freedberg, 2015).
Recently PBL has been hailed as a “natural fit” (Brownfield, 2015) for the Common Core. Consequently, more schools are beginning to adopt this instructional approach. According to Ellison and Freedberg (2015), “The Common Core standards include explicit expectations that students learn how to work together, acquire skills to solve real-world problems, and persist in doing so—all core components of project-based learning” (para. 8).

The CCSS is the educational framework that has been adopted by 46 states throughout the nation with the intent to improve college readiness for American students (Common Core State Standards Initiative [CCSS], 2016). Marchitello and Wilhelm (2014) stated, “Unlike prior state standards, the Common Core sets uniform expectations that are grounded in the knowledge and skills every child needs to be successful after high school” (para. 4).

Among the schools implementing PBL, one school in California has garnered particular acclaim on its accomplishments both in PBL instruction and student achievement. High Tech High (HTH) San Diego began as a single charter high school in 2000. Now it is an organization that encompasses an integrated network of 13 schools, including elementary, middle, and high schools, a teacher credentialing program, and a graduate school for teachers. This PBL network of schools touts impressive student achievement statistics. The organization website boasts that “98% of graduates have gone on to college, 75% to four-year institutions” (Declara, 2015, “High Tech High: A Snapshot,” para. 4).

High Tech High (HTH) has gained a tremendous reputation within the educational community and has garnered respect from such notable supporters as Oprah
Winfrey, Bill Gates (High Tech High [HTH] Graduate School of Education, 2014), and President Barack Obama (Magee, 2011). HTH has a unique technology-based PBL style, but there has been very little research published on the matriculation of HTH alumni through to graduation from 4-year colleges, specifically on those who have attended HTH for ninth through 12th grades.

With the Common Core a driving force behind PBL implementation, it is imperative that essential components of PBL are identified and shared so that all schools using PBL are able to successfully prepare students for collegiate matriculation. Contributing to the research of PBL is warranted as indicated throughout literature; “In fact, only a few studies have measured the effects of project-based learning on student achievement” (David, 2008, para. 5).

While several studies have been conducted on PBL in Grades K-12, there is limited research on the connection between PBL’s exemplar instructional practices and how they align with medium- and long-term collegiate preparation (Beauregard, 2015). Before schools spend valuable resources on the implementation of PBL, it is important to identify the factors most beneficial to collegiate readiness. This information may be used by schools to develop PBL programs that will best serve their students’ college preparedness.

**Background**

PBL has been around for nearly a century. The following sections cover the history of PBL, the types of PBL, and the advantages and disadvantages of using PBL in a classroom.
History of PBL

Dewey, while serving as a professor at the University of Chicago in the late 1800s, developed the project-based approach over a period of several years. At this time, many educators supported the idea that knowledge was a fixed collection of facts waiting to be discovered and collected (Warde, 1960). Dewey challenged this popular view, and instead interpreted learning as a fluid process that resulted from one’s interactions with the world. Dewey and other reformers changed societal attitudes that learning was a possession, available only to those in an affluent class (Clark, 2006).

A colleague and interpreter of Dewey’s work, William Heard Kilpatrick (1918), further described PBL in “The Project Method,” which subsequently launched him to literary fame with his new approach to learning in an otherwise industrialized educational system. Kilpatrick described the need to “get students involved in things that were meaningful to them” (Beyer, 1997, p. 3), and then devised activities that kept the student’s interest as the main objective. His guiding principles unified student interest with real-world action and emphasized “the hearty purposeful act” that connected learning to doing (Beyer, 1997, p. 8).

Although first defined at the start of the 20th century, PBL is not new to the educational field. Educational theorists and progressives including John Dewey and Francis Parker produced thousands of scholarly articles (Warde, 1960; Zilversmit, 2005) that touted the benefits of a “progressive approach” to education, which included methodology later described as a project method. According to Warde (1960),

The school has to give children, not only an insight into the social importance of such activities, but above all the opportunities to practice them in play form. This
leads naturally into the problem or “project method” which has come to be identified with the essence of the progressive procedure” (para. 40).

This curriculum was inspired by and designed with a project as the guiding force behind the learning (Peterson, 2012).

What Is PBL?

PBL is an instructional methodology used in today’s classrooms for students of all ages and capabilities. While focused on solving an essential question or authentic problem, students involved in PBL work in teams to learn the necessary skills and knowledge to uncover solutions (Buck Institute for Education [BIE], 2015). The real-world problem is developed so that students acquire standards-based knowledge, as defined by their state’s educational expectations, throughout their experiences as they research, reflect, receive feedback, revise, document, and present their solutions (BIE, 2015).

Buck Institute for Education (BIE) is known as a leader in PBL, and focuses on providing resources and sharing exemplary PBL practices for teachers worldwide (BIE, n.d.-a). The organization has identified core components of exemplary PBL instruction, and used this knowledge to develop eight standards that should be incorporated into every PBL project (Larmer & Mergendoller, 2015a). Every gold-standard PBL project should do the following:

1. Pose a challenging problem or question. A well-designed PBL project must pose a problem or question that will motivate and sustain student learning (Larmer & Mergendoller, 2015b).
2. Contain key knowledge, understanding, and success skills (Larmer & Mergendoller, 2015b). Strong PBL projects should incorporate all key content knowledge that would be appropriate for the student’s grade and subject matter. Throughout the project, students should be engaged in success skills such as collaboration, critical thinking, and providing evidence for reasoning.

3. Sustain student inquiry (Larmer & Mergendoller, 2015b). The driving question should allow opportunity for students to delve deeper into understanding and developing solutions. As students learn more, it leads to deeper research and understanding until the student can confidently arrive at a solution or mastery of a particular concept.

4. Be authentic (Larmer & Mergendoller, 2015b). PBL projects should be relevant to the student and applicable to his or her life. They should be driven by the student’s own need for knowledge and lead to a stronger understanding of his or her world.

5. Provide student voice and choice. To spur motivation, BIE recommends that students be involved in what they study, why and how they study it, and how they demonstrate their knowledge. This can be done with varying degrees of student freedom, depending on the age and needs of the student (Larmer & Mergendoller, 2015b).

6. Allow opportunity for reflection. Stemming from its inception with John Dewey, frequent reflection by both the student and the teacher remains an integral part to a successful project. Reflecting on the learning, the course of the project, and the future path it may take is critical to project time management and effectiveness (Larmer & Mergendoller, 2015b).

7. Provide frequent feedback and time for revision. Students and teachers alike should provide feedback throughout the course of the project. Students should be instructed
on appropriate methods for peer review and guided by rubrics and formal assessments.

Teachers should provide one-on-one feedback promptly and frequently (Larmer & Mergendoller, 2015b).

8. Culminate in the presentation of a public product. The final component raises the bar of traditional projects in a classroom by requiring the student to publicly display his or her learning beyond the walls of the classroom. Public products can include presentations to an audience outside of school, tangible objects produced for a particular group, or multimedia presentations made available through social media or the Internet (Larmer & Mergendoller, 2015b).

**Advantages and Disadvantages of PBL**

PBL has shown promise with student achievement in the K-12 educational system. In a summary of the benefits of PBL, the BIE (2013) cited many achievements of PBL including longer retention of material, improved standardized test scores, improved problem solving and critical thinking skills, and improvements in both teacher and student motivation.

**Discrepancies in PBL Implementation**

There are numerous variations of PBL methodology, which may account for the mixed reports on student achievement in schools implementing PBL in Grades K-12. With such broad definitions and approaches to implementation, PBL may be markedly different from school to school. As documented by the Association for Supervision and Curriculum Development (ASCD), “Although projects are the primary vehicle for instruction in project-based learning, there are no commonly shared criteria for what constitutes an acceptable project” (David, 2008, para. 3). Recently a teacher from San
Diego’s High Tech Middle School, a school famed for its PBL expertise, also acknowledged the difference between PBL and other similar methodologies in a San Diego news release:

The term “project-based learning” gets tossed around a lot in discussions about how to connect students to what they’re learning. Teachers might add a project meant to illustrate what students have learned, but may not realize what they’re doing is actually called “project-oriented learning.” And it’s quite different from project-based learning. (Scwhartz, 2013, para. 1)

PBL is often used as an encompassing term that includes several types of instruction in which a teacher assigns the completion of a project as means to acquire or implement academic content. However, it is important to clarify the different types of classroom instruction that are often misconstrued as PBL.

In project-oriented learning (POL), teachers often frontload students with all information they need to know before they start their project. In essence, the project is the culminating compilation of their learning. Often it comes at the end of the semester or the end of the year. The learning is not done throughout the building of the project or prototype (Robin, 2013).

In problem-based learning (PrBL), students learn about a subject as they simultaneously try to solve an open-ended, often real-world problem. In PrBL, the problem is presented first, and students must acquire the information and tools to solve it. PrBL is similar to PBL; the only difference is that the objective of this type of project is to solve a real-world problem (Cornell University Center for Teaching Excellence, n.d., para. 1).

HTH Consortium

Identifying key components of a successful PBL program would contribute to strengthening curricular development among schools. To do this, research conducted in this study focused on a school that is known for doing PBL well. Among the thousands of PBL-based schools, the one organization in San Diego County known for accomplishments both in PBL instruction and student achievement is HTH. Recent research supports HTH’s claims of increased student acceptance rates into college. In a 2015 study, 71% of HTH alumni enroll in postsecondary education, which is higher than the rate of applicants from traditional programs within the same district (Beauregard, 2015).
The HTH network has gained a tremendous reputation within the educational community. Schools around the country are attempting to mirror their methodology, but HTH continues to be the only large network of schools embracing the focused project-based technology learning program.

HTH’s leadership in PBL has allowed the school to conduct its own workshops, residencies, and even develop its own teacher credentialing program (HTH Graduate School of Education, 2015). Teachers and administrators attend from around the nation, and then attempt to mirror the instruction at their own schools. HTH teachers coach and provide insight through frequent phone, e-mail, video-conferencing, and even personal visits as a school begins the process of adjusting its current format to that which is closer to the methodology of HTH (“Getting Started,” 2014).

The Strengths and Weaknesses of PBL for Postsecondary Preparation

PBL provides a venue for students to hone a variety of skills. According to the BIE (2015), these skills include but are not limited to critical thinking, collaboration, self-management, sustained inquiry, project authenticity, and much more. PBL advocates compare these skills to those that are needed in a 21st century workforce, and state that these skills are undoubtedly the skills a student needs to succeed in the dynamic careers of the 21st century. In a 2014 study, the above claims were supported and concluded that PBL, when used correctly, was identified as “potentially rigorous enough to meet the cognitive processing demands of the CCSS as well as the cognitive processing demands of the 21st century skills” (Ragsdale, 2014, p. 109).

However, will these skills be all that is needed to matriculate through college and attain a bachelor’s degree? According to Hein, Smerdon, and Samboldt (2013), students
also need skills learned in AP coursework, college-prep math sequences that include trigonometry and calculus, and successful completion of the Early Assessment Program to be adequately prepared for college.

**College Preparedness**

The literature identifies skills that are often used as predictors of collegiate preparedness. These skills provide a comprehensive overview of the necessary knowledge, skills, and behavior that experts suggest a college freshman will need to succeed in their first year. They include hard skills such as math preparation and writing skills as indicated on college readiness exams such as the American College Test (ACT), the Scholastic Aptitude Test (SAT) or Early Assessment (EAP) exam (Hein et al., 2013). Other indicators such as key content knowledge, key cognitive strategies, academic behavior, and contextual skills and awareness are also identified and analyzed (Conley, 2007).

Developers of the ACT exam claim that the exam provides a strong indication of whether or not a student is ready for college. In their study, Radunzel and Noble (2012) demonstrated that there is a “medium correlation” between students’ performance on the ACT, their high school grade point average (GPA), and their long-term performance in college. Consequently, colleges often require students to take these exams and use their scores as predictors of student success. Findlay (2013) stated, “For now, the SAT and ACT remain the most helpful indicators of college readiness when combined with high school GPA” (para. 10).

The EAP is a test taken during a student’s junior year in high school. Developed in collaboration with the California State University system, State Board of Education,
and California Department of Education, this program “gives high school students an
early signal about their college readiness and adequate time to prepare before entering
CSU” (California State University [CSU], 2016). Completing this assessment early
during the junior year allows students insight into their current academic standing,
therefore clearing their senior year “for more direct and specific” collegiate preparation
(CSU, 2016, para. 3).

Another Perspective of College Preparedness

As noted previously, education expert David Conley (2007) identified four key
areas that also could be useful in ascertaining whether or not a student is ready for
college. These four areas are identified as key content knowledge, key cognitive
strategies, academic behaviors, and contextual skills and awareness.

**Key content knowledge.** Key content knowledge refers to “key foundational
content and ‘big ideas’ from core subjects that all students must know well, and an
understanding of the structure of knowledge in core subject areas” (Conley, 2012, para.
7). This may include such skills as knowing key vocabulary and other factual
information, linking core ideas, and organizing their knowledge for faster recall (Conley,
2013).

**Key cognitive strategies.** This aspect focuses on the student’s ability to use a
variety of methods to learn new information allowing him or her to research, synthesize,
and make connections in his or her learning. Students with strong cognitive strategies are
able to interpret and communicate their knowledge and also monitor and check their
knowledge for accuracy (Conley, 2013).
**Academic behaviors.** These are the behaviors that surround a college student’s academic life. Behaviors such as study skills, self-monitoring, time-management, and academic self-awareness are critical to a student’s collegiate preparedness (Conley, 2009).

**Contextual skills and awareness.** These skills center primarily on the student’s ability to understand how college operates. Conley (2008) suggested that this skill consists of two dimensions: both applying to college and also succeeding while enrolled. First, the student must understand the high school requirements necessary to be eligible for admission as well as have an awareness of the variations in college missions and tuitions. The student must be able to select an appropriate institution, know how to gain admission, and also be able to navigate obtaining financial aid. Furthermore, the student must be aware of and recognize the importance of the myriad deadlines in which to achieve all of this.

Once enrolled, the student must be able to maintain enrollment and take the necessary actions required to register for classes and understand their own progress toward matriculation. However, he or she must also be able to appropriately interact with a diverse population. This includes participating in and contributing to a collegiate system and culture as well as interacting and collaborating with their classmates and professors.

**Problem Statement**

Prior to the development of the Common Core, PBL has been used extensively in medical schools (Donner & Bickley, 1993). PBL involves solving a real-world problem
and forms a driving, solvable question. Solving this driving open-ended question involves the student learning about different subjects simultaneously.

Some schools have touted impressive student achievement due to their PBL model. One such organization is HTH, an organization that encompasses an integrated well-developed network of 13 schools of all grade levels, a teacher-credentialing program, and a graduate school. The majority of graduating seniors from HTH PBL schools are accepted into colleges, and more than half gain admittance into 4-year institutions (HTH, 2010).

The network of HTH employs a unique yet expert approach to PBL, and therefore warrants using the network’s design as the lens to examine how the skills students learn from PBL prepare them for the expectations of their college career.

Gaps in Research

Numerous sources allude to the high acceptance rate of students in PBL programs into traditional college programs (Beauregard, 2015), but little research has been done on the readiness and matriculation rates of these students from college. There are variations of PBL implementation, and consequently, there is a broad spectrum of methodology. Research shows that there is no default practice that all teachers follow (David, 2008). A recent article by Miranda Reagan (2015) clarified that factors of PBL should be more closely evaluated.

There are numerous studies (Conley, 2009; Cromwell, McClarty, & Larson, 2013) that address academic and behavioral skills associated with PBL. However, there is limited research on the importance of PBL and the preparedness of 4-year high school students for their first year of college. In particular, existing research fails to identify the
components of PBL which first-year college students report as most useful to their college success.

**Purpose Statement**

The purpose of this qualitative case study was to explore and describe collegiate PBL high school student graduates’ perceptions of their preparedness for their first year of college and the impact of how the BIE’s eight essential components of PBL (Larmer & Mergendoller, 2015b) contributed to their first year of college preparedness. A secondary purpose was to explore and describe the alignment of the students’ perceptions of the impact of how the BIE’s eight project-based components (Larmer & Mergendoller, 2015b) contributed to their first year of college preparedness as defined by Conley’s (2012) college readiness indicators.

**Research Questions**

1. How do collegiate PBL high school student graduates perceive they were prepared for their first year of college?

2. How do collegiate PBL high school student graduates perceive the impact of the BIE’s eight essential components of project-based learning (Larmer & Mergendoller, 2015b) on their first year of college preparedness?

3. How do the collegiate PBL high school student graduates’ perceptions of the impact of the BIE’s eight essential components of PBL (Larmer & Mergendoller, 2015a) on their first year of college preparedness align to Conley’s (2012) college readiness indicators?
Significance of the Study

With California’s recent shift to the Common Core, state education officials are encouraging schools to adopt curriculum that fosters collaborative thinking and critical reasoning, skills that are often found in PBL. Tintocalis (2015) agreed, “State education officials now want more schools to take on this approach, known as project-based learning (PBL), because Common Core academic standards ask students to collaborate and solve real-world problems” (para. 7). Therefore, using high-performing PBL schools as models, it is important that their methodology is examined and critical components are identified so all schools may replicate their PBL approach.

Using PBL as part of a school’s fundamental instructional strategy is not extraordinary. In fact, many schools often implement PBL as the framework for their learning model (Ellison & Freedberg, 2015). However, variations in the implementation of PBL allow for a large spectrum of methodology, and there is no default practice that all teachers follow (David, 2008). Consequently, there are a variety of ways to implement PBL.

Using the findings from this study will allow the researcher to compare skills and behaviors associated with PBL that support postsecondary achievement. These skills include performance markers evaluated by college readiness exams, such as the ACT and the EAP exam (Hein et al., 2013). Other indicators, such as key content knowledge, key cognitive strategies, academic behavior, and contextual skills and awareness, are also identified and analyzed (Conley, 2007). With these indicators serving as initial proxies to college readiness, this study provides a more comprehensive look at college readiness by including direct reflections from students who have graduated from PBL programs and
are now engaged in their first year of college. Using these reflections in conjunction with other evidence of college readiness provides a unique lens with which PBL should be examined.

With schools desperately trying to prepare their students for a new wave of educational testing, many schools are quickly adopting curriculum without taking the necessary time to adequately prepare their teachers for the shift in instructional mindset. “When you move too quickly, you run into quality control issues,” says Matthew Hewitson, principal of a northern California school which recently adopted PBL as its central methodology (Tintocalis, 2015, “Academic results mixed,” para. 5). Identifying critical, effective components of PBL will assist schools as they build a curriculum that best prepares their students for college and today’s dynamic workforce. The resulting data may be added to the knowledge of impactful school programs so that schools across the nation can implement PBL and generate similar student outcomes. In addition, these data will allow all schools to access their PBL methodology, and in turn, improve the performance of the students, particularly in regard to long-term outcomes of postsecondary academic achievement.

Definitions of Terms

Following are a collection of definitions that will provide insight to the research and conclusions made by this study.

Theoretical Definitions

Surface-level knowledge. “Learning that is best described as knowing or understanding of ideas or facts” (Hattie, 2009, p. 28).
**College readiness.** The level of preparation a student needs to enroll and succeed, without remediation, in a credit-bearing, general education course at a postsecondary institution that offers a baccalaureate degree or transfer to a baccalaureate program (Conley, 2007).

**College matriculation.** To enroll and commit oneself to an educational goal (San Diego Mesa College, n.d.).

**Key content knowledge.** Critical knowledge that is foundational to a subject (Conley, 2007).

**Key cognitive strategies.** The intelligent behaviors necessary for college readiness that lead to the development of cognitive strategies and capabilities necessary for college-level work, such as critical thinking and analysis (Conley, 2007).

**Academic behavior, and contextual skills and awareness.** The collection of skills that enable a student to navigate the entire process of college admissions, financial aid, and successful functioning in college (Conley, 2007).

**Operational Definitions**

**Project-based learning (PBL).** PBL is an investigative instructional methodology in which students gain knowledge and skill by working over an extended period of time on a real-world question or problem. The BIE stated that a “gold-standard” PBL project should include components such as standards-based content, critical thinking skills, authenticity, collaboration, reflection, opportunities for critique and revision, and finally, an opportunity to present its learning (Larmer & Mergendoller, 2015a).
**Common Core.** Common Core is a state-led effort that began in 2009 to develop a set of English and mathematical standards that students are responsible for knowing at the end of each grade level in the nation’s K-12 classrooms. These learning goals are designed so that the knowledge is developed vertically, and aims to provide the nation’s students with a strong foundation they can use to move to college or the work force after graduating from high school (CCSS Initiative, 2016).

**Deep learning.** Learning that encompasses a change in the quality of thinking that is cognitively more challenging than surface-level learning (Hattie, 2009). This type of learning requires a learner to go beyond the given information, knowledge, or ideas, and deduce a more general rule or proof that applies to all cases.

**PBL components.** Using the BIE (2015) as a guide, eight essential elements of PBL have been identified. According to the BIE, effective PBL projects should include (a) “key knowledge, understanding, and success skills” (para. 2), which are derived from the content standards; (b) driven by a “challenging problem or question” (para. 3); (c) “sustained inquiry” (para. 4); (d) have authentic, real-world context; (e) opportunity for student choice to steer the learning; (f) opportunity for the student to reflect on their learning; (g) processes for students to give and receive feedback; and (h) require students to produce a public product.

**Early Assessment Program and Exam (EAP).** A collaborative effort between the California State University (CSU) system and the State Board of Education, the EAP “incorporates the CSU’s placement standards into existing high school standards tests in English and mathematics” (CSU, 2016, n.p.). The purpose of the program is multifaceted. The program aims to (a) align school and CSU standards so that success in
school means readiness for the CSU system, (b) give high school students an early signal about their college readiness and adequate time to prepare before entering CSU, (c) make the senior year a time for more direct and specific preparation for college, and (d) exempt CSU-ready students from taking CSU placement tests or the SAT or the ACT, thereby reducing testing time for the students.

**Delimitations**

This study was delimited to alumni of the HTH network of high schools, currently enrolled in their freshman year of college. Furthermore, the study is delimited to those alumni who had attended HTH for all 4 years of their high school experience.

Student environmental factors, such as collegiate social factors, familial interferences, or attendance rates in both high school and college were also delimited.

**Organization of the Study**

The remainder of the study is organized into four chapters, references, and appendices. Chapter II delves into past research concerning PBL, including the history of PBL, its essential components, and the identified advantages and disadvantages of using PBL in K-12 settings. It also explores the key indicators of college readiness as identified by the State Board of Education and College Board, specifically the Scholastic Aptitude Test (SAT), ACT, and EAP exams. The literature review also considers soft predictors of collegiate readiness, which include such skills as study habits, test-taking skills, self-advocacy, time management, and many more as defined by leading educational expert, David Conley (2012). Chapter III presents the research design and the methodology implemented in this study, and additionally identifies the sample, population, and data gathering methods as well as the procedures used to analyze the data.
gathered. Chapter IV presents, analyzes, and offers discussion of the research findings.

Chapter V unveils the summary of the research, conclusions made as a result of gathered data, and recommendations for further research.
CHAPTER II: REVIEW OF THE LITERATURE

Education is undergoing monumental shifts in methodology and student expectations throughout all subjects. Educators around the nation are scrambling to find effective ways to teach with a new focus on skills rather than content. Driving this change is the nationwide adoption of Common Core State Standards (CCSS) and Next Generation Science Standards (NGSS; Konz, 2013).

The review of the literature examines both project-based learning (PBL) and indicators of collegiate preparedness. The researcher developed the review of literature using a Literature Review Synthesis Matrix (Appendix A) to identify and organize related literature. In Part 1, PBL is examined and a review of the literature includes its history and methodology, documents advantages of PBL as aligned with college preparation in K-12 classrooms, and includes an overview of the exemplar practices that have strengthened its reputation as a strong curricular choice. Part 2 introduces and explores widely accepted quantifiable academic indicators of college preparedness such as the Scholastic Aptitude Test (SAT) and American College Test (ACT) exams as well as the Early Assessment Program (EAP). It also explores four qualitative areas, which include the “soft skills” that some experts indicate are also important indicators of college success (Conley, 2012; Sloane, 2014). These include skills such as key content knowledge, academic behavioral skills, key cognitive strategies, and contextual awareness (Conley, 2013).

The review of literature provides the conceptual framework for this qualitative case study. The goal of the study was to explore the following research questions:
1. How do collegiate PBL high school student graduates perceive they were prepared for their first year of college?

2. How do collegiate PBL high school student graduates perceive the impact of the BIE’s eight essential components of project-based learning (Larmer & Mergendoller, 2015b) on their first year of college preparedness?

