EXAMINING THE EFFECTS OF INTERDISCIPLINARY PROJECT-BASED LEARNING ON STUDENTS' TWENTY-FIRST CENTURY SKILL DEVELOPMENT AWARENESS AND INTRINSIC MOTIVATION ORIENTATION

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Submitted to the Faculty of the
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in partial fulfillment of
the requirements for
the Degree of
DOCTOR OF PHILOSOPHY
December, 2016

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ACKNOWLEDGEMENTS

The completion of my dissertation would not have been possible without the help and support of many wise and knowledgeable individuals. In particular my final committee members demonstrated extreme endurance while maintaining professionalism. Drs. Catherine Curtis and Bill Ryan admirably displayed patience and fortitude with me. This project could not have completed without their continual and steady company. Additionally, Dr. Jayson Lusk provided an outside perspective that aided in communicating results in a more relevant and impactful way. Dr. Shane Robinson provided a depth of knowledge, rigor, and courtesy that inspires me. Along this journey, Dr. Sheila Scott-Halsell provided early guidance and support for the study and completion of my doctoral work. Dr. Yoonjung Cho opened my mind to studying human motivation and revealed herself to be a teacher I want to emulate.

The students and colleagues that were a part of this collaborative learning environment are some of the brightest people I have ever worked with. I am humbled to collaborate with: Dr. Blayne Mayfield, Mr. Dar Yasseri, Dr. Jane Vogler, Mr. Patrick Finley, and Dr. Penny Thompson. There have been many people that came into my life at just the right moment to provide the wisdom and encouragement I needed to push through the challenges and doubt that accompany this process. Some of these individuals are; Dr. Rebecca Eastham who offered reassurance, Joshua Hawkins (soon to be Dr.) who is a *foxhole* brother, Dr. Isaac Washburn was a consummate scholar, and Dr. Kim Soulek provided sage wisdom and counsel. Drs. Sue Williams and Ben Goh offered perspectives that kept me moving forward to completion.

Lastly, this dissertation would have never been completed without the longsuffering love of my wife, Kelli, and our boys, Drew, Benjamin, and Henry. My stamina and perseverance were only possible because of the support and freedom their love provided me. Thank you!

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Date of Degree: DECEMBER, 2016

Title of Study: EXAMINING THE EFFECTS OF INTERDISCIPLINARY PROJECT-BASED LEARNING ON STUDENTS' TWENTY-FIRST CENTURY SKILL DEVELOPMENT AWARENESS AND INTRINSIC MOTIVATION ORIENTATION
Major Field: HUMAN SCIENCES

Abstract: This was a quasi-experimental study that examined two Project-Based Learning (PjBL) environments to determine the impact PjBL has on the changing perceptions of 21st century soft skills, and students' intrinsic motivation. Further, researchers were interested in evaluating the difference in results between an interdisciplinary PjBL experience and a non-interdisciplinary PjBL experience. The fundamental elements of PjBL are well suited to stimulate soft skill development and produce intrinsic motivation in participants. Researchers used a Non-Equivalent Group Design to collect and organize data. Students were asked to rank order 21st century skills in order of their perceived importance of which skills were most important for early career success. The *Partnership for 21st Century Skills* framework was used to describe the skills, as they have been used widely to illustrate the abilities needed for the challenging demands of the global workplace. In addition, students completed an Intrinsic Motivation Inventory (IMI) cultivated from research in Self-Determination Theory (SDT). A factor analysis was completed to determine the unidimensional nature of the Interest/Enjoyment sub-scale that measures intrinsic motivation and was found to be unidimensional in this study. Using several multivariate regressions and a multiple regression, researchers determined that PjBL may have an effect on the perceived level of importance for 21st century soft skills, such as Information Technology Application, and students' intrinsic motivation is improved when the project is interdisciplinary and tied to a students' area of interest. It can be inferred from this study that authentic projects that are of personal interest to a student population may develop appropriate perceptions of soft skills and have higher levels of intrinsic motivation.

TABLE OF CONTENTS

Chapter Page

Chapter Page

LIST OF TABLES

Table Page

LIST OF FIGURES

Figure Page

CHAPTER I

INTRODUCTION

Institutions of higher education tasked with preparing students for success in the 21st century are designing and examining various academic environments to validate and amend antiquated pedagogical practices (Hillman, 2012). Teaching for 21st century skills and creating environments that promote intrinsic motivation are two ways to meet the aims of higher education (Maes, Weldy, & Icenogle, 1997; Pintrich & Schunk, 1996). The purpose of this study was to examine Project-Based Learning (PjBL) environments. PjBL maintains as a core construct, the development of 21st century skills and the elements recognized to produce intrinsic motivation (Bell, 2010; Connell & Wellborn, 1991; Deci & Ryan, 2002). This study examined variations of PjBL and the impact of the environment on student rankings of importance of 21st century skills, as well as assessed their intrinsic motivation as a result of a PjBL experience. The students in these academic environments were non-technical students in hospitality and technical students in computer sciences and graphic art design.

According to Barr and Tagg (1995), the role of higher education has been a debatable topic for more than one century, with workplace readiness at the core of the discussion (Taylor, 2006). In addition, Taylor (2006) stated that arguments of whether higher education exists for workplace readiness or deepening liberal education consistently has been a basis of difference. Whether college is about helping students to *learn to think* in John Dewey's terms (as cited in Halpern, 2002) or to prepare citizens with general skills for providing the workforce with productive laborers (Espinoza, 1999), it is postulated that higher education environments should focus on developing competencies that support both arguments (Robinson, 2006).

Research has explored various gaps between employers, students, and instructors regarding the perceived objectives and actual output of skills required for college graduates (Holmes, 2012; Jackson & Chapman, 2012; Morley, 2001; Robinson, Garton, & Vaughn, 2007; Tribble, 2009). This *skills* gap provides substantial mandates for research and action. Robinson (2006) connected the urgency of this need to numerous issues in society. These societal issues included, but were not limited to, education, various forms of legislation, employment, and job satisfaction (Robinson, 2006). Researchers and academicians have been aware of the need for classroom environments that meet the aims of society for decades (Candy & Crebert, 1991b; Chickering & Gamson, 1987; Fuhrmann & Grasha, 1983; Kolb, 1984; Skinner & Belmont, 1993; White, 1959). However, little advancement in the transformation of the college classroom has occurred (Baer, 2014; Barnthouse, 2013; Johnson, 2009; Strobel & van Barneveld, 2009).