3. How do the collegiate PBL high school student graduates’ perceptions of the impact of the BIE’s eight essential components of PBL (Larmer & Mergendoller, 2015a) on their first year of college preparedness align to Conley’s (2012) college readiness indicators?

**Project-Based Learning**

PBL is an instructional methodology used in today’s classrooms for students of all ages and capabilities. While focused on solving an essential question or authentic problem, students involved in PBL work in teams to learn the necessary skills and knowledge to uncover solutions (BIE, 2015). The real-world problem is developed so that students acquire standards-based knowledge, as defined by their state’s educational expectations, throughout their experiences as they research, reflect, receive feedback, revise, document, and present their solutions (BIE, 2015).

**The Increase of PBL in Today’s Classrooms**

Together, CCSS and NGSS make up the new set of standards that students are expected to master during their K-12 education. The CCSS focus on expectations in math and literacy and the NGSS focus on science. Both sets of standards have primarily shifted student expectations to critical thinking, analyzing text, communicating reasons and results, and collaborating and problem solving (Dhar, 2013). Some experts argue
that PBL is an instructional methodology that perfectly satisfies the requirements of both NGSS and CCSS (Larmer, Mergendoller, & Boss, 2015). Figure 2 demonstrates the connection of student expectations throughout all core subject areas, as identified by CCSS and NGSS (Chuek, 2013).

Figure 2. Venn diagram demonstrating skill expectations throughout all curricular areas, as defined by CCSS and NGSS. From Relationships and convergences among the mathematics, science, and ELA practices. Refined version of diagram created by the Understanding Language Initiative for ELP Standards, by Tina Chuek, Stanford University, Palo Alto, CA, retrieved from http://nstahosted.org/pdfs/ngss/PracticesVennDiagram.pdf

Switching the mindset of teachers and the community involves shifting curricular methodology, resources, and classroom interactions (Murray, n.d.). Consequently, as more and more schools adopt CCSS, schools throughout the nation have begun to adopt
PBL in an effort to fulfill these curricular requirements as mandated by the new set of standards (Ellison & Freedberg, 2015).

Other experts have noted the increase of PBL due to CCSS and NGSS. Condliffe (2016) stated, “Education reformers and policymakers increasingly support a more expansive and holistic vision for public education that aligns with the deeper learning goals of PBL” (p. 7). PBL methodology inherently includes a collaborative and multidisciplinary approach that will often integrate more than one standard within CCSS and NGSS, thereby making it a strong curricular approach in this nation’s schools (Ross, 2012).

Not only does PBL methodology enable the integration of CCSS, NGSS, and science, technology, engineering, and math (STEM) standards in its implementation, it also has been noted as a strong approach to foster STEM in schools (Gorman, 2013). These standards support the learning of skills rather than content, although relative content is usually included in the focus of the methodology (Dischino, Donnelly, Massa, Hanes, & DeLaura, 2011).

Now more than 5,000 schools nationwide are implementing PBL in some way as part of their Common Core curriculum (California Academy of Sciences, 2015). As schools across the nation vest valuable education time into this methodology, educators are wary about its long-term impacts on student achievement: “Some teachers are concerned that PBL classes will not cover the amount of material necessary for students to do well on standardized tests, which are written for students taught with traditional methods” (California Academy of Sciences, 2015, para. 6).
The History of PBL

PBL has been around since the early 20th century. Educational theorists John Dewey and Francis Parker are accredited with its beginnings, but many have added to the methodology that now presents itself in public school classrooms.

**John Dewey and the birth of PBL.** Originally penned by educational theorist John Dewey, PBL began as the notion of simple inquiry and collaborative discussion in American schoolhouses. Beginning as early as 1891, Dewey introduced the concept of “free discussion” in classrooms, starkly differentiating his approach from the rote memorization typical of the day (Nebeker, 2002). This was a drastically new approach, and Dewey advertised frequent meetings with his students to discuss class content through ads in the local paper (Walker, 1997). Dewey also adjusted his testing protocol, sometimes substituting quizzes for final exams and occasionally foregoing testing altogether and instead simply asked students to keep journals (Walker, 1997).

After his experience in Michigan, Dewey continued his educational career at the University of Chicago and continued to pave the way for collaborative discussion in classrooms. He not only focused on increasing collaborative work between students but also attempted to redefine the role of a teacher as more of a facilitator, rather than the sole provider of knowledge. According to Dewey (1916), “The teacher must, in other words, be the mediator of the curriculum, not its delegate” (as cited in Nebeker, 2002, p. 16).

Dewey broke through the ceiling of fixed, traditional classroom behavior at the time. The simple concept of allowing students to discuss and debate rather than sit quietly and listen to the teacher fostered a strong foundation for the collaborative nature of PBL and its role in today’s schools.
**Francis Parker.** A colleague of John Dewey, Francis Parker also supported the nontraditional approach in classrooms under the name of progressive education. Parker supported an approach to education that rejected rote learning and enlisted the natural curiosity of children in the schooling process (Zilversmit, 2005).

Moreover, Parker supported that learning could be fun, and students could drive their own curiosity (Schugurensky, 2002). Together with Dewey, this strengthened the movement toward an alternate methodology in American classrooms. Schugurensky (2002) elaborated,

Parker’s proposals and school successes, together with Dewey’s research in the Chicago Laboratory School, made a large impact in shifting educational perspectives and school practices in the United States (from a traditional curriculum to a child-centered approach), and opened a fertile discussion on the possibilities and limits of education in fostering social change. (para. 3)

**William Heard Kilpatrick.** William Heard Kilpatrick (1918) followed the vision of Dewey and Parker, adding to it the concept of a “wholehearted purposeful activity” that would later be called a “project” (as cited by Peterson, 2012, para. 6). By centering children’s attention toward a project, Kilpatrick theorized that children will innately be more invested in the educational experience. This results in a deeper learning experience (Kilpatrick, 1918).

**Other key contributors.** Using a project as the centerpiece for instruction also connects the students to the community. Beyer (1997) explained, “The project method, in unifying students’ interests with action in the world and emphasizing ‘the hearty
purposeful act’, provides one example of the way in which ‘education’ and ‘life’, knowing and doing, are continuous” (p. 8).

Stevenson (1922) wrote of several scenarios where PBL would hold merit in any educational setting, even elementary and high school classrooms. However, it was not until 1969 when McMaster University in Toronto, Ontario, Canada, implemented PBL as a part of the training for medical students (Donner & Bickley, 1993). Since then, the popularity of PBL has progressively grown and is now frequently incorporated into K-12 classrooms (Stanford University, 2001).

The various forms of PBL. Parker (1901, as cited in Schugurensky, 2002), Dewey (1916), and Kilpatrick (1918) collectively laid the foundation for the pillars of PBL. However, as time has passed, various educators refined their ideas and several variations of PBL are now found in today’s classrooms. Variations of project-centered instruction are differentiated in the following paragraphs.

PBL. The Buck Institute of Education (BIE) has developed a gold standard of PBL, which according to its educators provides an in-depth, meaningful, and quality learning experience for students (Larmer & Mergendoller, 2015a). This gold standard is comprised of eight essential components. According to BIE, projects should always do the following:

- Cover key content knowledge, understanding, and success skills;
- Pose a challenging and relevant problem or question;
- Attempt to explore or solve an authentic situation;
- Be conducted over enough time to provide sustained inquiry;
- Provide student voice and choice in the project itself or its solution;
• Provide ample opportunity for reflection;
• Support opportunity for critique and revision; and
• Produce a publicly-displayed product or culmination of learning.

*Problem-based learning (PrBL).* Another variation of PBL is called problem-based learning. PrBL boasts many of the same criteria as PBL. However, PrBL centers around one particular problem, and students work to find various pathways to solve it. Most notably, the differences lie in that PrBL frequently centers around one particular subject, and the time required and provided by the teacher to accomplish the solution is often less. Also, the end product may not necessarily be a tangible object such as a poster or model; the proposed solution may be simply written in a short essay or brief presentation. Lastly, PrBL may be developed around fictitious problems, thereby lacking the *real world* connection (Larmer, 2014). Figure 1 (repeated here for ease of reference) summarizes the similarities and differences between PBL and PrBL.

*Project-oriented learning (POL).* Yet another variation of PBL is POL. POL is frequently found in K-12 classrooms, often mistakenly called PBL. In POL, a project is used at the end of a unit of learning as a culmination of study (Robin, 2013). The teacher front-loads the students with content and activities to *get the basics down* before the project commences. Often, the projects are lacking time for revision, or they may not change course as the directions are given ahead of time. The project does not drive the learning; instead the project demonstrates the learning done beforehand (Robin, 2013).

The subtle difference between PBL and POL is often confusing to many teachers. This leads teachers to mistakenly label what they’re doing in the classroom as PBL, when in reality they are implementing POL (Schwartz, 2013).

Key Components of PBL

As mentioned above, the BIE has identified itself as a resource for educators implementing PBL in any educational setting. According to the BIE (n.d.-a), “At the Buck Institute for Education (BIE), our highest priority is to help teachers prepare students for successful lives. We do this by showing teachers how to use Project Based Learning in all grade levels and subject areas” (para. 1). As a forerunner in PBL, the organization has established what it calls the “gold standard of PBL” (Larmer & Mergendoller, 2015a, para. 3). This model of PBL has developed and changed over the years and is now used as a leading resource for teachers implementing PBL in their classrooms. They begin with a simple definition of PBL as “a systematic teaching method that engages students in learning knowledge and skills through an extended
inquiry process structured around complex, authentic questions and carefully designed products and tasks” (BIE, n.d.-b, para. 1).

BIE provides various resources for educators interested in or already implementing PBL. One of their most widely referenced resources is the essential components of exemplary PBL projects. First developed in 2010, these essential standards are an attempt to unify the methodology behind PBL. There were originally seven standards. Figure 3 represents the infographic presented by BIE as a guide for the essential components of PBL as it was defined in 2010.

![Image of Figure 3](image-url)


As PBL began to spread across the nation and teachers began implementing it in their classrooms, there was growing concern that PBL did not cover the key content needed for students to succeed in following coursework or standardized tests. As BIE reported,

Soon thereafter we added an eighth element, “Significant Content,” to counter stereotypes that PBL was not an effective method for teaching standards-based
knowledge, understanding, and skills—and to remind teachers to design projects with a clear focus on content standards. (Mergendoller & Larmer, 2015b, para. 1)

Figure 4 represents the modified essential standards, paying special note to the importance of key knowledge and skills that should be present in every PBL project (Mergendoller & Larmer, 2015).


With eight components, BIE supports that PBL projects contain all the necessary content, rigor, and collaboration needed for students to thrive in a 21st century classroom and workforce. Each of these components is described in detail in the following paragraphs:

**Challenging problem or question.** A gold-standard project hosts a challenging question or problem at its core. The question can be abstract, such as providing an opportunity for a student to explore the facets of a controversy and provide evidence for
his or her opinion. It can also be more concrete in nature and focus on a real-world problem that is prevalent in the students’ lives. This question is, What drives the students’ curiosity and engagement? It is recommended to be challenging but not intimidating (Robertson, 2013). BIE recommends that the teacher be directly involved in the drafting of this question so it is properly formatted so that it is student-friendly, applicable to students’ pedagogical content, and will sustain their interest (Larmer & Mergendoller, 2015a).

**Key knowledge, understanding, and success skills.** Gold standard projects contain all the core content and key understandings that are fundamental to a student’s subject and grade level. In a well-designed project, students should be applying this key knowledge to solve problems, answer critical questions, and produce well-informed public products (Larmer & Mergendoller, 2015a).

**Sustained inquiry.** The process of sustained inquiry indicates that a well-designed PBL project will last more than just a few days. Students ask driving questions, then research to answer them, which likely leads to further questioning. This process repeats over and over until a solution is found or an answer is developed. Students are allowed to explore all areas of research; this may include reading about their topic from a book or the Internet, interviewing experts in the field, or exploring the needs of an audience that may use their product, or testing their solutions with a proposed group of participants.

**Authenticity.** Educational projects should reflect real-world problems or questions. These problems or questions should be relevant to the students’ lives at the time. It can reflect current problems in their community or incorporate tasks that are applicable to the workforce outside of school. It can also create products that are useful
to a particular population or surrounding community, or it can have personal interest. In essence, if the project is driven by students’ needs and will sustain prolonged interest, it fits the bill for a gold-standard PBL project (Larmer & Mergendoller, 2015a).

**Student voice and choice.** Simply put, when students are given choice for project selection or the course in which they study it, they will work harder (Brewster & Fager, 2000). Student input can range from just selecting student roles and resources, to drafting driving questions and engineering the product they will create. Older and more advanced students may be capable of forming their own driving question and designing the path in which they’ll research the solution (Larmer & Mergendoller, 2015a).

**Opportunity for reflection.** Through the course of the entire project, both students and teachers should find time to reflect on what they are learning, how they are accomplishing it, and why they have undertaken this project. Reflection can come informally through dialogue and discussion, but should also be documented through journals, formal checkpoints, assessments, and public presentations of learning. Scheduling time for reflection allows students to internalize the learning objectives, set goals, and grow in their project management skills. It also helps the teacher improve on developing and implementing PBL strategies (Larmer & Mergendoller, 2015a).

**Critique and revision.** Giving and receiving constructive feedback is an essential component of a well-designed project. Students must practice both skills, and the internalization of these skills should be guided by rubrics, modeling, and formal critique protocols. Community members and area experts may also add another opportunity for critique and real-world connection. Most importantly, critique must not only be given by the teacher; students must be involved in their own learning and be afforded the
opportunity to evaluate their own learning (Larmer & Mergendoller, 2015a). The timing and specificity of the feedback is also important. Feedback should be prompt, and students should be coached to provide specific feedback that identifies what they did well and isolates what they should improve (Hattie & Timperley, 2007; Stenger, 2014).

**Production of public product.** Incorporating the presentation of a public product raises the stakes of a student’s learning. Products can take several forms: tangible objects, summative presentations in front of an audience, or even a multimedia presentation displayed through social media. The important factor is that the product is shared beyond the walls of the classroom and with a public audience. It also fosters strong connection between school and community (Larmer & Mergendoller, 2015a).

**Advantages of PBL**

The advantages of PBL are perceived as far outweighing its disadvantages, and many experts conclude that eventually PBL will see wider use at all levels of education (Donner & Bickley, 1993). Several advantages are discussed in detail in the following paragraphs:

**Increased student engagement.** Formal research indicates an improved level of student engagement in PBL projects (Rotgans & Schmidt, 2011). Teachers also often comment about increased student engagement during project time at school. When asked how to maintain student engagement during the spring when student emotions are running high, one teacher quipped, “My least engaged students become highly engaged when project time rolls around” (Provenzano, 2016, para. 5).

**Strengthened real-world skills.** The California Academy of Sciences (2015) noted that the innate design of PBL lends to improving student applications of learned
skills in authentic situations. Projects pose questions that are reflective of current issues or challenges in the community. Exploring or solving these problems offers students exposure to relevant issues that will strengthen their contribution to today’s workforce. Moreover, the skills acquired during the project often mirror skills required in the job market today. In fact, sometimes the projects are proposed, designed, and facilitated by employer partners of the school, providing a concrete connection between school and career (D. Adams & Willner, 2016).

PBL not only provides opportunity to learn skills, but these skills often translate to higher test scores, particularly with the Common Core. The California Academy of Sciences (2015) stated, “According to recent standardized test scores for science sections from schools using PBL, students who engage in PBL excel in fundamental skill-based areas, thanks to their ability to apply basic knowledge from hands-on experience” (para. 5).

**Improved teamwork and collaborative skills.** Another suggested benefit of PBL is improved student collaborative skills. Through PBL, students engage in collaborative skills such as researching, designing, revising, and presenting as a group. Both NGSS and CCSS have identified the importance of teamwork and collaboration within their frameworks (NGSS, n.d.), and using PBL for classroom instruction satisfies these criteria.

The benefits of social learning stretch beyond the limits of mandated curriculum. Social learning also teaches students how to interact with peers and navigate personal and professional relationships. Jones (2016) explained, “Schools are a primary setting in which children first learn to negotiate complex social relations with peers and have the
opportunity to build the essential skills that will allow them to be productive members of society” (para. 2).

**Deeper understanding and longer knowledge retention.** Advocates of PBL also claim that students engaged in effective PBL programs gain a deeper understanding of content and retain knowledge longer than those of traditional programs (Penuel & Means, 2000). Research in the elementary grade levels also supports this claim (Cinar & Bayraktar, n.d.) This may be due to the open nature of PBL. It is this *open approach* to methodology that allows students to come to their own conclusions rather than provide structured experiments with expected outcomes that cements their learning and extends retention (California Academy of Sciences, 2015).

Several sources indicated that deeper understanding of material results from collaborative learning experiences, such as those found in PBL. In a well-documented study by Boaler (1997), students taught through traditional instruction were compared to those taught through PBL. Results showed striking improvement in the areas of knowledge depth and retention for students taught through PBL.

**Narrows the gap between low socioeconomic status and school performance.** A review of the literature indicates that implementing PBL will allow all students, even those in poverty-stricken areas, the same quality education throughout the United States. Without the burden of expensive resources such as textbooks or other curricular resources, PBL has the potential to narrow the gap between students of low socioeconomic status and the availability of quality resources. This could help level the nation’s educational playing field for all students (Laur, 2011).
Not only does PBL narrow the socioeconomic achievement gap, but it also shortens the achievement gap found between genders and racial divides. Both boys and girls learn at similar rates, as do students from varying racial, ethnic, and socioeconomic backgrounds (Harris, 2014).

**Schools That Implement PBL: Why High Tech High?**

Nearly 5,000 schools are currently implementing PBL throughout the nation, and that number is expected to grow as schools continue to implement and integrate CCSS and NGSS curriculum (California Academy of Sciences, 2015). One educational network in particular has taken the spotlight of PBL: High Tech High (HTH). Featured in a recent documentary titled *Most Likely to Succeed* (Whiteley, 2015), HTH is described as a school that is “upending the traditional framework” and implements methods that “eschew the traditional instruction” (Thilman, 2015, para. 5).

In 2005, HTH received a $250,000 grant from the California Department of Education to fund the dissemination of successful PBL methodology to non-charter public schools. Since then, HTH teachers have created hundreds of publications documenting their projects, methodology, and developmental processes (College & Career Academy Support Network, n.d.). A recent case study on HTH also described HTH as an *exemplar* school that was characterized by its reported success and was often recommended by experts in the educational field (Behrend et al., 2014).

Referenced as the school “with the most well-refined PBL program” in the world, teachers travel from all over the country to San Diego to be trained by HTH’s PBL experts (Humberstone, 2012, para 3). Teachers may attend on-campus workshops, residencies, or even enroll in HTH’s (2010) credentialing or graduate program.
HTH

HTH is located in San Diego, California, and comprises a network of 13 schools in three locations throughout San Diego. It was founded by 40 civic and high-tech leaders with the objective to facilitate strong leaders in the high-tech industry. All grade levels are represented; students may attend elementary, middle, and high school grades within the HTH network. Each campus boasts a curriculum centered solely on PBL (HTH, 2010).

Approximately 5,000 students are enrolled in the network. Sixty-three percent of HTH’s (2010) population is classified as students of color, and 42% of the student population qualifies for free or reduced lunch. HTH offers a strong PBL program that boasts academic success. In a 2015 study, 71% of HTH alumni enrolled in postsecondary education, which is higher than the rate of applicants from traditional programs within the same district (Beauregard, 2015).

The Need for Further Research on PBL

Some sources have identified the success of HTH alumni and their high acceptance rate to 4-year colleges (Beauregard, 2015; HTH, n.d.). However, there is little evidence documenting the success of HTH alumni and other PBL alumni regarding their academic success in their first year of college. Recent articles suggest that students coming from PBL have a difficult time adjusting to the structure found in traditional collegiate programs. For example, one recent article in the San Diego Reader reflected on the experience of a HTH alumnus as she entered college. The student described her strengths in collaborative work, yet acknowledged that she struggled with traditional assessments, such as multiple-choice exams (Salaam, 2014). Other alumni have spoken
about their thoughts through social media avenues, such as reviews of the school’s experience on Yelp. One reviewer spoke very highly of her experience at HTH, yet noted there were some drawbacks to her academic preparation at HTH, most notably in content acquisition and key behaviors necessary for collegiate success, such as study skills (Ballesta, 2013).

Collectively, the gaps in the research indicate the need for further exploration in regard to the collegiate preparation of alumni from PBL institutions.

Preparing Students for Collegiate Success

College Readiness

The focus of this study was to investigate PBL in terms of preparing students for collegiate success. Research suggests that not only will most future jobs require a college degree, but the salaries of college graduates far exceed those of noncollege graduates, making college a necessary step in today’s economy. Likewise, the strength of the U.S. economy is dependent on the number of postsecondary graduates who will enter the workforce in the next decade.

Today’s workforce demands college graduates. By the year 2020, 65% of jobs will require postsecondary education (Carnevale, Smith, & Strohl, n.d.). Most concerning is that considering the rate of college graduates enrolled in American universities, the United States will fall short of filling its college-educated workforce by 5 million workers (Carnevale et al., n.d.). In short, graduating from college has never been more critical. The U.S. economy is banking on it.

Lifetime salaries of college graduates far exceed those without college diplomas. Research indicates a large discrepancy in salaries for those with bachelor’s
degrees and those without; those with a high school diploma only earn 62% of the salary of a college graduate (Yen, 2014). In a recent study by David Autor (2014) and published in *Science*, the true cost of a college degree is about *negative* $500,000. Not only is college “free” in the long run, but those who do not go to college will lose about half a million dollars in lifetime salary. Leonhardt (2014) stated, “Yes, college is worth it, and it’s not even close. For all the struggles that many young college graduates face, a four-year degree has probably never been more valuable” (para. 3).

**Attending college is far different that being prepared for college.** According to the National Assessment of Educational Progress (NAEP), many students are heading off to college without adequate preparation, and this could be a costly mistake (Petrilli & Finn, 2015). Paying for college when one is not ready for college can have daunting financial consequences on the applicant, with college fees averaging between $24,000 and nearly $50,000 annually (CollegeData, n.d.). Because of this financial impact, determining if students are college ready and will likely succeed is vitally important before a student undertakes the challenge.

**Determining college readiness.** There are various ways in which students are assessed for college readiness. The most familiar is student performance, which is determined by college entrance exams. Both the SAT and the ACT are college entrance exams designed to indicate a student’s collegiate preparedness. These exams are used as a filter to sift through thousands of applications when admissions are at a premium to selective colleges, particularly when the number of applicants outweigh the number of available freshmen enrollments by thousands. They are also used to measure student populations in reviews such as the *U.S. News & World Report*, and in some cases,
employers, such as Goldman Sachs and global investment giant The DE Shaw Group will use these scores to ascertain employee intelligence (Schifrin, 2014).

Most colleges depend on scores from the SAT and the ACT as they provide a standardized measurement void of any factors such as grade inflation or course rigor that often plague this nation’s high schools (Edwards, 2015). Edwards (2015) stated,

It’s easier for college admissions officers to compare students from different cities or states by using the ACT/SAT, rather than their GPA. After all, a 4.0 could mean very different things at different schools, but a 36 on the ACT looks impressive no matter what. (para. 4)

The SAT. Created by the College Board and first administered in 1926, the SAT is one entrance exam option. There are two sections: Evidence-Based Reading and Writing (EBRW) and Math (The Princeton Review, n.d.-b). A third section, the optional essay section, is required by many colleges but not all.

The test requires participants to read lengthy passages and answer approximately 100 multiple-choice questions that ascertain whether or not a student is able to analyze an author’s work and recognize evidence that support claims (Reed, 2015). The math section is formatted to assess students’ skills in higher algebra, statistics, and trigonometry, and relies on calculator-friendly, multiple-choice and short-answer questions (Reed, 2015).

Scoring the SAT reveals that students are now evaluated on a 1,600-point scale, rather than the 2,400-point scale in previous versions of the exam (Edwards, 2015). Each of the two sections has a maximum score of 800. Points are given for correct answers only with the intent of gaining as many correct answers as possible; skipping questions or
marking incorrect answers does not lower one’s score (Edwards, 2015). The test is nearly four hours in length, and costs $54.50 to take all parts, including the optional written essay portion.

**The ACT.** Another option for college-bound students is to take the ACT. Like the SAT, the ACT is comprised of multiple-choice questions and an optional essay-writing section. Students are assessed in four areas: English, math, reading, and science.

Started in 1959 by E. F. Lundquist of the ACT program, the ACT exam was developed as a promise to accurately ascertain what was taught in school. This is the only college entrance exam that includes science content knowledge in its assessment, and ACT boasts that it was the first to develop college and career readiness standards (ACT, n.d.). Several states also administer the ACT as part of their standardized high school exams, thereby increasing its popularity and testing population. All 4-year colleges and universities accept ACT as part of their entrance exam requirements (Marklein, 2007). In its 2014 Career & College Readiness Report, ACT (2014) also notes that more than half of the nation’s college applicants take their test and use it for college admission.

The ACT is scored on a 36-point scale. Each subject is scored individually, and an average or composite score is calculated. Figure 5 compares the SAT and the ACT in respective areas (The Princeton Review, n.d.-b).
<table>
<thead>
<tr>
<th>SAT</th>
<th>ACT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Why Take It</strong></td>
<td>Colleges use SAT scores for admissions and merit-based scholarships.</td>
</tr>
<tr>
<td><strong>Test Structure</strong></td>
<td>Math</td>
</tr>
<tr>
<td></td>
<td>Reading</td>
</tr>
<tr>
<td></td>
<td>Writing and Language</td>
</tr>
<tr>
<td></td>
<td>Essay (Optional)</td>
</tr>
<tr>
<td><strong>Length</strong></td>
<td>3 hours (without essay)</td>
</tr>
<tr>
<td></td>
<td>3 hours, 50 minutes (with essay)</td>
</tr>
<tr>
<td><strong>Reading</strong></td>
<td>5 reading passages</td>
</tr>
<tr>
<td><strong>Science</strong></td>
<td>None</td>
</tr>
<tr>
<td><strong>Math</strong></td>
<td>Covers: Arithmetic</td>
</tr>
<tr>
<td></td>
<td>Algebra I &amp; II</td>
</tr>
<tr>
<td></td>
<td>Geometry, Trigonometry and Data Analysis</td>
</tr>
<tr>
<td><strong>Tools</strong></td>
<td>Some math questions don’t allow you to use a calculator.</td>
</tr>
<tr>
<td><strong>Essays</strong></td>
<td>Optional. The essay will test your comprehension of a source text.</td>
</tr>
<tr>
<td><strong>How It’s Scored</strong></td>
<td>Scored on a scale of 400–1600</td>
</tr>
</tbody>
</table>


**The EAP.** The California State University (CSU) system has also authored a predictor for college success. Written in collaboration with the California Department of Education and State Board of Education, CSU’s EAP is intended to be taken during a student’s junior year in high school. The CSU (n.d.) described, “The program was established to provide opportunities for students to measure their readiness for college-
level English and mathematics in their junior year of high school, and to facilitate opportunities for them to improve their skills during their senior year” (para. 1)

A student’s EAP score is now interpreted from his or her performance on the California Assessment of Student Performance and Progress (CAASPP). This standardized exam is taken during a student’s junior year. The results provided also include an equivalent score on the EAP, and students can use this information to gauge their college readiness. Any remedial coursework can be taken during the summer of their senior year (CSU Success, n.d.). Individualized plans are available through the CSU’s network of websites.

Assessing soft skills. College readiness has been described as being more than just knowledgeable about subjects. Many experts now agree that content knowledge and other measureable academic indicators are only small portions of preparing a student for college. Life skills, such as perseverance, compassion, and study skills, are now considered an important piece of a student’s K-12 academic preparation, and consequently contribute to a student’s readiness for college (Felton, 2016). Specifically, a study conducted in 2004 quantified the importance of soft skills in determining college readiness. According to Robbins et al. (2004), soft skills such as study skills, motivation, and responsibility account for 32% of a student’s readiness for college. Therefore, to adequately define college ready, this research incorporates criteria suggested by experts such as Robbins et al., and further defined by academic expert, David Conley (2007).

According to Conley (2007), college readiness is “the level of preparation a student needs to enroll and succeed—without remediation—in a credit-bearing general
education course at a postsecondary institution that offers a baccalaureate degree or transfer to a baccalaureate program” (p. 5).

Conley explained that currently the U.S. educational system defines college readiness in a two-dimensional, easily quantifiable fashion—only through GPAs, course titles, and college entrance exam performance. Assessment of college readiness in this fashion lends to two prevalent problems; Conley (2007) argued that this has created a system of inflated grades and inaccurately titled coursework: “Rather than leading to an improvement in student readiness for college, this appears simply to have resulted in the compression of grades at the upper end of the scale” (p. 5).

To counteract this skewing of GPAs and high school course curriculum, Conley (2007) supported measuring students in four areas: key cognitive strategies, key content knowledge, key transition knowledge and skills, and key learning skills and techniques. Figure 6 summarizes these four areas and identifies critical skills found in each category.

**Key cognitive strategies.** Not to be confused with the ability to simply recall fragments of memorized knowledge, Conley (2007) explained that key cognitive strategies include skills such as (a) intellectual openness; (b) inquisitiveness; (c) the ability to analyze data; (d) the ability to reason, argue, and prove an idea based on evidence; (e) the ability to interpret conflicting pieces of data; (f) the ability to select the correct tool for precision depending on subject matter, and report its findings with accuracy; and (g) the ability to develop multiple strategies to solve problems.
Key content knowledge. Conley (2012) stated, “Key Content Knowledge refers to key foundational content and ‘big ideas’ from core subjects that all students must know well, and an understanding of the structure of knowledge in core subject areas” (para. 7). Above all core content knowledge, Conley emphasized the importance of the ability to write and research effectively. Knowing how to identify credible sources and then communicate your one’s knowledge in a variety of formats is critical in all coursework (Conley, 2007). However, Conley (2007) also described particular skills in detail for each of the core subjects. These key skills are identified below.

English. Students should hold strong vocabulary and word analysis skills, such as root word and word derivation knowledge. They should be able to critically analyze texts as well as write well-organized and evidence-supported literary pieces, to be presented in
both written and oral formats. Students should be able to strategically read a wide array of literature, using a variety of strategies that aid in comprehension. These strategies might include knowing when to slow down or re-read for comprehension, underline or mark key terms, or highlight important pieces of text (Conley, 2007).

Math. Conley (2007) believed that “college-ready students [must] possess more than a formulaic understanding of mathematics” (p. 15). Students must be prepared to apply their conceptual understandings in an effort to extract a problem from a contextual situation. They must then be able to use mathematics to solve it, and then interpret the solution in the context of the situation. Lastly, Conley described the importance of being able to use a calculator as a tool, “not as a crutch” (p. 15).

Science. Students must be well-versed in the scientific method and be able to use this method to solve problems. They must be aware of how to “think like a scientist”—and understand that scientific knowledge is a dynamic and changing database, with new information being interpreted, challenged, and added to the scientific community every day. They must master core content knowledge and understand that the laboratory is where scientific thinking and core knowledge merge (Conley, 2007).

Social sciences. Using their knowledge of the scientific method, college-ready students are able to interpret sources of information and evaluate evidence and competing claims. Having an awareness of the big ideas that are present in social science will help students avoid feeling overwhelmed when presented with too many details (Conley, 2007).

World languages. More than just learning vocabulary, a college-ready student is able to communicate in another language using a variety of contexts, such as reading,
writing, and speaking. Acquiring a new language is not word-for-word memorization and translation; it’s about acknowledging the culture along with the language (Conley, 2007).

The arts. College-ready students have an understanding and an appreciation for the contributions made by the most innovative leaders in the fields of art, music, dance, and visual arts. They understand their own role as an instrument of communication through physical expression of sound, movement, and visual imagery. They are aware of the role of art in political and social expression. Lastly, they are able to justify their own decisions when demonstrating their own artistic creation, either through sound or visual representation (Conley, 2007).

Key learning skills and techniques. These skills are classified into two wide categories: student ownership of learning and specific learning techniques. Student ownership of learning includes skills such as goal setting, persistence, motivation, self-awareness, advocating for help, and the ability to monitor one’s own progress toward a goal. Specific learning techniques include techniques employed to acquire new knowledge, such as study skills, time management, collaborative-learning behavior, memorization techniques, and strategic reading.

Key transition knowledge and skills. Conley (2012) believed that “Key Transition Knowledge and Skills are necessary to navigate successfully the transition to life beyond high school” (para. 9). This includes knowing which courses to take in high school, understanding financial aid, understanding college-level workloads and norms, and knowing how to self-advocate in a postsecondary setting. This level of
understanding in college may not be readily available to all students; it is often not included in the coursework of students in lower socioeconomic areas (Conley, 2012).

Figure 7 summarizes these key areas of skills, behavior, and knowledge a high school graduate should have as he or she enters college in order to succeed and graduate with a bachelor’s degree (Conley, 2012).

![Figure 7. Key skills included in Conley’s college readiness indicators.](http://www.epiconline.org/ccr-definition/)

**Summary**

When reviewing the literature, it became evident that PBL has only recently become popular in the K-12 setting, particularly as schools strive to fulfill Common Core requirements (Ellison & Freedberg, 2015).
The BIE (n.d.-a) has become the resource frontrunner of PBL. It clarifies the definition of PBL and provides numerous resources for teachers and schools to implement and strengthen PBL programs in K-12 education.

PBL has numerous documented advantages and many see it as the ‘Holy Grail’ of education reform. Noted advantages include (a) increased student engagement (Cinar & Bayraktar, n.d.); (b) deeper understanding and longer knowledge retention (Barron & Darling-Hammond, 2008); (c) improved collaborative skills; (d) emphasizes real-world skills (Adams & Willner, 2016); and (e) narrows the gap between low socioeconomic students and academic performance (Laur, 2011).

Still, many educators and psychologists are questioning the effectiveness of PBL programs across the nation. Psychology research indicates the cognitive gap that is present in PBL, citing specifically that PBL and PrBL assume pedagogical requirements that many students are not prepared for at the time (Kirschner, Clark, & Sweller, 2012; Kirschner, Sweller, & Clark, 2006; Mayer, 2004). Behavior experts are worried that the collaborative nature of PBL excludes introverted students, not providing them enough time to contemplate and reflect on their learning (Godsey, 2015; TED: Ideas Worth Spreading, 2012). Education experts claim that PBL is both a waste of class time and inefficient at teaching content (Provan, 2011; Sweller, 1988). Lastly, the research on PBL may be misleading. With the noted broad interpretation of acceptable PBL projects (Larmer & Mergendoller, 2015b; David, 2008), schools across the nation are implementing PBL programs without clear direction.

Analyzing PBL programs has its own inherent difficulties. Several sources alluded to the misinterpretation of data and skewed samples found in current research.
Data presented on behalf of PBL is taken from a handful of schools known to do PBL well. Resulting data present inaccurate reflections of the majority of PBL programs found nationwide (Brooks, 2015; Sanson-Fisher & Lynagh, 2005).

Collectively, the literature review indicated conflicting evidence on the collegiate preparation of students participating in PBL programs (Brooks, 2015; Kirschner et al., 2006, 2012; Nowak, 2007). Formal research also indicates the gap in data from long-term achievement studies of PBL alumni in college (Beauregard, 2015). With the importance of college education in today’s dynamic workforce (Autor, 2014; Yen, 2014), K-12 schools must prepare their students for college. Therefore, the purpose of this study was to explore the connections found between PBL preparation and college readiness.

Collegiate preparation is also extensively explored throughout the literature review, with the U.S. Department of Education issuing standardized exams in an attempt to measure preparation (Gaggioli, 2014), and behavioral experts noting the importance of soft skills in collegiate readiness (Cromwell, McClarty, & Larson, 2013). To provide a comprehensive overview of college readiness, the literature reviewed various standardized academic indicators such as the ACT exam, the SAT exam, and the EAP exam. The importance of soft skills was also acknowledged, and the literature focused on David Conley (2007, 2012, 2013) as the leading expert on soft skills necessary for collegiate success.

Clearly, not all PBL programs are successful in terms of adequately preparing students for college. This research identifies which college preparatory skills PBL programs are implementing well, and which skills needed for college preparation need to be added and strengthened. Exploring the preparation of students in PBL programs will
assist in the development of PBL programs that consider both academic and behavioral skills in relation to the direct preparation of collegiate success.
CHAPTER III: METHODOLOGY

Overview

This chapter describes the methods and procedures used to conduct this study. It includes the purpose of the study, the research questions, the research design, a description of the population and sample, the development and descriptions of the instrument, field testing, a description of the data collection procedures, explanation of the data analysis, and the limitations of the study.

Purpose Statement

The purpose of this qualitative case study was to explore and describe collegiate PBL high school student graduates’ perceptions of their preparedness for their first year of college and the impact of how the BIE’s eight essential components of PBL (Larmer & Mergendoller, 2015b) contributed to their first year of college preparedness. A secondary purpose was to explore and describe the alignment of the students’ perceptions of the impact of how the BIE’s eight project-based components (Larmer & Mergendoller, 2015b) contributed to their first year of college preparedness as defined by Conley’s (2012) college readiness indicators.

Research Questions

Answers to the following questions were sought to address the purpose of the study:

1. How do collegiate PBL high school student graduates perceive they were prepared for their first year of college?
2. How do collegiate PBL high school student graduates perceive the impact of the BIE’s eight essential components of project-based learning (Larmer & Mergendoller, 2015b) on their first year of college preparedness?

3. How do the collegiate PBL high school student graduates’ perceptions of the impact of the BIE’s eight essential components of PBL (Larmer & Mergendoller, 2015a) on their first year of college preparedness align to Conley’s (2012) college readiness indicators?

Research Design

This study is a qualitative case study, which focuses on students in PBL programs and their perceptions of their own collegiate preparedness as a result. Selecting qualitative research is appropriate as Merriam (2009) confirmed that qualitative research attempts to interpret “how people interpret their experience, construct their world, and what meaning they attribute to their experiences” (p. 14). To accurately describe the experience of PBL, critical questions such as “What constitutes well-designed project based learning?” and “Why would education lean towards this methodology?” and “How well does it prepare kids for college?” were asked. These types of questions are directly aligned with qualitative research (Patton, 2015).

Case Study Research

Merriam (1998) further suggested that this research is best defined as a case study so that “specific issues and problems of practice can be identified and explained” (p. 34). In this study, alumni from the High Tech High (HTH) network of schools in San Diego County, California, were the sample case study used to collect the data. The bounded case of PBL at HTH represents a single unit of analysis as part of the topic of PBL as a
whole. Case study research plays an important role in advancing the knowledge of PBL and its impact on college readiness (Yin, 2014). Yin (2011) also supported the selection of a case study approach to investigate a contemporary phenomenon, such as PBL, in its own authentic context.

A qualitative case study was selected as the methodology for several reasons. First, according to Creswell (2005), a case study aims to accurately define a phenomenon by conducting an “an in-depth exploration of a bounded system (e.g., an activity, event, process, or individuals) based on extensive data collection” (p. 439). Yin (2012) confirmed that using a case study methodology is applicable when a researcher is attempting to address a descriptive question, and is interested in analyzing data that have been collected in a natural setting, thereby retaining holistic and meaningful characteristics of real-life events. Woodside (2010) proposed that a deep understanding of the participants, interactions, and behaviors are all part of the chief objective of case study research.

A qualitative case study is also particularly strong when researching areas in education. As it pertains to research in education, authors Check and Schutt (2011) explained that using the case study approach is “not so much a method, but more of a way of thinking” (p. 190) and is a better alternative to quantitative methods. This is because quantitative methods attempt to “slice and dice” the whole of education in a way that actually “obscures the way it functions” (Check & Schutt, 2011, p. 190). Second, it provides a “thick description” of the whole of project (Check & Schutt, 2011, p. 190). Lastly, a case study has the ability to handle a wide variety of evidence: documents, artifacts, interviews, and observations (Yin, 2014).
Population

A target population is defined by Creswell and Plano Clark (2011) as “a group of individuals (or a group of organizations) with some common defining characteristic that the researcher can identify and study” (p. 142). For the purpose of this research, the target population was all PBL charter high school alumni who at the time of this study were enrolled in college and were within their first year of collegiate instruction at an accredited college or university.

McMillan and Schumacher (2014) defined sample frame as “the list of elements from which the sample is actually selected” (p. 129). From this target population of alumni from all PBL charter high schools, the sample frame for this study narrowed this population to college-enrolled alumni from HTH consortium’s class of 2015 or 2016. This population included alumni from any one of the five from HTH schools located in San Diego County, California. All five schools use the same PBL curriculum and the components of the BIE. Graduation statistics from the five HTH campuses was attained from the California Department of Education (CDE). Table 1 represents a statistical breakdown of these 2015 graduates.

Sample

Patton (2015) indicated that through purposive sampling, researchers “purposively select individuals who they believe will be good sources of information” (p. 51). As demonstrated in the table, the HTH consortium of schools produced 577 graduates, with 2016 results still pending. Selection of the sample participants started with the researcher contacting HTH and requesting a list of contacts who fit the study
### Table 1

**Number of 2015 Graduates and Their Respective Ethnicities From all Five High Tech High Campuses in San Diego County**

<table>
<thead>
<tr>
<th>High Tech High Campus</th>
<th>Total number of graduates</th>
<th>Hispanic or Latino of any race</th>
<th>Amer. Indian or Alaskan Native</th>
<th>Asian, not Hispanic</th>
<th>Pacific Islander, not Hispanic</th>
<th>Filipino, not Hispanic</th>
<th>African American, not Hispanic</th>
<th>White, not Hispanic</th>
<th>Two or more races, not Hispanic</th>
<th>Not reported</th>
<th>Number fulfilling UC/CSU RQMTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Tech High, Gerry and Ann Jacobs Campus</td>
<td>138</td>
<td>60</td>
<td>3</td>
<td>7</td>
<td>1</td>
<td>8</td>
<td>14</td>
<td>44</td>
<td>1</td>
<td>0</td>
<td>136</td>
</tr>
<tr>
<td>High Tech High Intl.</td>
<td>96</td>
<td>45</td>
<td>0</td>
<td>7</td>
<td>0</td>
<td>8</td>
<td>9</td>
<td>25</td>
<td>2</td>
<td>0</td>
<td>94</td>
</tr>
<tr>
<td>High Tech Media Arts</td>
<td>95</td>
<td>40</td>
<td>15</td>
<td>5</td>
<td>1</td>
<td>6</td>
<td>13</td>
<td>29</td>
<td>0</td>
<td>0</td>
<td>94</td>
</tr>
<tr>
<td>High Tech High, Chula Vista</td>
<td>134</td>
<td>93</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>12</td>
<td>9</td>
<td>12</td>
<td>1</td>
<td>0</td>
<td>133</td>
</tr>
<tr>
<td>High Tech High North County</td>
<td>114</td>
<td>19</td>
<td>1</td>
<td>6</td>
<td>0</td>
<td>5</td>
<td>3</td>
<td>80</td>
<td>0</td>
<td>0</td>
<td>111</td>
</tr>
</tbody>
</table>

*Note. Graduate information from 2016 was unavailable as of October 2016. From Graduates by ethnicity, 2014-2015, by California Department of Education, Educational Demographics Unit, n.d.; retrieved from http://data1.cde.ca.gov/dataquest/GraduateReporting/GraduatesByEth.aspx?cTopic=Graduates&cYear=2014-15&cSelect=High%5eTech%5eHigh--San%5eDiego%5eUnifi--3768338-3731247&cChoice=SchGrdbyEt&Thename=&Level=School&cType=ALL&cGender=B&cGroup=G12*
criteria. The potential participants in the first set of contacts were identified using the following criteria:

1. Student attendance for all 4 years at one of the five HTH PBL schools.
2. Student was currently enrolled in his or her first year at an accredited 4-year college.

**Sample Selection**

In the case of this study, the researcher used nonprobability sampling. According to McMillan and Schumacher (2014), “Nonprobability sampling does not include any type of random selection from a population” (p. 136). Instead, as explained by McMillan and Schumacher, the researcher used participants who were accessible and who happened to represent certain characteristics.

Qualitative research typically focuses on relatively small samples. McMillan and Schumacher (2014) defined sampling as identifying “the group of subjects or participants from whom the data are collected” (p. 129). Patton (2015) further clarified that these participants provided “information-rich” data from which to draw conclusions (p. 264). The selection of these participants is called purposeful sampling and can employ a variety of strategies by which the participants are gathered. In any case, purposeful sampling involves the researcher directly selecting members of the target population who represent the criteria defined in the study (Patton, 2015). The researcher depends on his or her own judgement to select these individuals to participate in the study, therefore not leaving the selection of the individuals up to random chance. Selecting these individuals can be done using any of several methods.

Two purposeful sampling strategies were used to gather participants in this study. In order to find the type of participant needed for this descriptive case study, the
researcher used purposeful snowball and convenience sampling techniques that produced the identification of “information-rich cases” like those Patton (2015, p. 264) alluded to as mentioned above. Convenience sampling involves selecting participants who fit the criteria and who are conveniently available to participate (Dudovskiy, n.d.). With convenience sampling, the participants involved in the study were selected due to the level of accessibility (McMillan & Schumacher, 2014).

Snowball sampling was also used. Snowball sampling is an approach that uses key informants to help locate other participants (Patton, 2015). As one participant leads to another, the snowball of study participants gets larger and larger. Creswell (2011) added further that snowball sampling allows a researcher to select the best people for the study, particularly when they are unfamiliar with the topic or complexity of the phenomenon. The snowball strategy used to obtain this sample allowed the researcher to identify a sufficient number of study participants by asking other individuals, well-connected informants, and the participants to suggest names of other potential study participants. The choice to use purposeful snowball sampling was to help the researcher collect a minimum sample size of 12 research subjects who satisfied the specific participant criteria. As Patton (2015) noted, “Exercising care not to overgeneralize from purposeful samples, while maximizing to the full the advantage of in-depth, purposeful sampling will do much to alleviate concerns about small sample sizes” (p. 329).

Beginning first with the list of student contacts provided by the administration of HTH (Appendix B), the researcher then asked each potential study participant to consider his or her own personal and professional network of contacts, and identify anyone who satisfied the initial set of participant criteria. If the participant identified additional
individuals, the researcher asked him or her to provide her with their contact information. Each identified participant was provided with an explanation that he or she would be asked to be involved in an interview and to sign a request form to participate in the study. As potential additional participants emerged, follow-up emails and interviews were scheduled using the same protocol as the original list of contacts.

**Sample Size**

Snowball and convenience sampling led to the acquisition of 12 participants who were included in the study. Although Creswell (2005) suggested that the more cases a researcher chooses to study, the less in depth each case will be, which results in a dilution of the overall analysis; he suggests that “there is not a set number of cases” (p. 76). Creswell suggested that the researcher typically chooses fewer than four or five cases. However, other qualitative researchers have expressed that it is not necessarily the number of participants that defines validity, but the quality of the information collected, thereby warranting smaller sample sizes in qualitative research. Even though a particular phenomenon may appear only once throughout the data collection, it is enough to be considered in the overall analysis of the study (Ritchie & Lewis, 2003). Moreover, after 12 interviews, it is likely that phenomenon will begin to repeat and data saturation be reached (Guest, Bunce, & Johnson, 2006). It is at this point of diminishing return that increasing the sample size lends little to no new information that is pertinent to the results (Crabtree & DiCicco-Bloom, 2006). Therefore, the sample size for this case study consisted of a total of 12 participants. The research further selected a minimum of two students from each of the five HTH schools located in San Diego County, California.
Instrumentation

The researcher represented the primary instrument of qualitative data collection for this study. Using the researcher to administer the instrumentation was vital to this study as to gain an “insider’s perspective” of PBL and how it prepared students for college (Leech, 2002).

Some experts argued that using humans as research instruments is valuable in that they are “highly responsive to environmental stimuli, have the ability to interact with the situation, pull together different pieces of information at multiple levels simultaneously, and perceive situations holistically” (Sanjari, Bahrameneshad, Shoghi, Cheraghi, & Khosnava Famani, 2014). The ability to personalize and synthesize meaning and perceptions from in-depth interviews was also documented by Patton (2015) in his work which identifies key strategies in qualitative research. Another qualitative study expert, Yin (2014), emphasized the important role of collecting data from multiple sources in order to support the qualitative nature of case study research.

Semistructured Interview Questions

This study utilized a standardized open-ended, descriptive semistructured interview (Turner, 2010) to explore how the participants perceived their PBL high school experience prepared them for college, particularly in the four key areas of college readiness as discussed in the study’s literature review. The semistructured format was selected in an effort to collect data that “can provide detail, depth, and an insider’s perspective” (Leech, 2002, p. 665). Interview questions focused on collecting information about the perceptions of the participants’ lived experience within the culture of PBL.
Yin (2014) emphasized the importance of individual interviews as part of case study research. Rather than asking a fixed set of structured questions or a more flexible set of unstructured interview questions, the researcher elected to utilize a semistructured collection of questions as part of this study. The questions within the interview were descriptive questions (Harrell & Bradley, 2009), and were asked to elicit descriptions of PBL in an effort to deepen the understanding of PBL and how it prepared participants for college. Participants were asked identical questions, but the responses were left open-ended. Questions were posed in a conversational and unbiased manner to help produce the necessary data to support this study’s research questions.