Need for the study

Recent college graduates lack the preparation for the modern workforce and the unique demands of 21st century careers after college (Barr & Tagg, 1995; Casner-Lotto & Barrington, 2006; Rateau, 2011). The 21st century workplace is in need of motivated people with a variety of skills that can function across disciplines (Bell, 2010; Pearlman, 2010). Although numerous attempts have

existed to understand the impact education has on developing 21st century skills and increasing motivation across the spectrum of educational levels, limited research has been conducted in hospitality, computer science, and graphic art design (Carter, 2011; Dunlap, 2005; Lefever & Withiam, 1998; Sisson & Adams, 2013; Spowart, 2011). Moreover, previous research encourages the exploration and understanding of interdisciplinary project work in higher education (Bender, Fulwider, & Stemkoski, 2008; Walker & Leary, 2009). Therefore, the need for this study is strengthened by the lack of ample findings regarding PjBL and the effects it has on 21st century skills awareness and intrinsic motivation for the participants studied.

Theoretical framework

Employers today are looking for employees with both technical and soft skills at an increasing rate (Bancino & Zevalkink, 2007; Coll & Zegwaard, 2006; Spowart, 2011). Further, university educators acknowledge the utility of developing both skill-sets realizing that "soft skills typically complement a student's hard or technical skills" (Harris & Rogers, 2008, p. 19). To achieve its objectives, higher education must prepare students to adapt and acquire new skills at a more rapid rate than ever before (Crawford, Lang, Fink, Dalton, & Fielitz, 2011). To obtain these new skills, it is necessary for academic environments at the higher education level to promote the development of technical and soft skills (Hofstrand, 1996; Shivpuri & Kim, 2004; Shubert, 2011). A common label of the combining of technical and soft skills is 21st century skills (Casner-Lotto & Barrington, 2006). In related literature there are synonymous labels for soft skills. These include but are not limited to critical, non-technical, professional, practical, employable, and life (Casner-Lotto & Barrington, 2006; Davis & Miller, 1996; Robinson, 2006; Shuayto, 2001; Tribble, 2009).

Twenty-first century skills

Twenty-first century skills are competencies that have a strong influence on early career success (Crawford et al., 2011; Davis & Miller, 1996; Johnson, 2009; Mitchell, 2008; Taylor, 2006).

During the early stage of a person's career there are higher expectations regarding their ability to work with others and navigate the various demands of their time as opposed to basic knowledge (Rainsbury, Hodges, Burchell, & Lay, 2002). The knowledge acquired from their discipline and previous experiences are sometimes less influential on their early career success as compared to the 21st century soft skills (Lefever & Withiam, 1998).

As students transition from an academic life to a competitive business environment, or similar position in society, it is possible to determine the effectiveness of how institutions of higher education prepared them for success. Literature exposes the chasm that exists between the intent and outcomes of higher education (Barr & Tagg, 1995; Casner-Lotto & Barrington, 2006; Kuh, 2008; Maes et al., 1997; Mitchell, 2008; Taylor, 2007). Robles (2012) revealed that the educational system has shifted at a slower rate than society from an industrial or manufacturing mindset to one of information and office settings. Morley (2001) referenced the influence of industry on higher education, and other scholars agree that higher education should prepare students for productive employment after college (Coll & Zegwaard, 2006; Jackson & Chapman, 2012; Rainsbury et al., 2002; Rateau, 2011).

Casner-Lotto and Barrington (2006) produced evidence that reveals a shift in the importance of applied or soft skills over technical or hard skills. Tribble (2009) posited that, to adequately prepare college students for workplace readiness, learning environments should place more emphasis on transferrable soft skill development over technical and specific outcomes. Evidence of this opinion has been supported widely over the past few decades by the National Business Education Association (1995) and others (Boud & Solomon, 2001; Hofstrand, 1996; Lazarus, 2013; O'Banion, 1997; Pearlman, 2010; Shivpuri & Kim, 2004; Skinner & Belmont, 1993). Taylor (2007) claimed that evidence points to problems with colleges preparing students for the realities they will face in the workforce. Likewise, other researchers have revealed dangerous gaps between what society needs from college graduates and what colleges and universities are doing to satisfy those needs (Bok,

2006; Grossman, 2005; Jackson & Chapman, 2012; Quinn, 2013; Tribble, 2009). Although it is a relative declaration, evidence does support substantial gaps in college graduates' preparation for the workplace (Casner-Lotto & Barrington, 2006; Jackson & Chapman, 2012).

Robinson (2006) stated that employers are most aware of the deficiency in soft skill development during the application and interview stage of hiring college graduates. This realization points to evidence of students' lack of preparation and their misperceptions of what the goals of their education should be (Johnson, 2009; Shubert, 2011). The gap between what students and prospective employers perceive as important impose substantial challenges for higher education (Robinson, 2006). These gaps have been linked to the output of college graduates' abilities as compared to society's needs, as well as the perceptions of which skills matter between graduates and the workplace. Pearlman (2010) declared that today's students are most stymied by the un-evolved learning environments of yesterday that they still endure today. Therefore, higher education is wise to assess and amend learning environments to best bridge the gaps evident in research by effectively teaching and developing soft skills in the classroom. PjBL is one such learning environment that provides the potential for these skills to develop naturally (Bell, 2010).