The data were triangulated to include information from the interviews, aligned with existing research pertaining to PBL, and finally, connected to college preparedness.

The interview protocol (Appendix C) was designed based on how BIE’s eight essential components PBL instruction readies students for college, as defined by Conley’s four quadrants of college readiness. The interview was divided into two sections. Each interview lasted approximately one hour. The following section is a discussion of the construction of the interview protocol with individual questions. The actual questions and protocol are found in Appendix C.

**Grand tour questions in Section 1.** The first section consisted of five questions, designed as “Grand Tour” (Leech, 2002; Yin, 2011) questions and sought an overview of the student’s collegiate preparedness. Qualitative researcher, Robert Yin (2011), documented the importance of the “Grand Tour question” (p. 137) while opening interviews. The opening questions should serve three purposes:
1. To set the stage of the interview, so that the interviewee will likely provide more detail in his or her answers,

2. To get the interview started on a topic relevant to the research study

3. To direct the interviewee in as minimal a way as possible.

**Experiential and example questions in Section 2.** The second section of the interview consisted of 10 semistructured questions, each written as experiential or example questions (Harrell & Bradley, 2009). The content of each question focused on one of the eight essential components of BIE’s standards of PBL instruction. Each answer allowed insight into how the eight gold standards of PBL instruction fostered improved college preparedness. Probing questions (Harrell & Bradley, 2009) were then asked, depending on the response to the first question. Following is a detailed description of each of the questions asked in the interview.

**Question 1.** Question 1 focused on PBL Essential Component #1: PBL projects pose a challenging problem or question to facilitate projects. Students were given a description of the essential component in a familiar context. Then probing questions were asked to develop an understanding of the value of question-driven instruction in high school as it pertains to college readiness. Additional probing questions were drafted to elicit deeper responses regarding the structure and value of question-driven projects in high school and college if the participant provided limited information.

**Question 2.** Question 2 focused on PBL Essential Component #2: PBL projects are driven by a question or problem that sustains student inquiry. Students were first asked to define the average length of their projects in their PBL high school. Follow-up questions were asked to develop an understanding of the value of the lessons learned that
coincide with completing projects over a long period of time in high school as it pertains to college readiness. Additional probing questions were ready to elicit deeper responses if the participant was unable to provide examples or recall particular situations.

**Question 3.** Question 3 centered on PBL Essential Component #3: PBL projects are designed according to and aligned with real world and authentic context. Students were asked to describe the projects they were assigned in high school and then relate the value of project authenticity in a high school setting to their collegiate preparedness. Probing questions delved into how this particular PBL essential component influenced their collegiate preparedness and impacted their interest level in the project.

**Question 4.** Question 4 explored PBL Essential Component #4: PBL instruction provides ample opportunity for students to share their own voice into project selection and choose the project’s path, direction, and mode of assessment. Question 4 asks students to describe how they were provided an opportunity to use their own voice during their experience in a PBL program. Questions also asked students to describe the value of such an opportunity in regards to college preparation. Additional questions explored whether students carried this same skill into their collegiate experience by exhibiting the confidence to ask professors about course structure or assignments. However, the researcher recognized that in some school cultures, expecting a student to question the authority of a professor may be unlikely. Therefore, probing questions asked participants if they found other opportunities, such as a college club or organization, where they demonstrated the confidence needed to voice their own thoughts or opinions.

**Question 5.** The objective of Question 5 was to explore PBL’s Essential Component #5: PBL projects should provide time for frequent feedback and revision.
Students were asked to describe the frequency and quality of their feedback at HTH. They were then asked follow-up questions that explored the value of frequent high school feedback as it pertained to college readiness. Questions further explored whether students had transferred the skills learned from such a component into their college study skills, specifically if they sought out feedback from professors and were comfortable receiving feedback. Questions also asked students if they maintained professional relationships with their past teachers at HTH and if these relationships assisted their transition through their first year of college.

**Question 6.** Question 6 explored PBL’s Essential Component #6: PBL projects should provide opportunity for frequent self-reflection. Students were asked to identify how they included self-reflection in their PBL program at HTH. Additional questions identified how this essential component transfers into collegiate preparation, specifically if the student continues to use these skills during college. Students were also asked how the ability to self-reflect has helped in their college studies.

**Question 7.** Question 7 focused on a portion of PBL’s Essential Component #7, which recommends that all PBL projects should contain key knowledge, understanding, and success skills. Initial questions were asked in order to gain more information about particular areas of academic strength or weakness. Probing questions pertaining to admission exams such as the ACT or SAT were asked in an effort to provide a more comprehensive and quantifiable picture of the student’s academic capabilities. Students were then asked if they were required to enroll in any remedial classes in an effort to identify any weakness that the student was unaware of in terms of their collegiate academic readiness.
**Question 8.** Question 8 provided an open response question that centered on PBL’s Essential Component #8, which requires all PBL projects to culminate in the production of a public product. Students were asked to describe the types of products they had developed while in high school at HTH, and then identify how this experience has impacted their performance during their first year of college.

Lastly, students were provided a chart of the key skills as identified by Conley (2012). Participants were asked to complete two tasks: first, to place a check mark next to the skill if they recalled using the skill frequently in high school at HTH as well as in college. Next, they were asked to rank the skills in terms of importance from 1-5 with 1 being the most critical skill to master before a student goes to college, and 5 indicating a skill that is not as imperative for collegiate readiness. This information was gathered to identify the most critical skills required as perceived by students in college who completed their high school preparation in a PBL school.

**Validity and Reliability**

The differences between validity and reliability, as well as their place within qualitative research, are reviewed as they pertain to the conclusions made by this researcher. Validity defines the precision with which the findings accurately reflect the collected data, and consists of construct validity and both internal and external validity (Noble & Smith, 2015; Yin, 2014). In other words, validity depends upon the researcher being able to recognize that multiple realities may exist, that the study is dependent upon participants’ perspectives, and that the researcher’s personal experiences may have resulted in bias (Noble & Smith, 2015). Reliability is defined by the consistency of the analytical procedures, and must account for personal bias and methodological biases that
may have influenced the conclusions (Noble & Smith, 2015). Acknowledging these factors is critical to the researcher in order to support the validity of the conclusions and the reliability of the methodology; this is in response to the core of criticism that is often associated with qualitative research.

**Establishing Validity**

Validity was established so that the instrumentation was accurately measuring BIE’s essential components of PBL and relating them in terms of how they prepare students for college.

**Content validity.** Content validity usually depends on the judgment of experts in the field (Kimberlin & Winterstein, 2008). Therefore, the scripted interview questions (Appendix A) were developed by the researcher and reviewed by an expert group before the pilot interviews were conducted. The questions were derived based on the literature review and designed to address the research questions. Each question was written based on how BIE’s eight essential components of PBL instruction readies students for college, as defined by Conley’s four quadrants of college readiness.

For this study, experts in the field of K-12 education and PBL reviewed the interview questions (Appendix B). These experts were two individuals who had earned a doctoral degree, and both had served as superintendents in Southern California schools in the past. One now serves as a coach for current superintendents and is part of a foundational board aimed to open a project-based charter school. The second expert serves as a doctoral chair and is familiar with designing interview protocol, which strengthens validity in qualitative research.
These experts verified the validity of the measure by reviewing the cohesion and relevance between the interview questions (Appendix B) and the research questions. They screened the questions to ensure that they were written in a manner that elicited shared understandings of the key terms in both PBL and college readiness. Following pilot interviews with these two experts, the researcher revised the instrument based on their feedback. This external review procedure was done per suggestions to improve validity in qualitative research (Creswell, 2007).

**Internal validity.** Internal validity refers to the inferences about whether the degree of a student’s collegiate preparedness is indeed caused by his or her participation in PBL (Ary, Jacobs, Sorenson, & Walker, 2014). To establish internal validity, interview questions were drawn so that each essential PBL component could be isolated in terms of how the interviewee perceived its impact on his or her college preparedness. Questions varied in format to establish conversational tone. Probing questions allowed the researcher to expand on particular components that were more or less helpful, as defined by the interviewee and how they rated the component on a Likert scale.

The interview questions were reviewed by an expert group familiar with PBL instruction, and adjustments were made based on their suggestions. The panel of experts included an associate superintendent from traditional schools as well as a retired superintendent who at the time of this study was acting as a founding board member of a project-based charter school. Both experts were familiar with both traditional and project-based instruction. Modifications to the interview protocol were made based on suggestions from the panel.
Establishing Reliability

Roberts (2010) stated, “Reliability is the degree to which your instrument consistently measures something from one time to another” (p. 137). In other words, reliability is the ability of the instrument to repeat results. In this study, reliability was strengthened by the use of a field test. The previously discussed panel of superintendents reviewed the interview protocol to ensure question reliability and consistent interview techniques during field tests (Merriam, 2009).

Field testing. Field tests, also known as pilot tests, are used to ensure that the researcher obtains the correct data to make decisions as well as mitigates issues enabling the researcher to identify and correct problems with both the process and content of data collection instrument (Kimberlin & Winterstein, 2008). A field test of the instrument was administered to students who were familiar with the PBL methodology and attended HTH for all 4 years, yet were not selected for the study. These initial interviews were called pilot interviews and were used to gauge the neutrality and effectiveness of the interview protocol. The pilot group received the exact documents as were given to the sample population. The information given included the cover letter, online survey administration instructions, the electronic informed consent, and the interview protocol itself. During the pilot interviews, an expert observed and provided feedback, until the interviews were able to be conducted while maintaining a neutral interview approach. After the pilot interview was conducted, the participants’ comments, suggestions, and concerns were noted and changes were made accordingly. The expert used was a prior student in the doctoral program who has obtained her Doctorate of Education partially through completion of a dissertation, which used interviews to obtain her data.
After the pilot interviews were completed, modifications were made to the interview protocol so the interviewees recognized the terminology used and it aligned with the PBL instructional practices that students at HTH would recognize.

**Interrater reliability.** Interrater reliability establishes equal ratings when different interviewers score responses. It requires completely independent ratings of the same event by more than one rater (Kimberlin & Winterstein, 2008). In qualitative studies, the researcher is the instrument of the data obtained (Patton, 2015), so all coded data are subject to the biases of the researcher. Interrater reliability was used to address the possibility of coding errors based on any biases.

To support interrater reliability in this case study, two steps were taken. First, the researcher acquired the assistance of two colleagues who had attained their doctorate through the completion of a qualitative study similar to this study. Both were responsible for reviewing the integrity of the interviews, specifically the reliability of the protocol, the interview setting, and the interview process. The protocol (Appendix C) was sent to them via e-mail, and each reviewed the questions as written. An initial discussion between both colleagues and the researcher reviewed the interview protocol, setting, and questioning strategies, and agreement was reached. Following this initial discussion, a pilot test of the interview was then conducted with the researcher as the administrator and each colleague independently as the participant. After the pilot interview, the interview process was closely examined through an in-depth discussion with each colleague to ensure that interviews were conducted in the same way and that all questions were asked as written.
Next, the colleagues reviewed the coding and analyzed the conclusions made from the collected data. They then provided feedback regarding the transcripts, analysis, and coding through an in-depth discussion conducted via Adobe Connect. The colleagues agreed with the analysis and findings of the researcher after reviewing the data. There were no additional questions or findings noted by the colleague.

**Data Collection Procedures**

The data collection process did not begin until the researcher completed several steps to protect the human subjects who participated in this study. The researcher sought and received approval from the Brandman University Institutional Review Board (BUIRB) to conduct this study by submitting the following documents for review: The interview protocol (Appendix D), a letter of invitation (Appendix E), informed consent for the qualitative data collection processes (Appendix F), and a participant bill of rights (Appendix G). Yin (2014) noted the importance of obtaining IRB approval prior to commencing research to ensure participants of their confidentiality, their safety, and their full knowledge of the research.

Upon approval by BUIRB (Appendix H), HTH Administrative Board was contacted requesting contact information from alumni who fit the selection criteria (Appendix B). HTH provided the contact information of 4 alumni who fit the criteria (Appendix I).

An e-mail identifying the researcher, describing the purpose of the study, and requesting an interview were sent to all alumni who fit the criteria in January 2017 (Appendix J). Follow up e-mails were sent 1 week later. (Appendix K). Four participants were gathered through snowball sampling. They were screened to ensure
that they also fit the sample criteria. Another eight participants were also acquired through purposeful snowball sampling as participants and community members provided additional references.

Of the e-mails requesting participation, 14 students responded to accept participation in the study. Twelve alumni were selected for interviews. Interviews were conducted face-to-face when location allowed, or via virtual meetings using Adobe Connect. Interview settings were selected to minimize interruption, yet maintain privacy and comfortable atmosphere. Meetings were recorded and responses were transcribed.

Data Analysis

The qualitative data were collected in the form of interview transcripts. Each interview participant agreed to allow the researcher to record the interview using a hand-held digital audio recorder and back-up audio recording unit to capture the full conversation. Further, the researcher kept a journal of written notes highlighting key interview discussion points and also the notes related to the direct observations made throughout the course of the site visit. The researcher reviewed and enhanced the notes just after completing the site visit to be more complete and comprehensive than was possible during each visit. These notes were transcribed onto a Microsoft Word document.

Coding

Denzin and Lincoln (2011) wrote, “Coding is the first step in taking an analytic stance toward the data” (p. 216). Once the data were collected from the responses, the information was coded by categorizing it into smaller categories of information (Creswell, 2005). Two raters, both doctors familiar with qualitative researcher and
previously described in the interrater reliability section, reviewed the transcripts carefully by reading them three times. Each reading posed new objectives; the first reading was simply to familiarize the reader with the responses, the second was to acknowledge and answer questions, and the final reading was directed toward marking the transcript for information used to analyze the data. The selected information was then narrowed down to a list of tentative codes, which identified key variables of PBL that impact college readiness (Creswell, 2005).

These codes were then inputted into NVivo (n.d.), a software program for qualitative data analysis. Interviews were coded for themes, and connections were drawn between participant responses. The first four of six themes were then grouped according to the theoretical framework of David Conley (2012). An additional theme was identified that corresponded with indicators of college success, namely student performance on college entrance exams, and included in the overall themes. Finally, a sixth theme was identified as the researcher reviewed participant responses and identified the number of responses relating to collegiate struggles. This marked the sixth and final theme included in the overall theme identification.

Trends in data were drawn between BIE’s eight essential PBL components, information gathered from the interviews and Conley’s (2012) skills that improve college readiness. This triangulation of data provided an objective view of the components present in a strong PBL program that are most successful in preparing students for college (Conley, 2012).
Limitations

As with most research that attempts to study human behavior, there are limitations. Limitations are elements in which the researcher has no control, which may include assumptions made by the researcher (Dusick, n.d.). Limitations in this study include the following:

1. Statistical data, such as the graduation and college acceptance rates at HTH, can vary over time.
2. This study was limited to only those who entered a 4-year college, and does not take into account those who entered a community college.
3. It also does not take into account attendance of these graduates, both while in HTH and in college.
4. This study does not account for outside influences on a student’s collegiate performance, such as social commitments, sports, and financial burdens.

Summary

This study was a qualitative case study that focused on identifying the factors that are present in a PBL program that help prepare students for college. The sample was gathered through nonprobability, purposeful sampling. Participants were selected through convenience and snowball sampling. The target population included all charter PBL high schools, and then the study narrowed the sample population to include only those who graduated from HTH network in San Diego County and were enrolled in their first year of an accredited 4-year college.

As with most qualitative research, the instrument conducting the study was the researcher. Data collection was done through semistructured interview questions,
including two grand tour questions, and then experiential and example questions. Probing questions were included to increase the detail provided by the participants.

Validity was established through the guidance of an expert panel to develop the interview protocol and conduct field tests to identify any weaknesses in the interview strategy. Field tests were conducted and an expert panel helped to refine the interview protocol.

Collected data were transcribed and coded using NVivo (n.d.). Trends were identified in the data, and these trends were then triangulated with the essential components found in PBL as defined by the BIE (Larmer & Mergendoller, 2015a), Conley’s (2012) predictors for college readiness, and the transcribed interviews of the participants.
CHAPTER IV: RESEARCH, DATA COLLECTION, AND FINDINGS

Overview

An increasing number of schools nationwide (Tintocalis, 2015) are implementing project-based learning (PBL) as part of their methodology in an effort to align with the Common Core. As schools shift to the Common Core State Standards (CCSS), educators are shifting their methodology to meet the new requirements, which not only include content changes but also stress collaboration and problem solving. In California alone, dozens of districts have increased the amount of time students spend on projects as part of their efforts to align to the Common Core (Ellison & Freedberg, 2015).

However, the literature review indicated conflicting evidence on the collegiate preparation of students participating in PBL programs (Brooks, 2015; Kirschner et al., 2006, 2012; Nowak, 2007). Formal research also indicates the gap in data from long-term achievement studies of PBL alumni in college (Beauregard, 2015). With the importance of college education in today’s dynamic workforce (Autor, 2014; Yen, 2014), K-12 schools must prepare their students for college. Therefore, the intent of this study was to explore the connections found between PBL preparation and college readiness.

This chapter presents the results of the research. It begins with a review of the purpose of the study, the research questions, the methodology utilized, the population, and the sample. Finally, a synopsis of the data is presented. The chapter concludes with the findings from the research.

Purpose Statement

The purpose of this qualitative case study was to explore and describe collegiate PBL high school student graduates’ perceptions of their preparedness for their first year
of college and the impact of how the BIE’s eight essential components of PBL (Larmer & Mergendoller, 2015b) contributed to their first year of college preparedness. A secondary purpose was to explore and describe the alignment of the students’ perceptions of the impact of how the BIE’s eight project-based components (Larmer & Mergendoller, 2015b) contributed to their first year of college preparedness as defined by Conley’s (2012) college readiness indicators.

**Research Questions**

Answers to the following questions were sought to address the purpose of the study:

1. How do collegiate PBL high school student graduates perceive they were prepared for their first year of college?
2. How do collegiate PBL high school student graduates perceive the impact of the BIE’s eight essential components of PBL (Larmer & Mergendoller, 2015b) on their first year of college preparedness?
3. How do the collegiate PBL high school student graduates’ perceptions of the impact of the BIE’s eight essential components of PBL (Larmer & Mergendoller, 2015a) on their first year of college preparedness align to Conley’s (2012) college readiness indicators?

**Research Methods and Data Collection Procedures**

This study was a qualitative case study that focused on students in PBL programs and their perceptions of their own collegiate preparedness as a result. The study explored a bounded case of PBL at High Tech High (HTH), a network of 13 schools located in San Diego County, California. This network represents a single unit of analysis as part of the
topic of PBL as a whole. The research described here plays an important role in advancing the knowledge of PBL and its impact on college readiness (Yin, 2014).

This study utilized a standardized open-ended, descriptive semistructured interview to explore how the participants perceived their PBL high school experience prepared them for college, particularly in the four key areas of college readiness as discussed in the study’s literature review. The use of a semistructured interview allowed the researcher to add additional probes as needed to provide depth to the discussion.

Before the interviews began, the interview protocol, preinterview survey, research questions, and research design were approved by the Brandman University Institutional Review Board (BUIRB) on January 26, 2017 (see Appendix H). Consent forms indicated the methods used by the researcher to protect the identity of the participants and their colleges.

To collect data, the researcher completed two steps. First, an electronic survey was deployed before the one-on-one interview to ascertain general demographics and identify the participants’ perceptions of their college preparedness as they related to the eight essential components as defined by the BIE. Following the completion of the online preinterview survey, participants participated in a virtual interview through the use of Adobe Connect. In the case of each interview, an interview protocol and corresponding presentation (Appendix J) were used to maintain uniformity in the interview process.

Conducting the interviews involved several steps. All consent forms were acknowledged digitally prior to conducting interviews. In addition to confidentiality and participation consent forms, participants acknowledged and provided verbal consent prior
to any digital recording of an interview. Interviews were then conducted and recorded using Adobe Connect, and their transcriptions were sent to a transcription service. The researcher reviewed the recordings with their corresponding transcript to verify the accuracy of the transcribed content. Participants were also asked if they wanted to review their transcript in order to verify content. No participants requested to do so.

Using the four keys of a college-prepared student as defined by education expert David Conley (2012), as well as indicators of collegiate success as defined by the board of education, five themes were identified as overarching themes present in the data. These codes were further defined as they identified key characteristics and skills of a well-prepared college student. A sixth theme emerged as frequent responses indicated gaps in the collegiate preparation of students from PBL institutions. Elaboration about how these gaps were identified is shared later in the chapter. Twelve interviews were then coded into each of these six themes.

Population

For the purpose of this research, the target population was all PBL charter high school alumni who, at the time of this study, were enrolled in college and were within their first year of collegiate instruction at an accredited college or university. From this defined target population of alumni from all PBL charter high schools, the sample frame for this study narrowed this population to college-enrolled alumni from HTH consortium’s class of 2016. This population included alumni from any one of the five HTH schools located in San Diego County, California.
Sample

The researcher contacted HTH and acquired a list of four alumni who fit the study criteria (Appendix B). Snowball sampling further led to the acquisition of 12 participants in total. All potential participants in the set of contacts were identified using the following criteria:

1. Student attendance for all 4 years was at one of the five HTH PBL schools.
2. Student was currently enrolled in his or her first year at an accredited 4-year college.

Demographic Data

Twelve participants took the preinterview survey, and of those 12, one participant skipped the last two questions pertaining to ranking skills and comparing particular groups of skills in a PBL institution and college. Demographic data questions were limited to gender and the site of their HTH high school campus. Figure 8 demonstrates the genders and locations of the participants’ PBL campus.

![Figure 8. Participant demographics: Gender and location of HTH attendance.](image)
Presentation and Analysis of Data

This portion of the study presents the findings of the research. First, the transcripts were reviewed and analyzed according to the three research questions, and overall themes were identified. The first four of six themes were then grouped according to the theoretical framework of David Conley (2012). An additional theme was identified that corresponded with indicators of college success, namely student performance on college entrance exams, and was included in the overall themes. Finally, a sixth theme was identified as the researcher reviewed participant responses and identified the number of responses relating to collegiate struggles. This marked the sixth and final theme included in the overall theme identification. Figure 9 demonstrates the six identified themes and the number of corresponding responses.

![Overall Emergent Themes](image)

*Figure 9. Overall themes and number of corresponding responses in each theme.*

These six identified themes served as the parent nodes to which data were coded. Within these six nodes, 35 daughter nodes further identified specific skills and mirrored those that were previously identified as indicators of college success. Figure 10 describes the skills included under each node.
Figure 10. Descriptions of the skills and characteristics encompassed by each node.

**Frequency of Participant Responses**

The quotes from participants summarized in this dissertation were anecdotal examples of how students described their experiences. These responses were first identified on the Likert scale, and interviews were used to elaborate responses to questions. Although each interview followed identical protocol, some participants were more verbal than others due to a variety of reasons, including language barriers, virtual interview connectivity, and clarity, or available time. Therefore, the number of exact quotes cited as examples of agreement(s) in responses by participants varied.

Figure 11 demonstrates the participant number and the number of corresponding responses referenced in this study.
Research Question 1

How do collegiate PBL high school student graduates perceive they were prepared for their first year of college?

The intent of this first question was to explore the student perceptions of college preparedness in relation to their PBL high school experience. This first question was designed as a grand tour, experiential question. Therefore, this question directly asked students to describe in what ways they felt prepared for college, and in what ways they struggled in their first year of college. Data were taken from the responses of the one-on-one interviews conducted after each participant completed a preinterview online survey.

Collegiate strengths. Participants identified three areas where they noted that their transition from a PBL institution to college was smooth and relatively easy. These three areas—communication, self-awareness, and collaborative learning—were
mentioned 155 times throughout the 12 interviews. Table 2 describes the frequency of response in terms of participants and numbers of references made during interviews.

Table 2

*Frequency of Perceived Strengths of PBL Education for the First Year of College*

<table>
<thead>
<tr>
<th>Theme: Collegiate strengths</th>
<th>Number of respondents indicating theme</th>
<th>Number of references</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication</td>
<td>12</td>
<td>56</td>
</tr>
<tr>
<td>Self-awareness</td>
<td>12</td>
<td>67</td>
</tr>
<tr>
<td>Collaborative learning</td>
<td>10</td>
<td>32</td>
</tr>
</tbody>
</table>

**Communication.** All 12 students interviewed responded with communication as their strongest asset to their college preparedness. Collectively, there were 56 references to communication as a strength that resulted from their PBL preparation.

As Table 2 demonstrates, all participants voiced some reference to communication as a resulting strength created by their PBL experience. Some voiced it as strength in presenting, such as Participant 6 who explained, “I was able to feel stronger and confident in my ability to give a presentation.” Participant 10 also mentioned this same confidence.

HTH helped me a lot, because at every grade we had to present at the end of the full year. In college, you have to do presentations and it helped me a lot. I was at first scared, but I knew that I was going to be great.

Participant 8 repeated this same confidence: “All the skills that I gained through a project and through presenting a project or having it public has helped in all of my little projects, little assignments in college, and then bigger, larger scale projects.” Still, some participants were able to sum their strength in communicating with, ironically, very few
words. Participant 12 summed her confidence in presenting concisely as, “We were required to present our work and talk about it.”

Others explained the ability to communicate in terms of with their peers and professors. For example, Participant 8 explained, “It’s being able to communicate with my classmates and not being afraid to speak to my professors. . . . It’s something from project based learning that’s really helped me.” Participant 9 also mentioned communication as a strong hold: “I think High Tech High did a really good job on providing me with really good social skills. I use these social skills to make friends and network with other people, including my peers as well as my teachers.” Yet another participant, Participant 11, voiced, “[HTH] cultivated a skill of being comfortable talking to authority figures. When having ideas about a project or other topic, HTH has made me more comfortable about doing that.”

**Self-awareness.** Yet another skill every participant mentioned was a keen sense of self-awareness that results from their PBL experience. Self-awareness was referenced 67 times, and it became evident that this is a second area of strength for PBL graduates. This, combined in some cases with strong communication skills, was identified as something that has helped these students succeed during their first year of college.

Participant 1 explained, “[I will] go up to the teacher and say, ‘Hey look this is working for me, or it is not working for me, or I have to figure out what works for me.’” Participant 2 agreed,

I think it was especially useful in the transition coming from high school to college because everything was new in the beginning, but [I started] figuring out where I studied best, how I studied best, and what I needed to do before each test.
Participant 8 mentioned, “I sort of [have] been able to figure out what exactly I’m having trouble with and then kind of do something to solve that.” Participant 10 also mentioned a similar idea: “What we worked on, what we still need to work on . . . HTH already taught me this.”

Participant 3 gave a broader description of the positive impacts of self-awareness. He explained that his PBL experience led him to be able to reflect on “how we think we’re growing as a student and a person,” also allowing him opportunity to “discover his own learning style.” He applied this to his life context and added,

I think that is super fundamental to not just growing up and going to college, but growing up and going into this world because most people that go to a traditional high school they just follow the rules, and just follow the status quo. I think that coming from a high tech school you really learn about yourself . . . what your strengths and weaknesses are, how you can improve your weaknesses, and how you can [improve] the strengths that you already have. But also it’s [about] learning how to help others.

**Collaborative learning.** Learning how to help and work with others was part of a third area of strength called collaborative learning. Collaborative learning was mentioned by 10 of the 12 participants and referenced 32 times.

Participant 4 noted, “I feel like one area where I feel prepared for when it came to my college courses was group work.” She continued, “Being from a project based learning school and having a lot of projects . . . you do work with other people. I feel like that was something big time helping me on my college transition.”
It became clear that these students from PBL programs were extremely comfortable working in groups and even leading other students occasionally in college. For instance, Participant 8 explained,

[Our college study group] probably honestly would have not gotten together if I was not the one to initiate a meeting or get together. After that, we needed more practice so I initiated another meeting. I kind of took charge of the situation which is something that I did a lot and that other people in high school did as well.

A similar leadership response was said by Participant 3: “Whoever wants to take [the] lead has to lead to their strengths and play to their weaknesses. And I think that is something completely essential in college because not a lot of kids want to talk.”

Participant 3 also gave more detail on how collaborative learning provided opportunity to learn how to lead while in high school: “[When] we were in groups, it really helped us focus our life, work together as a team, focus on the task at hand, [and identify] how to distribute the workload and what the best direction for us would be to play to our strengths and weaknesses.”

Collegiate struggles. Participants also noted three areas that were tougher transitions as they moved from a PBL program to a traditional program in college. These three areas included the methodology and instructional style of college, the pace of the information and coursework, and the nature of required math courses in college. Table 3 displays the number of responses within each of the three top themes of collegiate struggles.
Table 3

*Frequency of Respondents and References Made Regarding Collegiate Struggles of Students Graduating From PBL Education*

<table>
<thead>
<tr>
<th>Theme: Collegiate strengths</th>
<th>Number of respondents indicating theme</th>
<th>Number of references</th>
</tr>
</thead>
<tbody>
<tr>
<td>Differences in collegiate instructional methodology and style</td>
<td>11</td>
<td>48</td>
</tr>
<tr>
<td>Pace of information and coursework</td>
<td>10</td>
<td>34</td>
</tr>
<tr>
<td>Perception of math preparation</td>
<td>11</td>
<td>34</td>
</tr>
</tbody>
</table>

*Collegiate methodology and instructional style.* The difference in the instructional style and methodology of college courses was noted by 11 of 12 participants and was mentioned 48 times. Transitioning from a PBL program to a traditional collegiate program notably involved changes in the design of courses, the instructional style of the professors, and the grading requirements.

Participant 4 gave a detailed description of the differences and resulting difficulties she faced when coming from a PBL program to a traditional collegiate program.

> I did struggle with the class because it was just like, a ton of reading. I think I would overpack myself, [and consequently] not be able to manage my time, along with having a lot of reading to do. And I just feel like that kind of was challenging to be able to manage the workload and my time.

Participant 2 acknowledged this difficult adjustment: “The first round of midterms were the most stressful because I had never taken a midterm.” Participant 3 gave more detail into the difference in the design of the courses:
I think I’m still holding on to my lifestyle that I received from HTH because math classes here are like the same at a regular high school. They ask you for a book and they just teach you the lesson. And then we’re going to take a quiz on at the end of the week. Then we just go and recite it.

Participant 5 also noted the difficult adjustment to the instructional design of collegiate courses: “I think [I struggled because] it was mostly how the course was taught. Because it was mostly teaching by a presentation and just her really reading everything off her presentation.” Participant 6 also noted the difference in the testing styles:

I’m happy that in high school I didn’t learn so much on multiple-choice, just because I work better with projects. But in college I had to learn how to do that, so I guess that’s something that I was unprepared for compared to other students.

Participant 11 noted a more difficult area of transition as well: “I guess like memorizing information and midterms and other exams. At HTH that wasn’t the focus.” Participant 1 also noted that the style of the classes was “a lot of just lectures and exams,” and the coursework consisted of “just listening, reading the textbook, and taking exams.”

**Pace of information and coursework.** Wrapped into the differences in instructional style and methodology was the pace of the information delivered at the collegiate level. This quickened pace showed to be starkly different from the experience the participants had in their PBL high school. As seen in the following paragraphs, it was mentioned by 10 of the 12 participants and constituted 34 references found within the interviews.
As noted above, Participant 4 again had a lot to say about the differences in the pace of the information in addition to the comments she made about the differences in classroom instruction and design. She explained,

We move faster so I feel like it was a rough transition . . . like having [time in] high school for working on projects for like weeks to all of a sudden having to do [an assignment] in one week or day. It was kind of hard.

One participant, Participant 11, had numerous instances where she mentioned the pace of the class being a difficult transition from a PBL experience. She explained first, I don’t want to say [PBL hasn’t had a] positive impact because that kind of implies that it’s done bad things for me, but so far the assignments that I am being assigned at a big research university. . . . It’s not built around giving a full length of time for a project.

She described the most difficult transition for her: “I think PACING. It wasn’t like you had to do a crazy intense amount of covering the material in a short span of time like . . . because the projects were so long. It was more lenient.” She mentioned again in her interview, “I definitely think the pacing of content is really valuable because I think that’s been my biggest struggle. My biggest struggle [has been] just adjusting to how fast it is.” She also explained of her friend who was facing a similar struggle,

She actually feels that she’s been struggling even more than I can say I have . . . that she’s actually taking some time off because she just feels like so overwhelmed. I think it’s if there’s a way [for PBL] to somehow be a little stricter with deadlines for projects in the same way that some college professors are.
Other participants reflected on the pacing of collegiate courses throughout their interviews as well. Participant 7 explained, “You can’t sit back as much,” and then further clarified,

Your classes move on to new topics very quickly. There’s just not that feeling that “oh I’m going to be thinking about this one thing for a long time” anymore. So I just felt like I abandoned that mindset when I got into college.

Participant 1 summed up the thoughts on the difference in pacing in a very short, yet pertinent reflection: “We have deadlines in college.”

**Math.** Struggles in math were mentioned by 11 of the 12 participants and accounted for 34 responses. Participants 1 and 9 were the most frequent responders in regard to their struggles while transitioning from PBL math methodology to math instruction in a traditional collegiate program. Participant 1 described her math experience in a PBL program as “the one thing that PBL needs to work on,” because “math is really just formulas and there’s not really a creative way to look at it. It’s just like this is what it is the slope of a line, no matter how you try to make it seem . . . that’s just the way it is.” Participant 9 described his experience by stating, “So definitely I think math . . . math was something that was a very, very hard transition.” He continued, “Definitely I would say that the math department was something [that] I was shortchanged in coming into college.” Participant 7 also described his experience in math in a similar fashion:

I’m taking all of the math classes throughout my time here in college. So my first one didn’t go as well as I [would have] liked. I took calculus and it was pretty
hard to get accustomed to knowing so many things because I didn’t really have
that much of a foundation in trigonometry or just pre-calculus.

He compared his experience to that of his peers who had gone to traditional high
schools, and stated, “My peers . . . went into all sorts of tangents like applications . . . like
abstract applications. [Some] that I had never seen before. So I feel like there is a lot of
abstract thinking in college and intense mathematics. I wasn’t really prepared for that.”

Some participants stated that they were postponing entering math courses because
they did not feel prepared to take the math courses offered at their university. Participant
1 explained, “And I was honestly just holding myself back because I do not feel prepared
at all.” Participant 2 reflected the same apprehension:

I’m more tentative to register for math class or science because I don’t feel like
I’m strong with background and basic knowledge as my peers that are going in.
Maybe they’ve taken a class before, or they took an AP exam on it. They know
that they’re ready, but for me, I’m a little bit more tentative to take those math and
science classes.

Others mentioned that they were required to take remedial math courses to
improve their foundational knowledge so that they could strengthen their performance in
collegiate math courses. Participant 5 mentioned her lack of preparation in math on
several instances. For example, she explained, “I’m doing remedial math here, so it’s not
actually the math that I’m supposed to be taking in college because of what wasn’t
learned in high school.” She also stated,

Yeah they just don’t prep you like I feel they should because every year is a
different subject in math. . . . Math is something that I will struggle with and I
know I will always struggle on it, but I think that’s because of the way that it was taught in high school and in middle school as well.

Participant 5 hypothesized that the reason she may not have absorbed the math instruction is because of the collaborative nature of PBL. She clarified,

And that’s something I’ve never learned. It’s all group work. There’s nothing wrong with that, but in math we do so much of it. I don’t think that it’s needed. It’s giving too much time. You’re not actually learning as a student what’s needed to know in the short amount of time [of high school].

Lastly, Participant 9 expressed his disdain for his math preparation by saying,

“The math [instruction in PBL], I seriously think that it needs to be changed and I would say every way possible. It was not the greatest experience for my senior year.”

**Research Question 2**

*How do collegiate PBL high school student graduates perceive the impact of the BIE’s eight essential components of PBL (Larmer & Mergendoller, 2015b) on their first year of college preparedness?*

The intent of this second series of questions was to explore the student perceptions of college preparedness specifically in relation to the eight essential components of PBL. Students were first introduced to the eight components and provided a short description of the meaning of each component. They were then asked to reflect on the usefulness of each component via a preinterview, online survey. Participants then rated each component in terms of usefulness using a Likert scale of 1 (*not useful at all*) to 4 (*very useful*). Data were first reviewed in the preinterview survey,
and then participants were asked to expand on why they had scored this component with the particular rating they gave.

The preinterview survey produced results showing the usefulness of each of the eight components. Table 4 represents the resulting Likert scores from each of the eight components.

Table 4

Comparison of Mean and Percentage Responses for Participant Survey of the Perception of Usefulness of Buck Institute PBL Components

<table>
<thead>
<tr>
<th>Essential PBL component</th>
<th>Mean</th>
<th>Not useful at all</th>
<th>Not very useful</th>
<th>Somewhat useful</th>
<th>Very useful</th>
</tr>
</thead>
<tbody>
<tr>
<td>Challenging problem or question</td>
<td>3.58</td>
<td>0</td>
<td>0</td>
<td>41.67%</td>
<td>58.33%</td>
</tr>
<tr>
<td>Sustained inquiry</td>
<td>2.92</td>
<td>0</td>
<td>25.0%</td>
<td>58.33%</td>
<td>16.67%</td>
</tr>
<tr>
<td>Authenticity</td>
<td>3.33</td>
<td>0</td>
<td>8.33%</td>
<td>50.00%</td>
<td>41.67%</td>
</tr>
<tr>
<td>Student voice and choice</td>
<td>3.42</td>
<td>8.33%</td>
<td>8.33%</td>
<td>16.67%</td>
<td>66.67%</td>
</tr>
<tr>
<td>Frequent feedback and revision</td>
<td>3.83</td>
<td>0</td>
<td>0</td>
<td>16.67%</td>
<td>83.30%</td>
</tr>
<tr>
<td>Provide opportunity for reflection</td>
<td>3.25</td>
<td>0</td>
<td>8.33%</td>
<td>58.33%</td>
<td>33.33%</td>
</tr>
<tr>
<td>Key knowledge, understanding, and success skills</td>
<td>2.67</td>
<td>8.33%</td>
<td>25.0%</td>
<td>58.33%</td>
<td>8.33%</td>
</tr>
<tr>
<td>Production of a public product</td>
<td>3.75</td>
<td>0</td>
<td>0</td>
<td>25.00%</td>
<td>75.00%</td>
</tr>
</tbody>
</table>

Essential Component 1: PBL projects should pose a challenging problem or question to facilitate projects. The first essential component suggests that PBL projects should be driven by a challenging problem or question. This question is what drives the students’ curiosity and engagement, and is recommended to be challenging but not intimidating (Robertson, 2013). Participants were asked to rate the usefulness of this
component in terms of their collegiate preparation using a 4-point Likert scale of 1 (not useful at all) to 4 (very useful). Of the 12 respondents replying, students scored this particular component as somewhat useful with an average score of 3.58.

When asked about this component, Participant 12 explained, “I’ve learned how to select a topic and expand all ideas under the arching idea. Now I’m better able to pick topics to sustain my interest.” Participant 2 related her experience with this component to projects she has been assigned in college: “I think I’m used to this because I’m used to focusing a lot of time into one question and exploring all different options and all different types of solutions.”

**Essential Component 2: Projects should sustain student inquiry.** The process of sustained inquiry indicates that a well-designed PBL project will last more than just a few days. Students ask driving questions, and research to answer them, which likely leads to further questioning. This process repeats over and over until a solution is found or an answer is developed. Given an average score of 2.92, the 12 respondents collectively scored this essential component as barely somewhat useful in terms of collegiate preparedness. This lower score is represented in their responses from their interviews. Some participants pondered the pace of college instruction as the reason why this particular component was not as useful in college. Participant 6 noted, “Yes it really depends on the class.” She explained how in some classes, they are more experiential and project based, yet other classes are designed to maximize the amount of content learned, and therefore, do not offer the time for a long project. Participant 7 also rated this particular component lower and supported his rating as he explained, “But when you come to college, you don’t have enough time; you can’t just sit back as much.”
However, others noted the skills gained from being required to deeply explore topics over an extended period of time. For example, Participant 3 reasoned, “If you’re giving a long-term project, it teaches the kids the skills to self-manage and to maintain themselves, and not to leave [their work] till the last possible minute.”

**Essential Component 3: PBL Instruction should provide authentic projects.** Educational projects should reflect real-world problems or questions. These problems or questions should be relevant to students’ lives at the time. Participants in this study scored this particular component an average of 3.33, indicating that it was *somewhat useful* in their preparation for college. Participant 1 noted, “I said somewhat useful because I feel like it’s going to come into play later on.”

Not only are students expressing their knowledge about current events, but they are connecting these ideas to their writing and academic achievement. Participant 11 supported the concept of authentic projects in a high school setting: “What I definitely have appreciated about HTH is that it doesn’t literally follow textbooks. All of the projects that I’ve done at HTH . . . I was able to connect to current events.” Participant 3 made a more direct connection to her academic achievements, and closely tied these achievements to her knowledge of current events as a result of participating in authentic projects:

This way I can have a conversation and a discussion with people about the topics and themes about certain subjects, and then integrate that into my writing . . . which then becomes more valuable and a better piece of writing. Other people can relate [to it] and open up to [my ideas].
Participant 4 described an overarching advantage due to her participation in authentic projects:

I feel like providing authentic projects was really helpful because like everything you do in college, [it] is kind of what we’re studying. It’s real facts, it’s real studies. So everything that we do, write about, or read about and [the projects] we do are authentic.

Participant 8 related her experience learning with authentic projects to her college experience and explained how it had eased her transition to college: “A lot of the professors are posing real-world questions. And so I feel like I already had my experience to real world questions in high school, so it’s nothing different in college.”

**Essential Component 4: PBL instruction must provide opportunity for student voice and choice.** This component encourages teachers to carve opportunities for students to be involved in choosing the project, defining how they will study it, and also how they will present their knowledge. This component scored an average of 3.62, comfortably identifying it as somewhat useful in college preparedness.

Participants 1 and 2 both described feeling a sense of empowerment, and they related that feeling to having frequent opportunity to voice their choices in a PBL curriculum. They both scored this essential component as strongly somewhat helpful, and further described how it has helped empower them to choose to pursue particular majors in college. Participant 1 described, “It was up to me to figure out what worked and how I wanted to go about projects.” Participant 2 acknowledged, “For me this aspect was so important for my time in high school. Being able to actually choose and steer my education the way that I [wanted] was really empowering [to me] as a student.”
Essential Component 5: PBL instruction must provide opportunity for frequent feedback and revision. Giving and receiving constructive feedback is an essential component of a well-designed project. Students must practice both skills, and the internalization of these skills should be guided by rubrics, modeling, and formal critique protocols. This component scored the highest out of all eight components, with an average Likert score of 3.83. Ten out of 12 respondents gave this component a score of 4, meaning it was very useful to their collegiate preparedness.

Participant 6 discussed how the presence of this essential component in her PBL education taught her to present feedback and receive feedback: “It really teaches us how to use our words, and how to redirect the focus of a project or work without having to hurt anyone’s feelings.”

Participant 7 described that it helped him improve his projects and academic performance.

I was just learning more, and that really helps for college in a sense because you aren’t afraid of that critique whether you get it from your graduate instructors or your professors when they hand back work. You’re open to it and you’re ready to fix your mistakes.

If they didn’t find it readily, some described how they were actively seeking feedback on their own. Participant 1 explained, “I’m actively out looking for ways to have my papers critiqued, whether it is by going to the writing center or just giving it to other friends and having them critique it for me.” She further explained that this also transfers to the courage and willingness to attend a professor’s office hours if she was in need of help:
I feel really confident to go up to teachers or professors, and if I’m having any sort of issues I can just go up to them and ask them like, “Do you have any tips for studying? Or how would you go about doing these insane readings that you have us do?”

**Essential Component 6: PBL instruction must provide opportunity for reflection.** Throughout the course of the entire project, both students and teachers should find time to reflect on what they are learning, how they are accomplishing it, and why they have undertaken this project. This component scored an average of 3.25, with all respondents scoring it as at least *somewhat useful*. During interviews, participants offered clarification as to why this was particularly useful in college.

Participant 3 discussed learning about his/her own particular learning style throughout the course of frequent self-reflection: “I think if you learn more about yourself and your learning style as a person . . . you learn more of the road to get there . . . what works and what doesn’t.” Participant 5 confirmed this. “Yeah getting frequent feedback and revisions helps you understand what you’re doing as a learner as well as a student, and also knowing how to really challenge yourself.”

Some students expressed applying this self-reflection skill in a broader perspective, such as with their college course navigation. Although they may not have time for it in one particular class or with a formal reflection, several are employing this skill as they reflect on their academic performance, course selection, or study habits. Participant 8 explained, “So far [the skill of reflection has] been here for me mentally and to think about myself I suppose. But I haven’t actually reflected on anything in paper or in writing for school.” Participant 12 described how she is using the skills that she
garnered from frequent reflection in her PBL program now in her college studies:

“[When I] reflect on previous semesters, [I’m] able to pinpoint what part of the class worked and what didn’t. [I] use this to take a particular type of class. [It also helps me learn] how to find a balance.” Participant 2 describes specifically her advantages while practicing this skill during her transition to college:

I think [this] was especially useful in the transition coming from high school to college, because everything was new in the beginning. But [I used reflection to] figure out where I studied best, how I studied best, and what I needed to do before each test.

**Essential Component 7: PBL instruction must contain key knowledge, understanding, and success skills.** A well-designed project should contain all the core content and key understandings that are fundamental to a student’s subject and grade level. This means that through completing the project, students should learn and understand the academic content that is required for a particular grade level. This component scored the lowest of all eight with an average Likert score of 2.67, indicating that students on average felt that their understanding of academic content needed for college success was not very useful.

During each interview, participants were asked not only about their perception of their academic preparation, but they were also asked to provide information regarding their college entrance exam, such as the ACT or the SAT, which they were required to take to enter their university. The SAT or ACT provide unbiased, quantifiable measurements that colleges use to gauge a student’s academic knowledge.
In 11 of 12 responses, participants felt well prepared for their English coursework. In some cases, their performance on the reading and writing portion of their entrance exam mirrored this confidence. Participant 5 stated, “My writing and reading were stellar . . . like I have perfect scores on them.” Other respondents stated the same. Participant 12 acknowledged, “I’m definitely pretty prepared for writing.” Participant 9 responded, “My scores in English . . . I think [they were called] reading and writing. . . . I scored really well on those.” Participant 2 also reflected on her performance in English. “Analyzing text . . . I{409}o I think I got a really good base knowledge from [PBL], and I think I’m coming in at the same level [as students from traditional programs].

Participants offered specific ways in which they felt best prepared. Among the top responses, the ability to interpret and analyze text and information surfaced with the most sources and the most frequent responses. Eleven of 12 participants described positive perceptions of their preparation in terms of being able to interpret and analyze text, and it was mentioned 22 times. Participant 12 stated, “I’ve become very resourceful, as far as like analyzing text, or doing my research.” Participant 6 also confirmed, “And the critical thinking that I learned as a project-based learner has really helped me in the class.” Participant 8 also recognized her strength in English as a result of her PBL education. “I feel like the writing skills that I’ve gained have made it pretty easy and I do a decent job on those.”

When asked about their math preparation, participants seemed, overall, disappointed. All 12 respondents felt unprepared for math at the collegiate level. For some, this was directly reflected on their performance on college entrance exams. Participant 1 described, “My math [score on the college entrance exam was] either
average or a little below average.” Participant 6 mentioned that although she did not have to take remedial math courses, her performance on the SAT was not as high as she would have liked: “I took calculus at HTH, and it’s enabling me not to take any remedial classes because I got in an A in calculus at HTH, even though I didn’t do too well on the math portion of the SAT.”

Depending on the college and the student performance, some students were required to take remedial math courses to make up for their below average performance in math on their college entrance exam. Participant 5 explained, “Now I’m learning geometry and stuff like [that]. I’m learning remedial math stuff. I’m learning algebra that I should have learned in high school.” Participant 10 explained why she gave her PBL content preparation a Likert score of 2 on the preinterview survey. She attributed it to missing the foundational skills she should have acquired during her freshman year.

I would say a 2. At the beginning it was good, but I guess later on, I needed help and I kind of wasn’t getting any help. If you start in sophomore [and junior] year and you try to learn something new, but then you can’t because you didn’t learn it very well the first time.

One student in particular, Participant 9, was frustrated with his lack of math preparation and wanted the researcher to convey his frustration.