The Partnership for 21st Century Skills is a collaborative effort between higher education and industry. They assembled a framework that promotes the needs of the global economy and achieves the aims of education (Casner-Lotto & Barrington, 2006). This framework is intended to generate the potential for successful involvement, accomplishment, and advancement in the world (Johnson, 2009). Their collaboration has influenced major national education policy in addition to curriculum design across all levels of education (Holmes, 2012). Casner-Lotto and Barrington (2006) used the influence of this framework to compile employers' perceptions of the ranked importance of the 21st century skills across different education levels, including college. The list of twenty 21st century skills used in this study is derived from the Casner-Lotto and Barrington (2006) framework. An image of this framework is depicted in Figure 1. As the image reveals, traditional learning standards

and assessment devices are only effectively connected to core subjects and themes that limit learners to developing in the inner circle of the image in Figure 1, whereas, the outer band reveals that to be successful in the 21st century workplace, it is imperative to develop professionally through dynamic curriculum and instruction (Johnson, 2009).

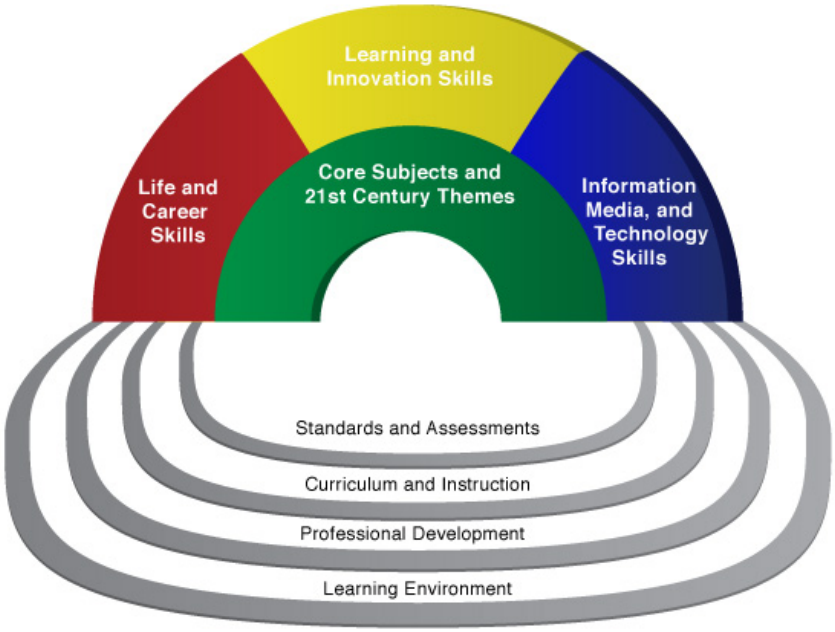

Figure 1. An illustration of the P21 Framework for 21st century learning. Reprinted from Partnership for 21st Century Skills, n.d., Retrieved from http://www.p21.org/our-work/p21-framework. Copyright 2007 by Partnership for 21st Century Learning. Reprinted with permission.

Project-based learning

A common critique of learning environments on college campuses includes a lack of evidence-based teaching methods designed to connect students to skills required to be successful in a post-academic period of life (Barnthouse, 2013). PjBL allows students, instructors, and collaborators to work dynamically to develop a finished product or outcome (Bender et al., 2008). PjBL is rooted in inquiry-based instructional theory and constructivist minded learning environments (Bell, 2010). This model of learning is recognized as a highly effective instructional technique for its simulation of

working environments that students will encounter throughout their lifetime (Kuh, 2008). The framework of PjBL which is depicted in Figure 2, includes the use and development of 21st century skills (Solis, 2010).

Figure 2. The new model of PjBL. Reprinted from Buck Institute for Education in Experts and Newbies, 2010, Retrieved from http://biepbl.blogspot.com/2010_10_01_ar-chive.html. Copyright 2010 by Buck Institute for Education. Reprinted with permission.

In a review of literature on traditional lecture versus PjBL, Barnthouse (2013) asserted that active participation in the classroom is warranted and wanted by today's learner. Nevertheless, passive learning environments, such as lectures and industrial classroom design such as auditoriums and lecture halls, continue to dominate the landscape of higher education in America (Taylor, 2010). Seminal research on high-impact educational practices affirms that today's college classrooms must pursue new pedagogies that equips students better for globalization (James & James, 2004; Kuh, 2008). To prepare students better for success post-graduation, a core focus of transformation for college learning environments should be the development of soft skills (Pearlman, 2010). Colleges

and universities should move away from mass-instruction directed only by the teacher (Wijnia, Loyens, & Derous, 2011). Velez (2012) connected the disparity in lack of preparation to learning environments that do not create learner-centered spaces that promote similar styles of collaboration akin to the modern workplace. Other research has discovered that the majority of memories and long-term learning retention from college occur outside of the formal learning environment (Candy & Crebert, 1991a). Though there is no one right learning environment, it is evident that workplaces and modern learning environments should be complimentary of each other and work successively (Davis & Miller, 1996; Rateau, 2011).

Additional questions regarding the assessment of today's college learning environment as adequate to produce productive members of the workforce are prudent. In addition to learning environments, it is crucial to evaluate the capability of faculty to generate proper instruction and foster appropriate development. Robinson (2006) posed the question of whether limited faculty knowledge of the lacking skills and how to teach to them is a reason higher education is not performing adequately in this area. Other research suggests that integrating learning environments with additional instruction from industry experts in the form of PjBL can facilitate the improvement required (Pearlman, 2010; Taylor, 2011; Velez, 2012). The encouragement to partner with industry and employers of college graduates to improve the learning environment is a key construct to PjBL (Bell, 2010).

Additional perspectives show that numerous employers are better able to complete *company specific* technical skill development as compared to higher education once a person is hired (Andrews & Higson, 2008). In addition, various employers have confessed to not taking adequate measures to improve generalizable soft skills asserting the strategy of hiring trainable employees that have developed or possessed these skills already (Patterson, 2014). These findings reveal opposing perceptions of *who is responsible for what* between faculty and employers. Additionally, it encourages stronger collaboration and connectedness between faculty members and employees. The

college learning environment could be an ideal place for this transformative teaching practice (Bender et al., 2008).

PjBL has emerged as a modern inquiry-based learning method with the exciting promise for transforming higher education to meet the needs of the rapidly expanding global economy (Thomas, 2000). For consistency and research measurability, the Buck Institute for Education (Does PBL Work?, n.d.) stated it is imperative that instructors follow a customizable framework when creating PjBL learning environments.

Intrinsic motivation in education: The use of self-determined learning theory

Learning environments that offer a balance of meeting student psychological needs, and thus promoting intrinsic motivation, may provide the opportunity to have a profound impact on the individual and society (Ryan & Deci, 2000). Self-Determination Theory (SDT) suggests that intrinsic motivation can occur as a result of autonomy, relatedness, and mastery (Deci & Ryan, 2002). The pedagogical framework of PjBL includes offering students *voice and choice* (i.e. autonomy), while systematically producing moments for growth (i.e. mastery) and challenge in a setting pertinent (i.e. relatedness) to their future employment (Bell, 2010; Rateau, 2011; Wijnia et al., 2011). Intrinsic motivation is about a student demonstrating behavior that is self-determined (Deci & Ryan, 1985; White-Taylor, 2001). The self-determined behavior leads to engagement in an activity or a project because of a student's own internal interest and curiosity. An additional factor that affects intrinsic motivation is environmental factors, such as classrooms and other learning environments (White-Taylor, 2001).

Students who are given control over aspects of their learning environments act in self-determined ways (Connell & Wellborn, 1991). This autonomy produces desirable outcomes, such as increased focus and project commitment (Bender et al., 2008). The relatedness of a project or course element leads to intrinsic motivation as well (Connell & Wellborn, 1991). When experiences are

unique and/or surprising, it produces cognitive dissonance, which students naturally want to resolve and is referred to as *curiosity* (White-Taylor, 2001). Curiosity provides an impetus for attraction to a class project, but the experience of mastery is what generates student engagement (Skinner & Belmont, 1993). Collectively, the elements of autonomy, relatedness, and mastery provide the ingredients for intrinsic motivation to be present (Ryan & Deci, 2000).

Statement of the problem

Learning environments in higher education should be designed to meet the needs of students (Fuhrmann & Grasha, 1983; Robinson, 2006). In addition, curriculum reviews have generated doubt as to the quality of training and adequate development students receive in higher education (Patterson, 2014). Unfortunately, there are also noticeable trends of disconnection between what chief academic officers perceive as their success in dealing with this problem and that of chief executives in industry (Busteed, 2014). Research and measurements regarding these outcomes are opaque in general contexts and nonexistent in various specific disciplines (Busteed, 2014; Lefever & Withiam, 1998).

Numerous instructional techniques are widely accepted that can facilitate the continued transformation of higher education to develop employable skills of students better (Soares, 2013). Project-based, team-based, problem-based, and case-based learning are a few of the learning environments designed to promote interaction, communication, and decision making amongst participants (He, Tang, Dai, Li, & Jiang, 2012). However, other than the medical field, there is limited research determining the impacts, if any, these learning environments might have in college education (Hommes et al., 2014; Lee, Cook, & Kamei, 2012). Moreover, previous research encourages the ongoing investigation of interdisciplinary PjBL due to the dynamic and unique nature of each environment (Hommes et al., 2014). In addition, past research has suggested that evaluating changes as a result of a PjBL experience would allow for determining which skills are most strengthened by the experience (Hughes, 2012).

Tribble (2009) considered the perception differences between instructors and employers of which soft skills were important in the workplace. As a result of the findings, further research was encouraged to understand the perceived importance for soft skills of college students as well. Rateau (2011) investigated how classroom strategies developed students' ability to learn and adapt in the rapidly changing workplace. This research encouraged the exploration of differences that may exist between different academic majors on a campus regarding their perceived importance of soft skills. The belief imagined is that this understanding would inform departments and facilitate the development of better learning environments and strategies (Rateau, 2011). Barnthouse (2013) provided a detailed comparison of the results of lecture versus PjBL. Barnthouse (2013) sought to expose a fallacy that millennial students would respond better to PjBL, but the research did not support this notion. Future research is needed to understand the framework of PjBL and its intention to lead to motivational changes in students (Barnthouse, 2013).

Purpose of the study

The shifting paradigms in the workforce are encouraging similar shifts in education. Students graduating from institutions of higher education are expected to be able to navigate this changing landscape and be equipped with skills beyond technical knowledge (Ganzel, 2001). Along the same lines, students who are prepared adequately with 21st century skills, as well as technical knowledge in their field, report an easier time finding jobs and retaining employment through tough economic times (Christopher, 2006; Evenson, 1999; James & James, 2004).

This study explored the change of students' rankings of twenty 21st century skills after an intervention. In addition, the fundamental framework of PjBL offers scaffolding that should satisfy basic human psychological needs and promote intrinsic motivation (Deci & Ryan, 2002). Therefore, this study sought to affirm if this was achieved as a result of a PjBL environment and determine if a

difference exists between an interdisciplinary PjBL and a non-interdisciplinary specific PjBL. The sample for this study came from students in an ongoing PjBL experience.

Research objectives and questions

This study compared an interdisciplinary PjBL environment and a non-interdisciplinary PjBL environment. The following research objectives came from the research design and articulate the control variables used to minimize the threat of interaction to internal validity.

1. Determine the relationship between treatment, age, major, classification, or gender is a significant predictor of students' rankings of which 21st century skills are most important to their success in the workforce.

2. Determine the relationship between treatment, age, major, classification, or gender is a significant predictor of intrinsic motivation.

The following research questions led to the hypotheses and analysis on which the results of the effect of PjBL was determined.

1. To what extent does a PjBL environment affect students' rankings of the 21st century soft skills deemed most important to their future success in the workforce?

2. To what extent does a PjBL environment affect students' intrinsic motivation toward completing the class project?

3. To what extent does an interdisciplinary PjBL environment produce intrinsic motivation toward completing the class project?

Definitions

Twenty-first century skills – a broad set of knowledge, skills, work habits, and character traits that are believed—by educators, school reformers, college professors, employers, and others—to be critically important to success in today's world (Johnson, 2009).