This is actually an awesome opportunity that I’m having [participating in this study] because this is actually something that I’ve wanted to bring up with our new director that we have at High Tech High. I’m just glad that I can talk about some of the problems and look at the pros and cons of PBL learning, and I’m glad that I can be part of this.
Participant 9, although enrolled at UC Berkeley, felt shortchanged in his math preparation, and felt that it limited his college options.

[In the case of] state schools, they only take in your GPA and your SAT or ACT. They don’t care about your extra-curriculars or anything else. So essentially for me, I had a really solid GPA. . . . I had a 4.26 graduating. However, I had 26 [on the ACT]. Which didn’t really help me, [because] I didn’t get into a few state schools because I didn’t have a good SAT or ACT.

He summed up his perception of his math experience in PBL by stating, “The math [education] at High Tech High, I seriously think that it needs to be changed and I would say in every way possible. It was not the greatest experience for my senior year.”

**Essential Component 8: PBL instruction should culminate in the production of a public product.** When students know their work will be shared outside the walls of the classroom, it raises the stakes of academic performance. A public product can take any form, including tangible objects, summative presentations in front of an audience, a consumable product or useable invention, or even a multimedia presentation displayed through social media.

This component scored an average of 3.75 on the Likert scale of usefulness. Participants reflected their positive perception in their interviews. Participant 12 stated, “That concept of beautiful work at HTH . . . we had to create something that displayed our learning and also looked aesthetically nice. That’s something I’ve definitely learned how to do really well.”

Participant 2 clarified how a public product created a sense of motivation for her: “That [your product] is actually going to have a life after you’re done with it. It can teach
someone something or somewhere. I think that’s really important.” She continued, “It changes your entire attitude on the project and in college. I wish that there was more of that.”

Participant 3 described the magnitude of the audience present at their product exhibitions. She explained that the presentation of the public product inspired her to do her best:

One of the reasons why we love to do the project so much is because at the end of the project, we would exhibit this project to like not just our parents and the faculty there, but HTH would invite everybody to go . . . whether it would be small companies, CEOs and just other people that we normally wouldn’t see at a school.

**Research Question 3**

*How do the collegiate PBL high school student graduates’ perceptions of the impact of the BIE’s eight essential components of PBL (Larmer & Mergendoller, 2015b) on their first year of college preparedness align to Conley’s (2012) college readiness indicators?*

A second intent of the second series of questions was to align the student perceptions of college preparedness to college readiness indicators as defined by Conley (2012). The responses from the 12 participants were reviewed and behaviors and skills described were aligned with college preparedness indicators.

As participants described particular behaviors and skills through their interview responses, they provided evidence on how PBL, when designed using BIE’s eight essential components (Larmer & Mergendoller, 2015b), prepares students for college.
These same behaviors and skills are included as critical skills that prepare students for college and may align to the categories of Conley’s (2012) college readiness indicators (see Figure 7, repeated here for easy reference).

![Figure 7. Key skills included in Conley’s college readiness indicators. From A Complete Definition of Career and College Readiness, by David Conley, 2012, para. 10; retrieved from the Educational Policy Improvement Center website: http://www.epiconline.org/ccr-definition/](image)

The previous data analysis for Research Question 2 describes the participants’ perceptions of the impact of the BIE’s eight essential components of PBL (Larmer & Mergendoller, 2015b) on their college preparedness and describes specific skills they perceive useful for college readiness for the eight components. Figure 12 represents the alignment of the skills identified in analysis of Research Question 2 to Conley’s (2012) college readiness indicators.
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<td><strong>Key Learning Skills and Techniques:</strong> Learning Techniques</td>
<td>Time management</td>
<td>collaborative learning</td>
<td>Self-awareness, self-efficacy</td>
<td>Help-seeking behavior, persistence</td>
<td>Self-awareness</td>
<td>Strategic reading,</td>
<td>Motivation, persistence</td>
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<td>• Collaborative Learning</td>
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<td>Key Transition Knowledge and Skills</td>
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*Figure 12.* The relationship of skills and behaviors indicated in PBL education as defined by the Buck Institutes’ eight essential components to college preparedness as perceived by student participants. Adapted from “Why We Changed Our Model of the ‘8 Essential Elements of PBL,’” by J. Larmer and J. Mergendoller, May 11, 2015 [Web log post], retrieved from BIE: [http://www.bie.org/blog/why_we_changed_our_model_of_the_8_essential_elements_of_pbl](http://www.bie.org/blog/why_we_changed_our_model_of_the_8_essential_elements_of_pbl); and *A Complete Definition of Career and College Readiness,* by David Conley, 2012; retrieved from the Educational Policy Improvement Center website: [http://www.epiconline.org/ccr-definition](http://www.epiconline.org/ccr-definition)
The following section describes how the collegiate PBL high school student graduates’ perceptions of the impact of the BIE’s eight essential components of PBL (Larmer & Mergendoller, 2015b) on their college preparedness align to Conley’s (2012) college readiness indicators.

**The role of Essential Component 1: The importance of using challenging problems or questions in project design to support college readiness.** Students’ responses show evidence of college readiness when asked about the use of an essential question to facilitate projects. Several students, particularly Participants 7 and 8 mentioned being flexible and being capable of expanding ideas under an overarching theme. This skill was mentioned in Conley’s (2012) suggestions of key cognitive strategies that indicate college readiness. Conley also included a particular skill of inquisitiveness and the ability to use multiple strategies to solve problems as indicators of college readiness. For example, Participant 7 reasoned, “Just that idea of having an overarching question and knowing that you can tackle it many different ways . . . like that flexibility . . . helps a lot in college.”

Participant 8 acknowledged how he is capable of applying multiple strategies to solve problems:

So I think having experience with choosing my own path . . . how I present or answer a certain question . . . has helped now and different ways to go about it have also helped. So I don’t need to just write essays and that’s all the time in order to complete the project.

**The role of Essential Component 2: The importance of sustained student inquiry in project design to support college readiness.** Examining the student
responses to sustained student inquiry, it becomes evident that several students gathered experience in time management. Conley (2012) described time management as an essential learning technique needed for college success. Eight of the 12 respondents mentioned time management as a gained skill, and the connection between extended projects through PBL in a high school setting and teaching time management was evident.

Participant 8 confirmed this connection by stating, “I am familiar with how a project should go, or how to go about a project in order to make it successful. So I think being able to spend a lot of time on one project helps me go through each step and now I’m just trying to do it at a faster pace.”

For example, Participant 3 described how he is using his sense of time management as well: “I think [long-term projects] definitely transitions over to college, because that’s the type of mentality that you need in college because you can’t leave everything to last minute. It’s just not possible.”

The role of Essential Component 3: The importance of authentic projects in project design to support college readiness. Conley (2012) described the value of students being able to link ideas and organize concepts as an indicator to college readiness. Categorized under the key content and knowledge component, Conley described a student’s ability to connect ideas to deepen understanding. This may include connecting ideas to the world around them or connecting ideas to another course and different perspective. In fact, Participant 6 made direct reference to this when describing her PBL experience: “We connected stuff with our biology class, and we learned about
what physical education did to our body. In our humanities class, [we learned] the writing component.”

Another participant connected ideas from a high school course to his college course. He stated,

There were a few readings that I did within with my gender studies class, that I actually did my senior [year] of high school. It was really interesting to see how two different teachers in drastically different settings kind of taught the same material.

Participant 8 described how this is a desirable skill in college courses: “A lot of the professors are posing real-world questions. And so I feel like I already had my experience to real-world questions in high school, so it’s nothing different in college.”

The role of Essential Component 4: The importance of incorporating student voice and choice in project design to support college readiness. Responses from students indicated achieved senses of independence, motivation, and self-advocacy. Conley (2012) also described the importance of self-advocacy and self-efficacy as part of key learning skills and techniques. He described these skills as academic behaviors that are necessary for a student to translate his/her intellectual capabilities into academic success. According to Conley, McGaughy, Kirtner, Van der Valk, and Martinez-Wenzl (2010), “Academic behaviors are self-management skills, attitudes, and habits necessary for students to meet the challenges of college workload and rigor. These include the students’ ability to self-monitor, self-regulate, and self-advocate” (p. 7).

Students suggested acquiring a sense of independence, increased motivation, and learning how to advocate for themselves as results of this essential component.
Independence. Participant 1 expressed her strong sense of independence as a result of being able to steer her project experience: “Coming into college I wasn’t used to having someone hold my hand and tell me what to do every step of the way.”

Motivation. Participant 2 described this motivation:
I think the biggest thing I learned was how to be a self-motivated student, which is so important when it comes to college, because you don’t really have teachers that remind you of deadlines, due dates, and things like that.
She continued, “I can try out things that I might like and I might end up not liking them, but that’s OK because I got pick and do what I was interested in, and then I got to explore that deeper.”

Self-advocacy. Participant 12 voiced this sense of self-efficacy clearly: “HTH is empowering; they let us use our ideas. You have an idea, you want to do something with it, and you can do it.” She in turn described how this has instilled a sense of self-advocacy as part of her personality: “[I] know when to stand up for what I want, what’s important to me, and what I believe in.”

Participant 3 attributed this strong sense of independence, motivation, and self-advocacy entirely to his experience at a PBL institution.

To do these public projects, I think really inspires some of these students to maybe join a club or start their own club. HTH does an excellent job of opening our minds and our eyes that what we’re doing here even though . . . most of the time it seems like we were just doing projects . . . we don’t realize that the stuff that we’re learning and doing is what people are getting paid to do.
The role of Essential Component 5: The importance of including frequent feedback and revision in project design to support college readiness. Results from the responses of this component show evidence of several tenets of Conley’s (2012) definition of college readiness. Conley described a college-ready student as one who demonstrates ownership of learning. To own learning, he suggested that the student they must demonstrate persistence and help-seeking behaviors.

Help-seeking behavior. Collectively, eight of the 12 respondents mentioned being comfortable asking for help while they were in college, and it was mentioned 35 times. Participant 1 described how this particular component transferred to the confidence needed to ask for help while in college:

So I feel like having this in high school . . . it gives me a voice and kind of confidence to trust my teachers and professors and be able to go up to them and ask them what I have when I need help.

Participant 3 confirmed this confidence: “I definitely am reaching out to a lot of adults and a lot of the departments here in Sac State.”

Communication. Several students also mentioned that their ability to communicate was improved due to this essential component. Participant 2 explained that getting and receiving feedback created a culture in her PBL school where students were open to feedback and used it to improve their projects: “I got to do this in high school, [and that] is huge because it kept me open to options and helped me learn from other people how to make how to make my work better.”

Several students discussed that the relationship that is built between the students and their teachers through frequent feedback and revision has helped them in college.
Participant 7 acknowledged this professional relationship: “I’d just like to say that you’re very right about missing our old teachers. They were some of the best teachers I’ve ever had in my life so there is no uncertainty there.” Participant 6 mentioned, “I feel like my relationship with my teacher . . . that kind of taught me not to be afraid of these professors.” Participant 8, when asked about frequent feedback and revision in her high school experience, described that she was very comfortable seeking help in college now: “Well as [for] attending office hours . . . because I did attend office hours when I needed to in high school, so it was kind of the same thing just . . . in the college setting.”

**Persistence.** Through frequent feedback and revision, other respondents described that they would repeatedly be asked to improve their work and were given a variety of suggestions on how to do it. This instills a sense of persistence in students, which is another attribute of a college-ready student, according to Conley (2012). Participant 1 described her confidence and understanding of the revision process: “I’m very used to taking my time. Writing a paper meant writing multiple drafts, and having all of them critiqued multiple times by different people.”

Participant 2 demonstrated behaviors consistent with a sense of persistence as evidenced in this particular comment when asked about the feedback and revision process: “If something doesn’t go as well you want it to, you can still find something that you learn to make next time better.” Through feedback and revision, students in PBL acquired persistence and motivation to do better. Participant 5 described a project in high school, and within her experience, mentioned feedback and the persistence she learned in her multiple attempts to revise.
The project worked really well because there were so many test trials to understand what we can do better, what was good about what we did, and how can we incorporate [the feedback] to know how to fix it and how to make it so [we could understand whether] people enjoyed it or not.

**The role of Essential Component 6: The importance of including reflection in project design to support college readiness.** Conley (2012) defined self-awareness as a student’s ability to monitor his or her own progress and gauge his or her true skill level. All 12 respondents mentioned self-awareness in their responses in some way, and there were 67 references to this skill.

Participant 9 succinctly described the benefits of using self-reflection in a college setting, and how this skill helped her improve her academic performance as she moved through her classes: “While I’m writing an essay or while I’m studying for a test, [I] reflect back on my different circumstances where I did well in my studies, and then I can replicate that and use it for the next time.”

**The role of Essential Component 7: The importance of including key content knowledge in project design to support college readiness.** According to Conley (2012), “Key Content Knowledge refers to key foundational content and ‘big ideas’ from core subjects that all students must know well, and an understanding of the structure of knowledge in core subject areas” (para. 7). Conley emphasized the importance of being to write and research effectively above the importance of being able to recall factual information.

*English.* Content knowledge looks different in various subjects. For English, a student who masters the content should be able to write and research effectively,
critically analyze texts, and write well-organized and evidence-supported literary pieces. This same language, writing and analyzing text, surfaced 22 times within the interviews. Participant 11 described that she is easily capable of writing essays, due to her participation in a PBL program: “I’ve been writing a lot of essays, and I know that solving them around a thesis is easier for me because I feel like we’ve had a lot experience with that in high school as well.” Participant 8 also acknowledged the strength of her acquired English skills in a PBL program: “I feel like the writing skills that I gained have made it pretty easy and I do a decent job on those.”

**Math.** In math, Conley (2012) suggested that students are able to extract mathematical problems from a situation and then use conventional mathematics to solve them. They should then be able to reinsert the answer and be able to solve the problem within context. As Participant 5 explained, pulling math out of context in a collaborative learning session is not always easy: “That’s all we did in math in high school—we collaborated with group things. We always worked with people, and teachers would come and help you out. But [collaborative math] is not something that you need to know in college.” Participant 1 clarified,

Because math is really just formulas and there’s not really a creative way to look at it. It’s just like this is what it is, like this is the slope of a line no matter how you try to make it seem. That’s just the way it is. So I think that’s why I said “not very useful” because it has been in one area [English] but not so much the other.

Participant 12 expressed disappointment that math was not as collaborative in college as it was in her PBL program:
I wish I could apply math more here, but I can’t and I feel like unless I decide to become a mathematician and do math research, those skills don’t come in handy too much anymore . . . how to persist through a problem and not give up. Maybe those skills will come handy in other aspects of life, but as far as math goes, it’s sad to say that math in college doesn’t work like that.

This incongruence between math instruction in a PBL program and math instruction at the collegiate level explains why the content knowledge score on the Likert scale was the lowest of all eight components.

The role of Essential Component 8: The production of a public product in project design to support college readiness. Under Conley’s (2012) key learning skills and techniques category, student traits such as motivation, persistence, and goal setting are included as characteristics of a college-ready student. As evidenced in the responses recorded in the previous section, the key word motivation or behaviors that demonstrate motivation surface frequently, particularly when students talk of producing a product that will be on display for the public. The production of a public product increases motivation for students to produce their best work.

This motivation is evidenced by the following statement from Participant 5 as she explained why she would stay at school until late at night during preparation for the exhibition of her product: “We weren’t forced or obligated to stay for our project, but everybody wanted to because we wanted to make it work that we’re proud of.”

Participant 5 also explained the same sense of motivation:

One thing I can tell you about High Tech High is that any projects that you make, the only reason that students make these outrageous projects . . . the only reason
why they’re so outrageous and they’re so great to look at and see and understand, is because whatever work were putting in. . . . They’re making sure that the work is what they’re proud of, because other people in our community and strangers are going to look at this.

Summary

Chapter IV began with a restatement of the purpose, research questions, methodology, and sample. Those sections were followed by the description of the coding process and overall themes. Six themes were identified from responses and congruencies with the literature review: key cognitive strategies, key content knowledge, key learning skills and techniques, and key transition knowledge and skills. Another theme, college entrance exam performance, was identified to further explore and quantify the key content knowledge of PBL students who are currently enrolled in their first year of college. A sixth theme, collegiate struggles, was added to reflect descriptions offered in response to Research Question 1.

The participants in PBL perceived their college preparedness as strong in terms of communication, self-awareness, and collaborative learning. In addition, they also perceived their preparation in English as strong and sufficient for their first year of college coursework. On the contrary, most participants voiced struggles in adjusting to the difference in course instructional style and methodology, the quick pace of college instruction and expectations, and the stark difference in math instruction and expectations.

In response to Research Question 2, participants were asked to rate the usefulness of each of the BIE’s eight essential components of PBL. Component 1, which requires
projects to be driven by an essential question or problem, scored a 3.58. Participants saw this type of high school education as strongly somewhat useful in terms of college preparation, particularly as it encourages research skills and problem formulation. These skills are listed by Conley (2012) as necessary skills for college readiness.

Component 2, which suggests that all PBL projects sustain student inquiry, was deemed less useful and had an average score of 2.92. Participants described the pace of college as a major contributor to the lack of time for long projects at the collegiate level but saw value in the skills of time management and persistence that are taught when students complete long-term projects in the high school level. Time management and persistence are listed as critical behaviors of a college-ready student as defined by Conley (2012).

Component 3, which suggests that all PBL projects be authentic and solve real-world issues or problems, was scored as a 3.33 by participants. Participants saw value in being exposed to real-world topics but felt that college does not always require this type of information in order to be successful. They did show evidence of the ability to link ideas and organize concepts, a critical skill found under Conley’s key content knowledge category.

Component 4, which suggests that all PBL projects provide opportunity for student voice and choice, scored a 3.42 on the Likert scale of usefulness. Students described this component as an opportunity to learn how to self-advocate and improve their self-awareness. These two skills are included under Conley’s key learning skills and techniques category.
Component 5, which recommends that PBL projects provide frequent opportunity for feedback and revision, was scored the highest out of any of the eight essential components at 3.83. Students found that this particular component creates opportunity for self-awareness. It also improves the confidence needed to seek help and self-advocate. Help-seeking and self-advocating are included under Conley’s key learning skills and techniques category.

Component 6 suggests that all PBL projects provide an opportunity for reflection. This scored 3.25 on average, and students saw value in the self-awareness skills it teaches. Self-awareness, as stated in the previous paragraph, is a key characteristic of a college-ready student. It also encourages communication, which is included in Conley’s key cognitive strategies category.

Component 7 suggests that all PBL projects contain the necessary key content knowledge that a student is required to know in their particular grade level. This category faced the strongest scrutiny from the participants. It scored only a 2.67. Students explained that they were torn between not useful and useful, as they felt their English preparation was strong at a PBL program. However, almost all participants complained of insufficient math preparation for college.

Component 8 suggests that all PBL projects culminate in some sort of public product. This component scored 3.75 on the Likert scale, and participants spoke very highly of the lessons garnered from this particular component. Many spoke of increased motivation as they knew their product would be on display to their community and described the persistence needed to produce a product worthy of public viewing. Conley
(2012) also made reference to motivation and persistence as important attributes of a college-ready student.

Research Question 3 aligned the skills and behaviors found integrated within PBL’s essential components with Conley’s indicators for college preparedness. Essential Component 1 found evidence of improving students’ research skills and problem formulation capabilities, two skills necessary for college under Conley’s key cognitive strategies indicators. Essential Component 2 provided evidence for problem formulation and time management improvement, two skills found under key cognitive strategies and key learning skills and techniques. Essential Component 3 provided evidence of students’ being able to link ideas, organize concepts, and improve their collaborative learning skills. These three skills are included in Conley’s key content knowledge indicators and key learning skills and techniques indicators. Essential Component 4 provided evidence for improved communication, self-awareness, and self-efficacy, all skills included in key cognitive strategies and key learning skills and techniques. Essential Component 5 revealed again, improved communication, but also improved students’ abilities to seek help and persist through difficult situations. These skills are included under key cognitive strategies and key learning skills and techniques as well. In addition, students showed evidence of improved self-advocacy in a collegiate setting, which is a skill identified in Conley’s key transition knowledge and skills category. Essential Component 6 again showed evidence of improved communication and self-awareness, also skills found under Conley’s key cognitive strategies and key learning skills and techniques.
Essential Component 7 had varying results in determining students’ college readiness in terms of key academic content knowledge and understanding. Conley (2012) explained that above all, students should be able to read and write effectively, but identified specific expectations in each subject matter that should be attained as well. In math, students should not only be able to apply mathematical concepts but also understand the formulaic math that is required to calculate problems from context. Students showed strong preparation in English skills, yet struggled with math concepts, which they perceived should have been included in their PBL education.

Essential Component 8 showed improved communication, motivation, and perseverance, all skills which are included under Conley’s key cognitive strategies and key learning skills and techniques.

Participants made suggestions as follows: to increase the rigor of math courses, give at least an introduction to standardized testing, provide AP courses, and also occasionally opt for more traditional instruction to ensure that they are receiving the necessary content needed to navigate collegiate math courses.

Chapter V provides major findings, conclusions, implications, and recommendations for further research.
CHAPTER V: SUMMARY, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

Summary

Chapter V begins with a summary of the study. It also includes the purpose, research questions, methodology, population, and sample. It lists key findings from the study and conclusions drawn from those findings. The chapter outlines implications for action and recommendations for further research surrounding this topic. The chapter ends with final comments.

Purpose Statement

The purpose of this qualitative case study was to explore and describe collegiate PBL high school student graduates’ perceptions of their preparedness for their first year of college and the impact of how the BIE’s eight essential components of PBL (Larmer & Mergendoller, 2015b) contributed to their first year of college preparedness. A secondary purpose was to explore and describe the alignment of the students’ perceptions of the impact of how the BIE’s eight project-based components (Larmer & Mergendoller, 2015b) contributed to their first year of college preparedness as defined by Conley’s (2012) college readiness indicators.

Research Questions

Answers to the following questions were sought to address the purpose of the study:

1. How do collegiate PBL high school student graduates perceive they were prepared for their first year of college?

2. How do collegiate PBL high school student graduates perceive the impact of the BIE’s
eight essential components of PBL (Larmer & Mergendoller, 2015b) on their college preparedness?

3. How do the collegiate PBL high school student graduates’ perceptions of the impact of the BIE’s eight essential components of PBL (Larmer & Mergendoller, 2015a) on their college preparedness align to Conley’s (2012) college readiness indicators?

Methods

This study was a qualitative case study, which focused on students in PBL programs and their perceptions of their own collegiate preparedness as a result. The study explored a bounded case of PBL at High Tech High (HTH), a network of 13 schools located in San Diego County, California. This network represents a single unit of analysis as part of the topic of PBL as a whole.

This study utilized a standardized open-ended, descriptive semistructured interview to explore how the participants perceived their PBL high school experience prepared them for college, particularly in the four key areas of college readiness as discussed in the study’s literature review. The use of a semistructured interview allowed the researcher to add additional probes as needed to provide depth to the discussion.

To collect data, the researcher completed two steps. First, an electronic survey was deployed before the one-on-one interview to ascertain general demographics and identify the participants’ perceptions of their college preparedness as they related to the eight essential components as defined by the BIE. Following the completion of the online preinterview survey, participants participated in a virtual interview through the use of Adobe Connect. The interviews were recorded, and their transcriptions were sent to a transcription service. The researcher reviewed the recordings with their corresponding
transcript to verify the accuracy of the transcribed content. Participants were also asked if they wanted to review their transcripts in order to verify content. No participants requested to do so.

After conducting the interviews, the researcher utilized NVivo software to assist with categorizing and coding the data. Using the four essential skills of a college-prepared student as defined by education expert David Conley (2012), as well as indicators of collegiate success as defined by the board of education, five codes were identified as overarching themes present in the data. These codes were further defined as they identified key characteristics and skills of a well-prepared college student. A sixth theme emerged as frequent responses indicated gaps in the collegiate preparation of students from PBL institutions. Twelve interviews were then coded into each of these categories.

**Population and Sample**

For the purpose of this research, the target population was all PBL charter high school alumni who, at the time of this study, were enrolled in college and were within their first year of collegiate instruction at an accredited college or university. From this defined target population of alumni from all PBL charter high schools, the sample frame for this study narrowed this population to college-enrolled alumni from HTH consortium’s class of 2016. This population included alumni from any one of the five HTH schools located in San Diego County, California.

The potential participants in the first set of contacts were identified using the following criteria:

1. Student attendance for all 4 years was at one of the five HTH PBL schools.
2. Student was currently enrolled in his or her first year at an accredited 4-year college

**Major Findings**

The major findings of this study are organized by research question, and pertain to PBL programs, which are designed using BIE’s eight essential components.