Project-Based Learning (PjBL) – a teaching method in which students gain knowledge and skills by working for an extended period of time to investigate and respond to a complex question, problem, or challenge (Does PBL Work?, n.d.).

Self-Determination Theory (SDT) – articulates intrinsic and varied extrinsic motivation sources, with a focus on how people's sense of choice and initiative and their influence on their well-being and performance quality (Deci & Ryan, 2002).

Autonomy - the universal urge to be causal agents of one's own life and act in harmony with one's integrated self; however, this does not mean to be independent of others (Deci & Vansteenkiste, 2004).

Relevance - the universal want to interact, be connected to, and experience content or caring for others (Baumeister & Leary, 1995).

Competence – seek to control an outcome, and experience mastery of it (White, 1959).

Soft Skills - A set of personal qualities, attributes, talents, or the level of commitment that an individual can bring to the workplace that set him or her apart from other individuals who may have similar skills and experience (i.e. – applied skills, practical skills, critical skills, life skills, employable skills) (Mitchell, 2008).

Intrinsic Motivation - motivation that comes from inside an individual rather than from any external or outside rewards, such as money or grades (Deci & Ryan, 2002).

Assumptions

For this study, the following assumptions were made:

1. Students respondents completed the questionnaires free of influence from classmates or outsiders.
2. Students were objective, honest, and accurate with their completion of each questionnaire.

Limitations

In this study, the following limitations were acknowledged:

1. This study was limited to students in hospitality, computer sciences, and graphic art design involved in PjBL experiences at a large Mid-western university.
2. Generalization of the results to other student populations is limited to the degree with which these groups are similar to the student populations within this study.
3. Rankings of 21st century skills were determined using ordinal rankings.
4. Due to the organized classroom environments chosen, selection was limited, therefore, analyses were limited due to sample size.
5. The results in this study are self-reported.

Summary

This chapter provided an introduction of this dissertation and offered the rationale, framework, research objectives, and questions, and importance of the investigation. This chapter provided the insight and awareness to conduct this research. In addition, the chapter identified some of the gaps existing in the current research. The following chapter supplies a review of relevant literature.

CHAPTER II

REVIEW OF LITERATURE

This review of literature describes the variables of the study in five parts, which include, project-based learning (PjBL) as learning environments, 21st century skills, soft skills and high-impact learning environments, intrinsic motivation, and the regression equation.

Project-based learning

PjBL is constructed of authentic learning activities that stimulate students' motivation (Worry, 2011). The activities are designed to solve a problem or answer a question and reflect on the activities and exploration of work people do every day outside of the classroom (He et al., 2012). Moreover, PjBL provides the constructs to support the development and awareness of soft skills and promote intrinsic motivation (Holmes, 2012; Worry, 2011).

PjBL is an inquiry-based instructional method that is learner-centered and connected to constructivist theories of learning (Pintrich & Schunk, 1996). Proponents of *learning by doing* have existed for centuries (Barnthouse, 2013). More recent theorists on education, such as John Dewey, claimed that learning was based in experience and driven by student interest (Hughes,

2012). Jean Piaget advanced the fundamentals for the constructivist approach to education, which promotes that students build on previous knowledge by asking questions, inquiring, interacting with others, and being given the chance to reflect (Hughes, 2012). In PjBL experiences, students are allowed to practice applying theoretical and technical skills with other more general, non-technical personal skills. These non-technical, or soft skills, are developed by working on authentic and contextualized projects driven by student interest but guided indirectly by a faculty member (Hmelo-Silver, 2004). The process begins with arranging teams of students that define their roles (Barrows, 1986). Next, students articulate the focus of a pre-determined project area. This process is different from traditional forms of learning environments or even other project learning initiatives with lesser frameworks (Baer, 2014; Lee et al., 2012).

An imperative construct of PjBL is linking learning outcomes with the practical and professional needs of today's workforce (Baer, 2014). Attempting to recreate learning environments to mirror real-world examples is dynamic and complex (Bender et al., 2008). Nevertheless, when this is accomplished in learning environments, remarkably strong correlations exist between outcomes and PjBL constructs (Mishra & Kereluik, 2011). Empirical evidence for the positive effects of PjBL have been documented well for the past four decades (Larmer & Mergendoller, 2015). According to the Buck Institute for Education, numerous studies have demonstrated strong academic and personal achievement when compared to traditional forms of instruction, through PjBL (Does PBL Work?, n.d.).

- In increasing academic achievement on annual state-administered assessment tests (Geier et al., 2008)

- For teaching mathematics, economics, science, social science, clinical medical skills, and for careers in the allied health occupations and teaching (Boaler, 2002; Cognition & Vanderbilt, 1992; Geier et al., 2008; Hickey, Kindfield, Horwitz, & Christie, 1999;

Lynch, Kuipers, Pyke, & Szesze, 2005; Mergendoller, Maxwell, & Bellisimo, 2006; Vernon & Blake, 1993; Walker & Leary, 2009)

- For long-term retention, skill development and satisfaction of students and teachers (Boaler, 2002; Geier et al., 2008; Strobel & van Barneveld, 2009)
- For preparing students to integrate and explain concepts (Capon & Kuhn, 2004)
- For improving students' mastery of 21st century skills (Gallagher, Stepien, & Rosenthal, 1992; Hmelo, 1998)
- More effective with lower-achieving students (Geier et al., 2008; Lynch et al., 2005; Mergendoller et al., 2006)

Studies comparing traditional and lecture-based courses to PjBL support the framework and demonstrate the effectiveness of PjBL (Kuh, 2008; Wijnia et al., 2011). Even so, additional research is necessary to understand further what impacts PjBL has on varying outcomes (Holmes, 2012). In addition, numerous studies, notwithstanding limitations, have offered mixed results and insignificant findings related to PjBL (Baer, 2014).

The need for interdisciplinary PjBL instruction and study

The literature reviewed also revealed a call for interdisciplinary experiments to improve on inconclusive results in non-interdisciplinary PjBL experiments (Strobel & van Barneveld, 2009). Few challenges facing the world of government, business, or society exist in isolation (Kuh, 2008). Therefore, working with people of differing cultures, backgrounds, industry disciplines, and educational levels is common and a mainstay of the world college students assimilate to (Casner-Lotto & Barrington, 2006). This understanding presents new opportunities and challenges for PjBL and research about its constructs. Therefore, as PjBL continues to be advocated for and practiced at all levels of formal education, additional research is called for.

Developing constructs that are more realistic to life only stand to improve education (Larmer & Mergendoller, 2015). In addition, these environments should be sound in set-up, execution, and investigation (Bell, 2010).

There are numerous characteristics of interdisciplinary PjBL that appeal to educators and students (Holmes, 2012). These advantages have attracted educators, scholars, and industry leaders toward PjBL as a learning environment. Interdisciplinary PjBL can include short-term strategies embedded within a single course or encompass an entire curriculum; the latter is popular at the high school level (Hillman, 2012). Moreover, it offers the instructor flexibility, adaptability, and creativity when making it part of a course or the course as a whole (Kuh, 2008). A desired outcome of formal education is to create life-long learners (Casner-Lotto & Barrington, 2006). Evidence for this outcome is strong as a result of interdisciplinary PjBL, which is the product of the autonomous and relevant nature of its constructs (Bender et al., 2008). Similarly, interdisciplinary PjBL creates a rich environment with many opportunities to develop 21st century skills. Modern literature states that the need for this type of development is prevalent (Davis & Miller, 1996; Johnson, 2009; Shubert, 2011; Velez, 2012; Weinstein, Acee, Jung, & Dearman, 2011). In addition, learning environments should strengthen a learner's awareness of his or her internal nature and appeal to that sense of ownership (Macías-Guarasa, Montero, San-Segundo, Araujo, & Nieto-Taladriz, 2006). Interdisciplinary PjBL environments offer the chance for this intrinsic motivation to flourish (Hommes et al., 2014).

PjBL elemental breakdown

The elements of PjBL can be divided into seven parts that begin with students asking driving questions or articulating challenges. Afterward, students are able to express what they need to know. Once they have determined what they need to know as a team, they set forth on a quest to inquire and innovate. All the while, they are using and developing 21st century skills and

being allowed *voice and choice* over the direction of their project. Subsequently, they are given periodic feedback and revision from faculty members or community and industry partners. Finally, the project is concluded with a publicly presented product or production (Larmer & Mergendoller, 2015). This flow of constructs is depicted in Figure 3 (Solis, 2010).

Figure 3. The new model of PjBL illustrating elemental constructs. Reprinted from Buck Institute for Education in Experts and Newbies, 2010, Retrieved from http://biepbl.blogspot.com/2010_10_01_ar-chive.html. Copyright 2010 by Buck Institute for Education. Reprinted with permission.

The constructs and elemental framework of PjBL has been enhanced through research that links the following professional competencies (Bender et al., 2008):

Functional Competencies concern the technical requirements students need to acquire to be successful in their chosen field of study. Notably these competencies are aligned more descriptively with course objectives. They also are described as technical skills or basic knowledge in a chosen field. These competencies align with basic knowledge skills in the literature.

Personal Competencies refer to mindsets and actions of individuals based on attitudes, beliefs, and feelings. Notably these competencies are aligned with relationships necessary in learning or working environments and not as easily defined in course objectives. These competencies align with soft skills in the literature (Bender et al., 2008).

The elements of the PjBL framework will be broken down more specifically in the following sections.

Students ask driving questions or state challenges

Articulating a project focus and directing in-depth inquiry is not enough to satisfy the framework of PjBL. A driving question is key to aiding students on the quest to complete the project (Blumenfeld et al., 1991). These questions are derived from helping students determine what is necessary to know to complete the project.

Project teams determine what they need to know

Bender (2008) asserted that what individuals need to know often generates questions they, and sometimes the instructor cannot answer. Therefore, this element of the framework leads to an instructor connecting students with information or resources, that individuals who can assist them (Bender et al., 2008). Instructors can connect students with numerous points of reference to obtain what is necessary to know.

The quest to inquire and innovate

PjBL begins with an in-depth inquiry (Bell, 2010). Instructors are necessary to provide a genesis for the project, but after that they should take on the role of supervision and formative assessment (Davis & Miller, 1996). This instructional technique allows students to make inquiries that are potentially greater and more in-depth. Inquiry can vary between different courses and education levels; however, it typically leads students beyond questioning and into a deeper discovery of answers and resources (Blumenfeld et al., 1991). Moreover, in-depth inquiry may result in new questions and conclusions that potentially lead to stronger results (Larmer & Mergendoller, 2015). In addition, instructors may approve step-by-step elements and processes to ensure the scaffolding of learning is accomplished and students' time is spent in an effective manner. As with all projects there is a beginning and an end. This inquiry is designed to provide focus and guide research necessary to answer the questions that are driving the project (Bell, 2010).

The application of 21st century skills in PjBL

Twenty-first century skills are practiced and therefore refined throughout the PjBL experience. When students are engaged through independent and challenging expectations it is common for new skills to emerge as a result of the learning environment (Holmes, 2012). Twenty-first century skills are discussed later in this chapter in a separate section.

The facilitation of autonomy through students having a voice and choice

Empowering students to give direction to their project is a fundamental trait of a learner-centered learning environment (Mitchell, 2008). In PjBL the genesis of a project often lies with the instructor. However, the boundaries of the project should include enough ambiguity that students have the ability to personalize and determine the specific focus of the project (Dunlap, 2005). This choice and autonomy support environments that can increase motivation and improve

student output (Connell & Wellborn, 1991). In addition, it serves to facilitate the development of skills employers find necessary in college graduates, such as dealing with vague directions (Crawford et al., 2011), taking initiative (Shubert, 2011), and making decisions (Lazarus, 2013).