**Research Question 1**

*How do collegiate PBL high school student graduates perceive they were prepared for their first year of college?*

**Major Finding 1.** The most important finding was the respondents’ unanimous agreement that PBL programs which follow BIE’s eight essential components strongly prepare students for college in the areas of communication, self-awareness, and collaborative learning. In addition, student respondents universally recognized their strong preparation in English skills, including reading and writing, analyzing text, and strategic reading.

*Communication.* Participants noted that PBL improves their ability to communicate effectively. It was evident that several of BIE’s essential components of PBL, specifically Components 4, 5, 6, and 8, contribute to the shaping and sharpening of this skill.

*Self-awareness.* Yet another skill every participant mentioned was a keen sense of self-awareness that is resultant from his or her PBL experience. PBL Essential Components 4 and 6 were noted to emphasize this skill.

*Collaborative learning.* Learning how to help and work with others was part of a third area of strength called collaborative learning. References to collaborative learning were found mainly when students discussed the usefulness of authentic projects, but
traces of student strength in collaborative learning were found in discussion throughout all components.

**English skills.** Student participants voiced appreciation for their preparation in English skills, particularly those that pertain to reading and writing. Students explained in several instances that they felt well prepared for English coursework and were capable of writing well-researched essays, bibliographies, and catering their writing to attract particular audiences.

These findings are parallel to the skills in which Conley (2012) determined as most essential to a student’s preparedness for college. Conley stated that students who are college ready are those who can write and research effectively, recall necessary factual information within an academic subject, and identify and use key terms and terminology within a subject as well as link ideas and organize concepts. Other experts (Holmes, 2014) in addition to Conley (2012) also noted the importance of soft skills, as is reflected on a recent article published in U.S. News and Education.

**Major Finding 2.** A second important finding was that students from a PBL education, which follows a BIE gold standard model, may struggle with differences in instructional style, the pace of college coursework, and mathematical skills when transitioning to college.

**Differences in methodology and instructional style of college.** Students from BIE PBL learning experiences have a tougher time transitioning to the instructional style and methodology of courses in traditional college programs.
**Pace of information and coursework in college.** Students from PBL learning experiences also struggle when transitioning from the pace of the information and coursework in a PBL program to the pace of the information and coursework in college.

**Nature of required math courses in college.** Almost all students from PBL learning experiences noted a difficult transition when moving from a PBL learning experience to the more traditional format of collegiate math courses.

This finding validates concerns introduced in Chapter II. An article by Cernavskis (2015) cited similar reactions from students who had recently graduated from a PBL program and were enrolled in their first year of college. “I didn’t really learn study habits at HTH,” said Grace Shefcik (as quoted by Cernavskis, 2015, para. 8).

Other students reflect the same level of frustration, as noted in this review highlighting a video about PBL:

PBL is a mess. In my 9th grade year, we spent 3 months making these boxes with rotating pictures. Almost no one’s would turn, so we had to throw them all away. . . . It is just a bunch of wasted supplies and efforts. It takes students who would be the first to go to college and tells them that they are entitled to a college education (which is totally fine) and then they don't prepare them. (Griffin, 2017)

**Research Question 2**

*How do collegiate PBL high school student graduates perceive the impact of the BIE’s eight essential components of PBL (Larmer & Mergendoller, 2015b) on their college preparedness?*

**Major Finding 3.** Each of the BIE’s essential components of PBL contributes to college preparedness. Each component is responsible for contributing to the education of
at least one skill that positively prepares a student for college. The following defines which skills are commonly acquired when a student participates in a project that is implementing that essential component.

**Essential Component 1: Essential question.** This component is somewhat useful to a student’s college preparedness as it improves a student’s ability to research and formulate problems. Students shared that they transition to college being able to research effectively and are also able to expand on ideas in essays and projects.

**Essential Component 2: Sustained student inquiry.** Essential Component 2 is not very useful to a student’s collegiate preparedness. It emphasizes problem formulation and time management, but many students shared that due to the quickened pace of collegiate instruction, having long-term projects in high school is not a realistic time line compared to college.

**Essential Component 3: Authentic projects.** This component is somewhat useful to college preparedness, as it encourages students to make connections between their coursework and the world around them. The concept of a project as a whole encourages students to work collaboratively, and within this context, prepares students to lead groups of people and facilitate meetings, which is required in some circumstances in college.

**Essential Component 4: Student voice and choice.** This component is somewhat useful to college preparedness. It encourages students to communicate and also instills a sense of self-awareness and self-efficacy. By allowing students the opportunity to use their own ideas and voice their preferences, they learn to self-advocate and engage in dialogue to support their own ideas.
**Essential Component 5: Frequent feedback and revision.** This component received the highest score for usefulness in college preparation. Therefore, it is fair to acknowledge that students who receive frequent feedback and are offered opportunities to revise their work are improving their preparation for college. When teachers implement this component within their project instruction, they allow students to practice their communication and help-seeking behaviors. With frequent revisions, students earn a sense of persistence, making it more likely that they will be able to withstand frequent setbacks, both academic and social, in college.

**Essential Component 6: Opportunity for reflection.** Students scored this as somewhat useful in college as many of them acknowledged that the pace of collegiate instruction does not often afford time to reflect formally on their performance. However, many noted that because this skill was often previously implemented in their PBL learning experience, they now stop to personally reflect on their collegiate performance. Reflecting strengthens a student’s capability to communicate with others and also emphasizes self-awareness.

**Essential Component 7: Key content knowledge.** Participants scored this as not very useful, mainly because of the discrepancy between their English preparation and their math preparation.

Students in PBL programs are confident and comfortable with their English preparation; they are able to write and research, interpret and analyze text, link ideas, and organize concepts. Collectively, these skills allow a student from a PBL learning experience to frequently perform well in collegiate English classes.
However, almost all participants from a PBL program were disappointed with their math preparation. They frequently expressed unpreparedness in terms of their content knowledge or an uneasiness or apprehension of the nature of collegiate math courses. They are unaccustomed to the rigors of collegiate math courses, the traditional nature of the instruction, and the tests they are required to take to prove their knowledge to their professors. Some are responding to their uneasiness by simply avoiding math courses during their first year of instruction at college. Some have had to take remedial courses to improve their foundational knowledge so they might better perform in collegiate math courses.

**Essential Component 8: Public product.** All participants scored this component favorably, leading it to be identified as somewhat useful in a college setting. The inclusion of a public product in a project increases students’ motivation to do their best work. Students describe the trials and tribulations they must have overcome to achieve their finished product, thereby showing improved persistence. When shown at a public exhibition, students are required to discuss their project, its challenges and achievements, and their learning throughout its completion. Therefore, the public exhibition of the product helps strengthen a student’s communication skills.

**Research Question 3**

*How do the collegiate PBL high school student graduates’ perceptions of the impact of the BIE’s eight essential components of PBL (Larmer & Mergendoller, 2015a) on their college preparedness align to Conley’s (2012) college readiness indicators?*

**Major Finding 4.** All essential components of PBL improve students’ college readiness as defined by Conley’s (2012) college readiness indicators.
**Key cognitive strategies.** Conley (2012) defined a college-ready student as someone who is capable of communicating, interpreting and analyzing information, forming problems, and researching effectively. All PBL essential components, with the exception of Component 3, showed evidence of emphasizing and enhancing these skills.

**Key content knowledge.** Conley (2012) stressed that students who are college ready are those who can write and research effectively, recall necessary factual information within an academic subject, identify and use key terms and terminology within a subject, as well as link ideas and organize concepts. Within this category, gold-standard PBL curriculum strongly prepares students in English and writing. Students leave these PBL programs well prepared with skills necessary for effective research, strategic reading, evidence-based and creative essay writing, and crediting sources through appropriate bibliography formatting.

However, based on student responses, PBL designed solely to the eight essential components lacks the rigor and factual knowledge required for students to successfully pass collegiate math courses. According to Conley (2012), well-prepared college-bound students should have a strong formulaic understanding of math and be able to extract a mathematical problem from context and application. They must then be able to use mathematical skills to solve it, and then interpret their answer through the context in which the problem was delivered. Based on the data gathered in this study, students lacked the traditional math skills needed to apply to solve extracted mathematical concepts.

**Key learning skills and techniques.** Conley (2012) also described the importance of students to be able to perform a variety of learning techniques. These techniques
include maintaining focus in a collaborative learning setting, which may include time-management skills. In addition, Conley suggested that students should be able to strategically read, which may include such skills as knowing when to reread material, writing thoughts in margins of text, and paraphrasing material. In this circumstance, students from PBL programs are well prepared. All students described strong collaborative learning skills, including facilitating group learning, conducting meetings, and managing time to get projects done on schedule.

However, Conley (2012) also noted the value in traditional learning techniques, such as memorization and test-taking skills when preparing for college. In this area, students from PBL learning experiences struggle as they move to college programs. Students noted the difficulty they faced when attempting to memorize large amounts of information for college courses, and perceived inadequacy on how to prepare for exams.

**Key transition knowledge and skills.** Conley (2012) noted the importance of preparing students for the *business* side of college. This includes knowing which courses to take in high school, understanding financial aid, understanding college-level workloads and norms, and knowing how to self-advocate in a postsecondary setting.

Only one component of PBL addressed this requirement: Essential Component 4. This component encourages students to voice their concerns as they pertain to their project. This in turn encourages them to self-advocate in a college setting.

In the scope of this research, student participants mentioned that their PBL program covered this component by providing additional instruction on college admission requirements through a college advisor. Students described various times where their campus offered *college knowledge* sessions to both students and parents.
College knowledge sessions offered information on application protocol, financial aid, tuition costs and debt, and the particular offerings that might best suit their needs at various college campuses.

**Conclusions**

The researcher used the key findings to draw relevant conclusions from the data to answer the research questions. The conclusions are listed in order of the research questions that they answer. All conclusions are referring to PBL that is designed using BIE’s eight essential components (Larmer & Mergendoller, 2015a).

**Conclusion 1**

In terms of collaborative learning, communication, self-awareness, and English academic skills, BIE PBL prepares students well for college. Students show strong communication skills, and this is evident as they are comfortable and confident when working with other students and interacting with their professors. They communicate and facilitate interaction between members of their team.

PBL students excel when placed in a collaborative setting in college. They have strong communication skills, and this knowledge is a key piece to their success in working in a collaborative setting. From the responses gathered, alumni from PBL programs seem confident when working with other students, and often described situations where they were leading and facilitating other groups of students. They understand how to account for people’s differences, implement others’ ideas, and respect the diversity of ideas within a group.

PBL students have a keen sense of self-awareness; they are adept at identifying what works well for themselves and what is necessary of additional attention. This sense
of self-awareness allows them to accurately identify when they are academically struggling and when they are academically strong.

Lastly, the perception of the PBL students surveyed was that they graduate with a strong repertoire of reading and writing skills. They are confident with research skills, strategic reading, both creative and evidence-based writing, and are capable of modifying their writing to fit particular audiences.

**Conclusion 2**

There are a few documented gaps in PBL education. These gaps leave students at perceived disadvantages when compared to their colleagues who have attended traditional programs. First, students leaving PBL programs may be unprepared for the instructional style of collegiate programs. If classes are centered on the traditional model of lecture and exams, PBL alumni often are unused to this pattern of instruction and grading.

Secondly, PBL alumni show evidence of being unprepared for the pace and rigor of collegiate instruction. With sustained student inquiry as a leading essential component of PBL, students are often used to long spans of time in which to explore and deepen their understanding of content. This time is simply not afforded in a collegiate calendar. With many schools operating on the quarter system, the length of an entire course is only 10 weeks. Concepts and course requirements are assigned and completed very quickly. The adjustment from the pace of a PBL program to a collegiate program is steep, and many students reflected stress when trying to maintain the pace of the collegiate course requirements.
Lastly, students struggle with transitioning from project-based math to traditional math instruction. They are unaccustomed to solving problems in the form of repetition and practice, and in some documented cases, never had to prove their knowledge on a one-on-one basis. Consequently when they arrive at college and participate in a traditional math course, they are unprepared for the lecture-style delivery of math concepts, the numerous problems assigned to practice a particular math concept, and the exam as the only means to prove their understanding. Moreover, as a result from the collaborative nature of their math preparation, students explained that they were left ill-equipped with foundational math knowledge, and many were now required to take remedial coursework to fill in the gap created from their PBL experience.

**Conclusion 3**

All essential components of PBL contribute to at least one skill needed by students to be prepared in college. Some components, such as giving frequent feedback and allowing for frequent revision, instill desirable behavioral characteristics such as help-seeking, persistence, and communication in students. Learning how to receive feedback improves persistence, while learning how to give feedback encourages communication and help-seeking behaviors. When students are encouraged to revise their work, they show stronger persistence and resiliency as they face repeated requests to improve their work.

Other components, such as ensuring that students have opportunity to voice their concerns and choose their course of study in a PBL project, provide opportunity for students to strengthen their sense of self-efficacy and awareness as well as improve communication.
Leading learning with an essential question allows students the opportunity to expand their research skills and practice forming problems under the guidance of a driving concept. This skill allows them to be able to expand on ideas in college and consider different aspects of a concept before moving on to the next.

Providing students with an opportunity to research authentic projects allows an opportunity for students to connect their learning in the classroom to the world around them, thereby deepening understanding of real-world material.

Learning within the parameters of a project also allows students to practice interpreting and analyzing text, strengthening their communication skills, improving time management, and sharpening their self-awareness and self-advocacy perception. Presenting these projects, particularly when exhibited to a public audience, improves motivation and persistence.

**Conclusion 4**

PBL aligns with indicators of college readiness as defined by Conley (2012). In all components, there is at least one opportunity to strengthen a skill or behavior that is recommended for college success. PBL provides numerous opportunities for students to strengthen their communication skills. It also provides a venue for students to improve their research skills, learn how to link ideas between subjects, and formulate their own problems to explore. Academically, they will likely form a strong foundation in writing and reading.

PBL also provides an opportunity for students to improve behaviors needed in college. They will have an opportunity to improve their sense of self-efficacy, persistence, and self-awareness. They will likely be more motivated to pursue their
education as a result from their increased interest in their chosen projects. If faced with difficulties, they will likely be able to advocate for themselves and seek help if necessary.

**Implications for Action**

The conclusions above suggest several implications for action. These are the researcher’s recommendations to address the conclusions described above. The group or organization responsible for implementing each implication is designated.

**Implication for Action 1**

The results of this study indicated that PBL is effective in improving student communication and self-awareness. It also indicates that PBL prepares students well for collaborative learning in a collegiate setting.

Although PBL is increasing in the amount of schools that use it (Tintocalis, 2015), not every school is using this methodology. It is recommended that an observational study be conducted, which compares PBL programs nationwide to determine the scope of variation within PBL programs. Through an observational study, a researcher has little to no control over the subjects being studied and there is no independent variable (Shuttleworth, n.d.). The researcher will simply observe how a PBL program is conducted without interference or recommendation. Data will be collected to explore the variance of PBL programs throughout the nation. This information would help identify the extent of variation in PBL programs, and provide more accurate statistics on the success of student graduates from PBL programs nationwide.

With results from an observational comparative study that examines the impact of PBL and traditional schooling, practices can be identified that best suit the needs and time constraints of our students. If PBL is identified as a best practice for schools across
the United States, it is recommended that U.S. schools incorporate instructional time within their curriculum for students to engage in at least an annual project that is aligned with the eight essential components as designed by BIE. Projects should be age appropriate and instructionally scaffolded to consider students’ pedagogical capabilities.

**Implication for Action 2**

The results of this study indicate that graduates from PBL programs face challenges when adjusting to the instructional style and methodology of college courses. Therefore, it is recommended that PBL programs in a high school setting offer some coursework that mirrors the instructional style of collegiate courses. This may take the shape of instruction on some traditional methodologies such as test-taking strategies or methods to improve study skills.

The results of this study also showed that PBL programs lack the rigor required to sustain achievement in a quarter-based collegiate system. Therefore, it is recommended that PBL programs offer opportunities for students to experience the increased pace and assignment schedule that is often found in collegiate courses. As students matriculate through high school, rigor should be increased incrementally, culminating in a pace and academic workload that is reflective of college courses.

Increasing rigor can be attained by offering key core content in the form of advanced placement (AP) courses, or providing opportunity for students to take introductory courses in math or other core subject at a local community college while still enrolled in high school. Either will mirror the pace of a collegiate course and also offer a cost-saving opportunity as students can take a college course for much cheaper than it will likely be offered at a 4-year university.
Additionally, BIE should add an additional component to its current eight-component model which recommends projects increase their rigor and pace as students become more adept in project management.

The results of this study also showed that PBL programs lack the rigor required to pass collegiate math courses. Therefore, it is recommended that PBL programs adopt the practice of extracting the math components that are covered within a project and review the math in a more traditional setting with the students. Not only will this allow students to see the applications of mathematical concepts, but it will also reinforce the math in a traditional context so that they will be able to recall the information when faced with similar instruction at the college level.

**Implication for Action 3**

The results of this study indicated that the essential components of PBL as defined by the BIE (Larmer & Mergendoller, 2015b) successfully encompass skills needed for students to be prepared for college. Therefore, it is recommended that the U.S. Department of Education formally adopt BIE’s eight essential components as a supported methodology to implement the Next Generation Science Standards (NGSS). This would require teachers to participate in professional development courses that expose them to the instruction and implementation of a project that is aligned with the eight essential components. It would also lessen the diversity of PBL implementation nationwide and begin to unify the approach to PBL, thereby providing a national standard of PBL implementation.
Implication for Action 4

The results of this study indicated that there is also a disconnect between the methodology offered at PBL institutions and collegiate instruction. Therefore, it is recommended that the university system become part of the discussion of high school preparation for college. It would also require open communication between high schools and colleges, so that K-12 schools can best prepare their graduates for a successful transition to college. This requires universities to inventory instructional practices at their colleges. They would then provide professional development to their professors on best instructional practices at the collegiate level. Beyond identifying best teaching practices at the collegiate level, it also requires universities to meet with high school coordinators to synchronize skills required to succeed in college and identify critical skills needed to attain in high school.

Recommendations for Further Research

Few studies have evaluated the impact of PBL on collegiate preparedness. This researcher was unable to find any prior studies regarding the perceptions of college preparedness of students who have graduated from PBL institutions. The current study determined that PBL instruction encourages communication, self-awareness, and collaboration among students. This study also identified that the eight-component model of PBL has a positive impact on the college preparedness, particularly as it is defined by Conley (2012). Yet it also identified gaps in a student’s college preparation as a result of participating in a PBL high school education, namely in math instruction and the differences in instructional styles of a PBL program and college. Therefore, further study in this area is needed.
This researcher recommends that a study of the effectiveness of PBL in college preparedness be done with a much larger sample to determine if the results of this current study would be confirmed by a larger sample. Perhaps, as more student alumni hear of the implications of this exploratory study, more students will be willing to participate.

Another study that should be conducted is a comparison study between the perceptions of college preparation of students from a traditional school with those who have gone to a PBL institution. There may be struggles in the math preparation of students who completed AP courses through traditional instruction in addition to those who are graduates of a PBL program.

Additionally, a future study should explore the perceptions of PBL graduates over a 4-year college academic career to determine if their perceptions of their PBL preparation on college preparation change as they matriculate through upper-level coursework. There may be more opportunity to use the soft skills honed by PBL as students move closer to graduation and into the workforce.

There is also a need of observational studies that compare PBL programs nationwide to determine the scope of variation within PBL programs. The researcher will simply observe how a PBL program is conducted without interference or recommendation. Data will be collected to explore the variance of PBL programs throughout the nation. Information gathered from such a study would help identify the extent of variation in PBL programs, and provide more accurate statistics on the success of student graduates from PBL programs nationwide.
Concluding Remarks and Reflections

The results of this study are important because they add to the body of research on the impact of PBL as a whole. The study provided data that may determine best practices in educational programs in a K-12 setting, and may even support the expansion of PBL into additional schools throughout the United States.

The researcher has experience in a K-12 school setting and is interested in the increased implementation of PBL nationwide. The researcher believes that PBL will be an important factor in improving educational programs, yet understands that the goal of the K-12 setting is to prepare kids for college. Therefore, it is necessary to identify the impact of PBL, particularly as schools purchase resources and materials to effectively implement it.

This study evolved through several stages into a more meaningful study than it was at its inception. In reviewing the literature, this researcher developed a deeper understanding of the components involved in designing an educationally-sound project for her students, and understands the differences between PBL and project-oriented learning (POL). This new knowledge has deepened her commitment to implementing the best practice of PBL for her students. It is also being used to develop a template for effective project design in her district.

The benefits of this study go beyond just providing data. This study allowed the researcher insight into the inner workings of a well-known PBL facility, and she was consequently able to share these practices with her district and staff at a traditional school. When planning this study, the researcher intended that the conclusions drawn
from its results would have an impact on the implementation of PBL programs in her district, but she now recognizes the implications on PBL across the nation.

The researcher believes that the main conclusions drawn from this study, namely the identified strengths and weaknesses of PBL, should be considered as data to support the development of new and modifications of existing PBL programs so that they better serve the students as they prepare for college. The researcher hopes that this will inspire further studies that will continue to build the evidence on the effectiveness of PBL in K-12 settings.

Ultimately, the researcher would like to publish this work and write a book that summarizes best practices to include as schools develop or modify their PBL programs. In the future, she hopes to build connections between the university and K-12 systems so that we may collaboratively develop methodology that will synchronize K-16 education in the United States.
REFERENCES


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/stem_and_pbl_a_natural_and_essential_connection
Griffin, A. (2017). Re: Oprah’s visit to High Tech High with Bill and Melinda Gates
experiment with data saturation and variability. Field Methods, 18(59). Retrieved
from http://fmx.sagepub.com/content/18/1/59.abstract
interviews and focus groups. Santa Monica: RAND.
Generation Science learning [web log post]. Retrieved from
https://www.sri.com/blog/how-curriculum-materials-make-difference-next-
generation-science-learning
Research, 77(1), 81-112.
http://www.hightechhigh.org/about-us/alumni/those-who-graduate/


155


*Evidence-Based Nursing, 18*(2), 34-35. doi:10.1136/eb-2015-102054


Petrilli, M., & Finn, C. (2015, April 8). College preparedness over the years, according to the NAEP [Web log post]. Retrieved from https://edexcellence.net/articles/college-preparedness-over-the-years-according-to-naep


Radunzel, J., & Noble, J. (2012). Predicting long term college success through degree completion using ACT composite score, ACT benchmarks, and high school grade point average. Iowa City, IA: ACT.


Sanjari, M., Bahrameneshad, F., Shoghi, M., Cheraghi, M., & Khosnava Famani, F. (2014). Ethical challenges of researchers in qualitative studies: the necessity to develop a specific guideline. *Journal of Medical Ethics and History of Medicine, 7*(14). Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4263394/


Whiteley, G. (Director). (2015). Most likely to succeed [Motion Picture].


### APPENDIX A

**Synthesis Matrix for Variables**

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APPENDIX B

Request for Expert Panel to Review Interview Protocol

TO: Mel Robertson, Lisbeth Johnson

RE: Expert Panel for Interview Protocol

Hi there!

How are you? Still typing, typing, typing on my end. Good news is I’m almost done with Ch. 3 and headed to Quality Review and Proposal Defense...hopefully before Xmas.

However, I need your help. Would you be willing to be part of my two-person Expert Panel who will review my Interview Protocol? I would really appreciate it and value your feedback. Do you have time in the next couple weeks to read through my I.P. and give me some feedback? It’s about 10 pages long, and I’m hoping to have the finished version sometime this week, so you would get it next week?

Let me know. Thank you!

Sincerely,

Tanya MacMartin
APPENDIX C

Preinterview Survey

Perceptions of PBL on College Readiness Questionnaire

Overview:

Thank you for participating in this short survey regarding the perception of project based learning on college readiness. The following survey is asking you to rate the degree of usefulness of these eight components towards your preparedness for college. Please respond to the following statements regarding your perceptions of your project based learning experience on your college readiness. Indicate your level of agreement by selecting the number that best describes your perceived perception of how the stated essential component of PBL contributed to your college readiness.

As a graduate of a Project Based learning high school your perceptions will be very helpful in determining the impact of PBL on a student’s preparedness for the college. The Buck Institute of Education has established eight essential components for PBL. The eight essential components are:

1. Essential Component #1: Pose a challenging and relevant problem or question to facilitate projects. One of the core components of PBL instruction is to lead the learning with a driving or essential question. This means that throughout your high school PBL experience, you were often posed with one question which required several disciplines to solve or answer.