The practice of giving feedback and offering revision

PjBL framework and pedagogy encourages frequent and regular connection with students on the part of the instructor for providing stimulation, encouragement, and correction (Bender et al., 2008). The Buck Institute for Education states that providing students with comments and the chance to produce multiple versions of their work is a cornerstone of PjBL (Does PBL Work?, n.d.). This element of PjBL encourages students to learn to receive and deliver feedback (Maes et al., 1997). Feedback can come from numerous sources that provides the chance for processes and products to develop at higher levels (Bell, 2010). Lastly, some modern versions of PjBL environments include peer-to-peer feedback incorporated into course grading (Hughes, 2012).

The communication of findings to a public audience

A unique element of PjBL is creating a project that is shared with a selected audience of individuals from outside the formal classroom, this could include administrators, industry professionals, and/or other student groups (Bell, 2010). Examples of PjBL include basic knowledge skills, such as mathematics, arts, science, and history, to name a few (Thomas, 2000). Therefore, PjBL is embedded commonly as a foundational part of curriculum and serves numerous traditional learning objectives. However, as technology and information continue to advance at a more rapid rate than ever before, faculty members should realize that the most relevant and accurate information might not be in their classroom (Hillman, 2012; Mishra & Kereluik, 2011). These outside influences serve multiple purposes in PjBL. Beyond the resources to answer driving questions and determine what is necessary to know, they provide an audience at

the conclusion for students to present their findings and creations. Additionally, they provide a unique opportunity for another element of PjBL, which is revision and reflection.

PjBL outcomes

Outcomes of PjBL include, but are not limited to deeper learning, more in-depth understanding of a subject or challenge, higher-order thinking, and increased motivation (Holmes, 2012; Wijnia et al., 2011). Further, PjBL is an instrumental strategy for creating independent minded learners and eventual citizens (Bell, 2010). PjBL provides a strong framework for educators at all levels to construct learning environments that produce positive outcomes. Along these lines, PjBL can provide students' better environments that prepare them more naturally to perform well on standardized tests and in life's pursuits (Boaler, 2002; Geier et al., 2008; Thomas, 2000). The numerous outcomes of PjBL offer researchers the opportunity to measure a cross-section of observable and quantifiable results.

Measuring PjBL

Measuring the effectiveness of PjBL is imperative to ensure it is achieving course objectives (Walker & Leary, 2009). To do so responsibly, it is vital to shift the mindset with which we approach assessment, as various skills developed in PjBL are not measureable through traditional testing methods (Bell, 2010). Fortunately, PjBL has genuine assessment occurring naturally through the collaboration of peers, partners, and the supervision of the instructor (Geier et al., 2008). Moreover, this assessment is more similar to feedback and evaluations people receive as part of the enterprising workforce. Professionals are judged by their performance on moderate to complex tasks and how they successfully navigate spans to time (Hmelo, 1998). This is in stark contrast to a standardized testing model of traditional academic assessment. However, when authentic assessment through PjBL is combined with self-reflection and team member evaluation, the results are dynamic and impactful for the learner (Hmelo-Silver, 2004).

Known effects of PjBL

The dynamic nature of learning that occurs in PjBL also takes into account students' individual learning styles and preferences (Bell, 2010). Due to the nature of exploration and freedom, students are able to pursue new knowledge in a place or at a time that is personally conducive to their lifestyle or particular needs. This autonomy provides welcome opportunity to engage with experts outside of the class and connect with material not always able to be present in the classroom or at class time. As a result of participation, students often report higher self-confidence and become more capable at pursuing learning and achievement with little prompting (Barrows, 1986; Capon & Kuhn, 2004).

Activity in PjBL can naturally cultivate social learning and development in numerous ways. During the process of a PjBL initiative students become more proficient with common 21st century skills (Bell, 2010). Skills such as communication, collaboration, leadership, and ethics are consistently identified in the literature as being fundamental to success in life (Casner-Lotto & Barrington, 2006; Johnson, 2009). Throughout a PjBL experience, students are engaged in active listening, problem solving, and creativity. They also develop essential skills related to work ethic, problem resolution, and having respect for others (Chamorro-Premuzic, Arteche, Bremner, Greven, & Furnham, 2010). It is common for the conclusion of a PjBL experience to include team and self-evaluations (Shubert, 2011). These reflections include examining students' progress in developing socially in the areas referenced. Research has revealed that consistent exposure and practice with these types of skills are critical to the future success of individuals and society (Casner-Lotto & Barrington, 2006; Hmelo-Silver, 2004).

Twenty-first century skills

Technological advances and globalization have led to rapid and tremendous change in the modern workforce; as a result, previous ways of *doing business* and educating people may not be

as effective or efficient (Redmann & Kotrlik, 2004). Reports from higher education have confirmed this realization by recognizing various shortcomings confronting today's workforce (Casner-Lotto & Barrington, 2006; Lefever & Withiam, 1998). The assertion from the National Business Education Association (1995) indicated that challenges extend beyond academic development and in to hands-on occupational and inter-personal skills. Twenty-first century skills are defined as personal qualities, attributes, or the level of commitment of an individual that sets them apart from others (Perreault, 2004). Others have described these skills as abilities or talents used to work on a team, communicate efficiently, lead effectively, and solve simple as well as complex problems (Chamorro-Premuzic et al., 2010; James & James, 2004; Lazarus, 2013; Mitchell, 2008). Scholars agree that 21st century skills include both basic knowledge skills and soft skills (Casner-Lotto & Barrington, 2006). Basic knowledge skills refer to those which are acquired commonly in education across the core academic subjects, such as Mathematics and Science to name two (Casner-Lotto & Barrington, 2006). Soft skills refer to those acquired by students to use their basic knowledge to perform in the workplace, which include social, behavioral, and cognitive skills (Casner-Lotto & Barrington, 2006).

Determining workplace readiness

In a collaborative study using twenty 21st century skills, researchers investigated the importance of each item according to employers at multiple academic levels (Casner-Lotto & Barrington, 2006). Their study provided the list and definitions of items used in this study. The list produced from their research was derived through a global literature review of employable skills (Casner-Lotto & Barrington, 2006). Table one displays the 20 items grouped according to their nature as a basic knowledge/skill or an applied skill.

Table 1

Twenty-first century skills categorized by subsets.