2. Essential Component #2: Essential questions should sustain student inquiry. Another of the core components of PBL instruction is that the question that drives projects must sustain a long span of in-depth learning. This means that most often, projects in a PBL institution take a longer stint of time, which is sometimes not afforded in traditional school settings.

3. Essential Component #3: Provide authentic projects. Experts in PBL instruction also encourage teachers to make certain their projects are authentic; in other words that the project or problem solves or explores a real-world topic or issue.

4. Essential Component #4: Provide opportunity for student voice and choice. “In PBL instruction, students are supposed to have a voice in what they study, how they study it, and how they will present their knowledge. Experts call this an opportunity for students to use “their own voice.”

5. Essential Component #5: Frequent feedback and revision. This describes a culture where students are comfortable both giving and receiving frequent feedback about their work.

6. Essential Component #6: Provide opportunity for reflection. PBL experts say that a well-designed PBL project allows students ample time to reflect on their learning. This may include reflecting on the progress your project has undergone, the learning you’ve done along the way or still need to do, or the future path your project may take.
7. **Essential Component #7: Projects should contain key knowledge, understanding and success skills.** PBL experts recommend that every PBL project should contain the core content and key understandings that are fundamental to a student’s subject and grade level. In a well-designed project, students should be applying this key knowledge to solve problems, answer critical questions, and produce well-informed public products.

8. **Essential Component #8: Projects should culminate in the production of a public product.** The last essential component of PBL is the production of a public product. Products can vary and may include but are not limited to presentations to the class, community or experts in the field, websites, models, artwork, or any other media. Students may sometimes choose their method of public presentation.

**Sample Question:**
How useful to your preparation for college was your high school PBL experience of leading learning with a question?

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**Demographic Data Information**

**Directions:** Please checkmark the item that best describes you.

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Please select which project based learning campus you attended for high school.

- _____ High Tech High, the Gary and Jeri-Ann Jacobs campus
- _____ High Tech High, International
- _____ High Tech High, Media Arts
- _____ High Tech High, North County Campus
- _____ High Tech High, Chula Vista
**Directions:**

Please circle the appropriate number that describes your perceptions about how useful each of the following PBL essential components have been to your preparedness for college?

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<td>2. How useful are the skills you acquired from <em>participating in longer, sustained learning projects in a project-based learning high school</em> in regards to your college readiness?</td>
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<td>3. How useful is having authentic projects in a high school project based learning experience in regards to college readiness?</td>
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<td>4. In terms of college readiness, how useful was having the freedom to choose your project’s path and voice your thoughts and opinions during your high school projects?</td>
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<td>5. How useful are the skills you’ve acquired from receiving and giving frequent feedback during your project based learning experience in terms of your college readiness?</td>
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<td>6. How useful have the skills you’ve acquired from frequent self-reflection during your high school project based learning experience been during your college coursework?</td>
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<td>7. How useful was the content knowledge you acquired in your high school PBL learning experience in terms of your college readiness?</td>
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<td>8. In terms of college readiness, how useful are the skills you acquired from the presentations of public products during your high school PBL experience?</td>
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APPENDIX D

Interview Protocol

Interview Introduction. Note to expert panel: the italics represent information that is for the interviewer only and will not be said to the participant.

“Hi __________, thanks for joining me today and offering your time. My name is Tanya MacMartin, and I’m pursuing a doctoral degree in education. My research is focused on the collegiate preparation of students attending a project-based learning institution, just as you did with High Tech High. I’m hoping that my brief time with you will allow others insight into the strengths of such a program, as well as illuminate if there are any areas of improvement that we should focus on in the future. I have a small gift for you as a token of my appreciation and will give it to you at the end of the interview. I really appreciate you taking the time from your busy college life to help me learn more about project based learning and document how education can better help college students like yourself. Would you mind answering a few questions about your experience at High Tech High?

Informed Consent. “As a reminder, any information that is obtained in connection to this study will remain confidential. All of the data will be reported without reference to any individual(s) or any institution(s). After I record and transcribe the data, I will send it to you via electronic mail so that you can check to make sure that I have accurately captured your thoughts and ideas. Did you receive the Informed Consent and Brandman University’s Bill Of Rights I sent you via email? Do you have any questions or need clarification about either document?
At any point during the interview you may ask that I skip a particular question or stop the interview altogether. With your permission, I would like to tape record this interview so that I ensure accurate recording of your responses. Do you have any questions before we begin?”

Section 1:

1. “When you transitioned from a Project-based learning school to college, were there particular areas that you felt well-prepared for in your college classes? Would you provide an example for me?”

2. “Is there any particular area of college life that was a struggle for you? Would you expand on any challenges you faced?

3. During the span of your coursework thus far, which courses or subjects have you found are fairly easy for you? Why?

4. Which ones are challenging? Why?

5. In what ways has your PBL education made your subjects easy or challenging?

Section 2:

As a graduate of a Project Based Learning high school, your perceptions will be very helpful to determine the impact of PBL on a student’s preparedness for college. The Buck Institute of Education has established eight essential components for PBL. These eight essential standards of PBL were key components of your high school PBL curriculum. I will be using the results of your pre-survey to ask a series of questions about these essential components and their impact on your readiness for college. If any of the following descriptions or terms used during this interview is not clear, please feel free to stop me and ask me to clarify.”

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1. **Essential Component #1: Pose a challenging problem or question to facilitate projects.** “One of the core components of PBL instruction is *to lead the learning with a driving or essential question.* This means that throughout your high school PBL experience, you were often posed with one question which required several disciplines to solve or answer. Do you remember experiencing this learning approach in your PBL experience? Using a Likert scale of 1-4, with one being it wasn’t useful at all, and 4 being it was tremendously useful, how useful was this type of instruction during your high school PBL learning experience in terms of your college readiness?

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Probing questions:

a. Can you tell me a little more about why you feel this component was (not useful at all; not very useful; somewhat useful; very useful) in preparing you for your college experience?

b. Can you give me an example where this component of posing a challenging problem or question has helped you with your current college coursework?

2. **Essential Component #2: Sustain student inquiry.** “Another of the core components of PBL instruction is *that the question that drives projects must sustain a long span of in-depth learning.* This means that most often, projects in a PBL institution take a longer stint of time, which is sometimes not afforded in traditional school settings. Using the same Likert scale of 1-4, with one being it wasn’t useful at all, and 4 being it was tremendously useful, how useful was
having sustained student projects during your high school PBL learning experience in terms of your college readiness?

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Probing questions:

a. Can you tell me a little more about why you feel this component was (not useful at all; not very useful; somewhat useful; very useful) in preparing you for your college experience?

b. How did having long-term projects in your PBL learning experience prepare you for college?

c. Can you tell me more about the length of projects in your first year of college? For example:

   i. What is the average span of time that is allowed for projects in college?
   
   ii. Can you describe a project that covered several weeks to complete in college?
   
   iii. What skills in particular did you learn within your PBL learning experience that helped you complete your project?

3. Essential Component #3: Provide authentic projects. “Experts in PBL instruction also encourage teachers to make certain their projects are authentic; in other words that the project or problem solves or explores a real-world topic or issue. Using the same Likert scale of 1-4, with one being it wasn’t useful at all, and 4 being it was tremendously useful, how useful was having authentic projects
during your high school PBL learning experience in terms of your college readiness?

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Probing question:

a. Can you tell me a little more about why you feel this component was (not useful at all; not very useful; somewhat useful; very useful) in preparing you for your college experience?

4. *Essential Component #4: Provide opportunity for student voice and choice.* “In PBL instruction, students are supposed to have a voice in what they study, how they study it, and how they will present their knowledge. Experts call this an opportunity for students to use “their own voice.” Using the same Likert scale of 1-4, with one being it wasn’t useful at all, and 4 being it was tremendously useful, how useful was having the opportunity to ‘use your own voice in your projects’ during your high school PBL learning experience in terms of your college readiness?

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Probing questions:

a. Can you tell me a little more about why you feel this component was (not useful at all; not very useful; somewhat useful; very useful) in preparing you for your college experience?

b. In what ways have you used this skill in college?

5. *Essential Component #5: Frequent feedback and revision.* “One thing I have frequently heard from PBL alumni is the incredibly positive yet professional
relationship students have with their teachers. This has been described by the Buck Institute of Education as “frequent feedback and revision” and essentially describes a culture where students are comfortable receiving frequent feedback about their work. Again using the same Likert scale of 1-4, with one being it wasn’t useful at all, and 4 being it was tremendously useful, how useful are the skills you’ve acquired from receiving and giving frequent feedback during your high school PBL learning experience in terms of your college readiness?

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Probing questions:

a. Can you tell me a little more about why you feel this component was (not useful at all; not very useful; somewhat useful; very useful) in preparing you for your college experience?

b. Would you describe a time when you visited or contacted your college professor during their office hours?

c. Have you ever contacted your high school PBL teachers for school advice after you’ve graduated? Have they provided you with guidance now that you’re in college?

d. Did your teachers in your high school PBL program offer you guidance on the costs of college, what college is like, and what it takes to graduate from college? Would you describe how they did this?

6. **Essential Component #6: Provide opportunity for reflection.** “Experts from BIE say that a well-designed PBL project allows students ample time to reflect on
their learning. This may include reflecting on the progress your project has undergone, the learning you’ve done along the way or still need to do, or the future path your project may take. Again using the same Likert scale of 1-4, how useful are the skills you’ve acquired from frequent feedback self-reflection during your high school PBL learning experience in terms of your college readiness?

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Probing questions:

a. Can you tell me a little more about why you feel this component was (not useful at all; not very useful; somewhat useful; very useful) in preparing you for your college experience?

b. In what ways do you use these self-reflective skills during college?

c. What strategies do you use to remember the content delivered to you during class? For example, do you take notes, record lectures, etc.? How did you learn how to do this?

7. **Essential Component #7: Contain key knowledge, understanding and success skills.** Another essential component of PBL instruction is that all projects should provide an opportunity for the student to learn key academic content, which are essentially the “big ideas” from core subjects. Experts also emphasize the importance of the ability to write and research effectively; this includes being able to identify credible sources, critically analyze text, have strong vocabulary skills, as well as write well-organized and evidence-supported literary pieces. In math, students should have a strong formulaic understanding and be able to apply the required mathematical concepts. In essence, it means that students who graduate
from PBL schools should have all the necessary academic content that is required to pass college courses. Using the same Likert scale of 1-4, how useful was the content knowledge you acquired during your high school PBL learning experience in terms of your college readiness?

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Probing questions:

a. Can you tell me a little more about why you feel this component was (not useful at all; not very useful; somewhat useful; very useful) in preparing you for your college experience?

b. In what ways do you feel your high school experience prepared you academically for college? Please explain.

c. In what ways were you not prepared? Can you expand on this and tell me why?

d. Did you take a college entrance exam as part of your admissions? Which one did you take? How well did you perform on the exam?

e. Did you have to make up any classes when you arrived in college? In other words, did you have to take any remedial classes so that you had the skills necessary to pass general education courses?

8. Essential Component #8: Production of a public product. “Thanks so much for sticking with me during this interview. This is my last question. The last essential component of PBL is the production of a public product. On your school’s website, there are dozens of public products showcased, so I imagine I am correct in saying that almost every, if not all, projects at your PBL high school
culminated in some sort of public product that was displayed. Using the same Likert scale of 1-4, how useful are the skills you acquired from the presentations of public products during your high school PBL learning experience in terms of your college readiness?

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Probing questions:

a. Can you tell me a little more about why you feel this component was (not useful at all; not very useful; somewhat useful; very useful) in preparing you for your college experience?

b. Would you provide some examples or stories as to how this portion of your project based learning background affected your college readiness?

9. Below is a chart that lists the skills experts think every student should have before they go to college. First, place a checkmark next to the skills which were used frequently in your PBL high school experience. Then, place a checkmark next to those that are frequently used in college.

10. Lastly, in your opinion, which are most important? Which are the least important? Please rank the skills in order from 1 being the most important, to 5 being the least important in regards to college readiness.

<table>
<thead>
<tr>
<th>Description of Skill</th>
<th>Used frequently in PBL high school</th>
<th>Used frequently in college</th>
<th>Rank of Importance</th>
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<td><strong>Problem Solving Skills</strong>&lt;br&gt;Such as hypothesizing, researching, analyzing data and interpreting results</td>
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<td><strong>Ownership of Learning</strong>&lt;br&gt;Including goal setting, persistence, self-advocacy, and motivation.</td>
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### Content Knowledge
Being able to recall factual information in each subject.

### Learning Techniques
Such as taking notes, memorizing and recalling new information, study skills and test taking strategies

### College Knowledge
Such as tuition awareness, admission procedures, financial aid, and graduation requirements.

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**End of the Interview**

“This concludes our interview. Do you have any other information that you would like to add or share regarding your experiences in regards to your preparation through project based learning and your college requirements? Within the next week, I will send the transcription of our interview through electronic mail. If you have any corrections or additions, feel free to send them to me. If you would like a copy of my final research findings once the university accepts my study, I would be happy to share it with you. Thank you very much for your time and support in completing my research. As a token of my appreciation, I will also send you a $5.00 Starbucks gift card via email. Please check the email address you gave me for the gift certificate in the next two days. Thanks again!
APPENDIX E

Letter of Invitation to Participate in Survey

Hi ________________.

My name is Tanya MacMartin, and I’m in the process of completing my doctoral dissertation through Brandman University, a subset of the Chapman University system. I’m focusing on the perceptions students have of their college preparedness after they’ve graduated from high school project based learning programs.

I was given your name by _______ at High Tech High, and he suggested I contact you as a possible participant in my study. I understand you are enrolled in your first year of college. To participate in my study, you must have also gone to HTH for all four years of your high school experience. If both criteria are met, then I’m hoping you’d be willing to participate in my survey and interview process. Through this two-step process, we hope to learn more about the strengths of a PBL program, as well as identify any areas of improvement for future programs.

As mentioned above, the study involves two steps. First participants will complete a brief pre-interview survey through an online link with Survey Monkey. After that’s completed, we arrange a time to meet virtually for an approximately 30-minute interview. All can be done through the comforts of your computer. All information is kept private, and in no way impacts you or your education. The results of the study are offered to you when the study is complete.

I’m hoping you can help. I’m offering all participants a $5.00 gift card to Starbucks or Jamba Juice as gratitude for their time. I figure it’s the least I can do as I know you’re likely very busy with your classes.
Would you be willing to participate in my study? Let me know. Thank you!

Sincerely,

Tanya MacMartin

Doctoral Researcher

Brandman University
APPENDIX F

Informed Consent

INFORMED CONSENT FORM

INFORMATION ABOUT: The Impact of Project Based Learning on College Preparedness

RESPONSIBLE INVESTIGATOR: Tanya T. MacMartin

PURPOSE OF STUDY: You are being asked to participate in a research study conducted by Tanya MacMartin, M.Ed., a doctoral student from the School of Education at Brandman University. The purpose of this research study is to explore the experiences of students whom have attended project based learning high schools and describe their preparedness for college. It will also strive to connect the components of project based learning to those recommended for college ready students. This study will fill in the gap in the research regarding the impact of project based learning on college preparedness. The results of this study may assist districts in the design of effective project based learning programs which aim to best prepare students for college.

By participating in this study, I agree to participate in a brief online survey and a one-on-one interview. The pre-interview survey will take approximately 20 minutes to complete. The one-on-one interview will last about 30-45 minutes and will be conducted in person, by phone or electronically. Completion of the pre-interview survey and the one-on-one interview will take place in February 2017.

I understand that:

a. There are minimal risks associated with participating in this research. I understand that the Investigator will protect my confidentiality by keeping the survey results and research materials in a locked file drawer that is available only to the researcher.

b. The possible benefit of this study to me is that my input may help add to the research regarding project based learning programs so that they strongly prepare for students to enter college. The findings will be available to me at
the conclusion of the study and will provide new insights about the project based learning program in which I participated.

c. If you have any questions or concerns about the research, please feel free to contact Tanya MacMartin at macmarti@mail.brandman.edu or by phone at XXX.XXX.XXXX; or Dr. Douglas DeVore (Advisor) at ddevore@brandman.edu.

d. My participation in this research study is voluntary. I may decide to not participate in the study and I can withdraw at any time. I can also decide not to answer particular questions during the interview if I so choose. I understand that I may refuse to participate or may withdraw from this study at any time without any negative consequences. Also, the Investigator may stop the study at any time.

e. No information that identifies me will be released without my separate consent and that all identifiable information will be protected to the limits allowed by law. If the study design or the use of the data is to be changed, I will be so informed and my consent re-obtained. I understand that if I have any questions, comments, or concerns about the study or the informed consent process, I may write or call the Office of the Vice Chancellor of Academic Affairs, Brandman University, at 16355 Laguna Canyon Road, Irvine, CA 92618, (949) 341-7641.

I acknowledge that I have received a copy of this form and the “Research Participant’s Bill of Rights.” I have read the above and understand it and hereby consent to the procedure(s) set forth.

__________________________________________
Signature of Participant or Responsible Party

__________________________________________
Signature of Principal Investigator

__________________________________________
Date
APPENDIX G

Participant Bill of Rights

Any person who is requested to consent to participate as a subject in an experiment, or who is requested to consent on behalf of another, has the following rights:

1. To be told what the study is attempting to discover.
2. To be told what will happen in the study and whether any of the procedures, drugs or devices are different from what would be used in standard practice.
3. To be told about the risks, side effects or discomforts of the things that may happen to him/her.
4. To be told if he/she can expect any benefit from participating and, if so, what the benefits might be.
5. To be told what other choices he/she has and how they may be better or worse than being in the study.
6. To be allowed to ask any questions concerning the study both before agreeing to be involved and during the course of the study.
7. To be told what sort of medical treatment is available if any complications arise.
8. To refuse to participate at all before or after the study is started without any adverse effects.
9. To receive a copy of the signed and dated consent form.
10. To be free of pressures when considering whether he/she wishes to agree to be in the study.

If at any time you have questions regarding a research study, you should ask the researchers to answer them. You also may contact the Brandman University Institutional
Review Board, which is concerned with the protection of volunteers in research projects. The Brandman University Institutional Review Board may be contacted either by telephoning the Office of Academic Affairs at (949) 341-9937 or by writing to the Vice Chancellor of Academic Affairs, Brandman University, 16355 Laguna Canyon Road, Irvine, CA, 92618.
APPENDIX H

Brandman University IRB Approval

BRANDMAN UNIVERSITY INSTITUTIONAL REVIEW BOARD
IRB APPLICATION ACTION – APPROVAL
COMPLETED BY BUIRB

IRB ACTION/APPROVAL

Name of Investigator/Researcher: Tanya MacMartin

- [ ] Returned without review. Insufficient detail to adequately assess risks, protections and benefits.
- [ ] Approved/Certified as Exempt form IRB Review.
- [X] Approved as submitted.
- [ ] Approved, contingent on minor revisions (see attached)
- [ ] Requires significant modifications of the protocol before approval. Research must resubmit with modifications (see attached)
- [ ] Researcher must contact IRB member and discuss revisions to research proposal and protocol.

Level of Risk: [ ] No Risk [X] Minimal Risk [ ] More than Minimal Risk

IRB Comments:

Tim Perez

IRB Reviewer: ____________________________ Date: ______________

Telephone: ____________________________ Email: ____________________________

BUIRB Chair: ____________________________ Date: ______________

REVISED IRB Application

[ ] Approved [ ] Returned

Name: __________________________________________

Telephone: ____________________________ Email: ____________________________ Date: ______________

BUIRB Chair: ____________________________
APPENDIX I

High Tech High Request for Contacts

TO: Ben Daley, Chief Academic Officer, High Tech High
RE: Doctoral study regarding project based learning and college preparedness

Hi ________,

My name is Tanya MacMartin, and I am a teacher at Oak Valley Middle School in Poway Unified. I spoke with you last spring during a brief meeting in which I introduced my pending doctoral study and we discussed the possible path it may take. Dr. Lisbeth Johnson has also been instrumental as part of my committee, and may have mentioned that I’d come knocking again soon. I also remember that you were enrolled in a doctoral program as well, so I hope it’s going well and am excited to hear about your adventures too.

I am in the throes of dissertation writing, and my research is focused on the impact of PBL on collegiate preparedness. It’s been a long journey, and as you know, your study morphs along the way. During our meeting in February of last year and we discussed the path my study might take and how High Tech High can help further the research on PBL. HTH is the only school in San Diego that has built a formidable reputation for systematically teaching using a PBL lesson design. In this regard, I am contacting Dr. Kaleb Rashad as well on a separate email in the hopes of gathering more participants for my study.

I’m emailing to ask for your help; I’m hoping you can provide the contact information of a few of your alumni who are in their first year of college. My target population consists of students who have attended a PBL learning experience for all four
years of high school and are now enrolled in their first year at an accredited four year university. I understand that you recently held an informational panel, and a teacher at HTH invited me to come observe, but unfortunately I was out of town for a funeral and also hadn’t cleared IRB yet!

If you have any questions or concerns, I’d love to meet with you and discuss more about my study. I’m also happy to provide any portion of the writing I’ve done so far so you are aware of my methodology. I’m hoping to have finished the dissertation by the end of March, so I’m looking to conduct interviews during the month of February.

Any help you can provide is greatly appreciated!

Sincerely,

Tanya MacMartin

Doctoral Researcher, Brandman University

Chapman University System
Dear Research Participant,

My name is Tanya MacMartin, and I’m in the process of completing my doctoral dissertation through Brandman University, a subset of the Chapman University system. I’m focusing on the perceptions students have of their college preparedness after they’ve graduated from high school project based learning programs.

I was given your name by Robert Kuhl at High Tech High, and he suggested I contact you as a possible participant in my study. I understand you are enrolled in your first year of college. To participate in my study, you must have also gone to HTH for all four years of your high school experience. If both criteria are met, then I’m hoping you’d be willing to participate in my survey and interview process. Through this two-step process, we hope to learn more about the strengths of a PBL program, as well as identify any areas of improvement for future programs.

As mentioned above, the study involves two steps. First participants will complete a brief pre-interview survey through an online link with Survey Monkey. After that’s completed, we arrange a time to meet virtually for an approximately 30-minute interview. All can be done through the comforts of your computer. All information is kept private, and in no way impacts you or your education. The results of the study are offered to you when the study is complete.

I’m hoping you can help. I’m offering all participants a $5.00 gift card to Starbucks or Jamba Juice as gratitude for their time. I figure it’s the least I can do as I know you’re likely very busy with your classes.
Would you be willing to participate in my study? Let me know. Thank you!

Sincerely,

Tanya MacMartin

Doctoral Researcher,

Brandman University
APPENDIX K

Follow-up E-mail to Study Participants

Hi __________.

Thank you so much for volunteering to help me out. This study essentially compares the eight essential components of project based learning (as defined by the Buck Institute of Education) to the skills and knowledge needed to do well in college, as defined by an expert named David Conley.

The first step I need you to complete is an electronic survey, (https://www.surveymonkey.com/r/CWVRKSL) which gives me some background information on your thoughts before we begin our interview. It will ask you to input your email address, give you a brief background of the eight essential components of project based learning, and then ask you a few questions about your experience with these key components of project based learning and how they helped or didn’t help you out in college.

The second step is to set up an online interview. We’ll need to arrange a time to "meet" online. I use Adobe Connect to launch our interview, and if you’re on a desktop or a laptop, you’ll need to have access to a microphone, but you don’t need to download any software. If you’re using an iPad or your smart phone, you’ll need to download an app to launch our interview. During the interview, I’ll show you a brief presentation about these eight components, along with some questions about why you scored these components as you did in the electronic survey. I will also ask you about any entrance exams you took to get into your college and your performance on them. All
responses are kept confidential, you can refuse to answer any question, and the data I collect will be only used for this study.

I’m nearing the finish line of this doctoral journey, and I can’t tell you how much I appreciate you taking the time to help me out. I’ll be sending you a Starbucks gift card electronically (I figure college kids need all the caffeine they can get:), but if you’re not a coffee drinker, I can send you a Jamba Juice e-gift card as well. Heck, I’ll send you an e-gift card to any place you choose...there’s an option to select your spot of choice on the electronic survey.

You can find the link to the electronic survey, and then all I need to know is when you’re near a computer for about 30 minutes to conduct the one-on-one interview. I’m a teacher during the day, so I can’t sit still with middle schoolers during school hours, but after school and on the weekends, I’m usually wide open. Let me know what works best for you.

Thank you so much for volunteering. And lastly, do you have any other HTH alum that you still are in contact with who are in college now and would be willing to be part of the study? I need about 8 more bodies, and any names or emails you can provide would be much appreciated.

Looking forward to meeting you! Thanks again!

Sincerely,

Tanya MacMartin