Basic Knowledge Skills	Applied Skills
English Language (Spoken)	Critical Thinking/Problem Solving
Reading Comprehension (in English)	Oral Communications
Writing in English (grammar, spelling, etc.)	Written Communications
Mathematics	Teamwork/Collaboration
Science	Diversity
Government/Economics	Information Technology Application
Humanities/Arts	Leadership
Foreign Language	Creativity/Innovation
History/Geography	Lifelong Learning/Self Direction
	Professionalism/Work Ethic
	Ethics/Social Responsibility

Reprinted from *Are They Really Ready to Work?* (p. 9) report, by J. Casner-Lotto and L. Barrington, 2006, Copyright 2006. Reprinted with permission.

Distinguishing between the skill subsets

As Table 1 reveals, there are nine basic knowledge/skills and eleven applied skills. Literature supports the connection that *basic knowledge/skills* are associated most closely with other employable terms such as, *technical* or *fundamental* (James & James, 2004). Moreover, the literature supports that this subset of skills is often more specific in type and related to specific industry needs in the workplace (Ganzel, 2001). Similarly, *applied skills* can be connected to different names. These other labels include most notably, *soft* and *life* (Andrews & Higson, 2008) but also are referred to as *practical* and *employable* (Davis & Miller, 1996; Robinson, 2006).

Various names of soft skills

Soft skills are referred to with many labels; it is common in European literature to find the same skills labeled *critical* or *professional* (Shuayto, 2001). In the United States, it is more common to find the same or similar skills listed as *soft* or less commonly *life* (Crawford et al., 2011). Similarly, industry and educational literature use differing labels for the same skills (Tribble, 2009). Literature from education commonly refers to these skills as *21st century* skills while industry and government entities have preferred *soft* and *real-world* skills (Casner-Lotto & Barrington, 2006; Kuh, 2008). Other names of soft skills include, but are not limited to, applied skills (Casner-Lotto & Barrington, 2006), practical skills (Davis & Miller, 1996), and employable skills (Robinson, 2006). This research study will refer to these skills as soft skills as is consistent with subject-related research.

A contrast of soft skills and basic/knowledge skills

In their report, Casner-Lotto and Barrington (2006) indicated that "applied skills on all educational levels trump basic knowledge/skills" (p. 9). They claimed that basic knowledge skills remain fundamental to job security, but emphasized that applied skills lead to success and achievement in the workplace (Casner-Lotto & Barrington, 2006). Technology has had a profound impact on the transfer of importance from basic knowledge skills to applied skills (Harris & Rogers, 2008). Casner-Lotto's and Barrington's (2006) study also asked employers to assess new members of the workforce according to their skills that were found to be crucial to job success. At the higher education level, the findings were more favorable than the other levels of education. Further, the findings revealed employers' increasing frustration with the lack of skills in college graduates (Casner-Lotto & Barrington, 2006). The specific deficiencies were in soft skills such as written communication and leadership (Casner-Lotto & Barrington, 2006). A final notable finding of this study was a ranking of all twenty items on the list of 21st century skills.

These findings revealed that seven of the top ten items were soft skills, emphasizing further the importance of inserting constructs for soft skill development into the college classroom via learning environments, such as PjBL (Casner-Lotto & Barrington, 2006).

Soft skills and high-impact learning environments

For a majority of the world's workforce academic institutions of higher education are the last stop of formal education (Maes et al., 1997). Therefore, it is responsible to acknowledge and consider the influence these environments and professors will have on students (Kuh, 2008). As the world continues to evolve at a more rapid pace than ever before, it is imperative that students receive skills training beyond knowledge and factual comprehension (Mitchell, 2008). These skills are referred commonly to in academic settings as soft skills (Chamorro-Premuzic et al., 2010). Soft skills are a set of personal qualities or skills that distinguish individuals in an organization that may have similar levels of experience (Mitchell, 2008). Learning environments that promote soft skills, such as problem-solving in a real-life setting, help students acquire knowledge and competencies that are required by the workforce today (Dunlap, 2005). Examples of soft skills include, but are not limited to, oral and written communication and leadership (Casner-Lotto & Barrington, 2006). Instances of oral communication enacted in a classroom would be small and large group discussions, listening, and giving feedback (Maes et al., 1997). Additionally, written communication in an educational setting may be in the form of electronic messages, digital discussion boards, and narratives on various topics (Casner-Lotto & Barrington, 2006). Leadership in learning environments is demonstrated through initiative, accountability, and responsibility (Britton, 2013). As mentioned previously soft skills are a subset of 21st century skills.

High-impact practices of higher education

The classroom-learning environment is not the only educational component of college life. Nevertheless, investigation into these learning environments is prudent, based on the time and resources spent bringing faculty and students together in these settings. A report by Kuh (2008) revealed teaching and learning practices that have been broadly examined and shown to have high impacts on college students across disciplines. The suggested execution by Kuh (2008) is, "for every student to participate in at least two high-impact activities during his or her undergraduate program, one in the first year, and one taken later in relation to the major field" (p. 21). When PjBL is implemented according to the framework presented in this chapter, it satisfies five of these top ten high-impact educational practices. For example, students are expected to work on self-driven projects with peers that create a collaborative learning community. This shared common intellectual experience helps students develop relationships and become more self-aware. Additionally, PjBL should include access to resources beyond the instructor, which are often community and industry partners, thus creating service and community learning opportunities (Hillman, 2012).

This report on high-impact practices in higher education lists the following as the top learning environments to increase student success and enhance engagement in the classroom (Kuh, 2008):

- First-Year Seminars and Experiences
- Common Intellectual Experiences
- Learning Communities
- Writing-Intensive Courses
- Collaborative Assignments and Projects
- Undergraduate Research
- Diversity/Global Learning
- Service Learning, Community-Based Learning
- Internships
- Capstone Courses and Projects

The report identified a collection of observations and surveys associated with these learning environments and faculty and student interviews to present the findings of high-impact practices in higher education (Kuh, 2008).

Differences in the perceived importance of soft skills

A primary critique of learning environments in higher education is their inability to adequately supply society with capable citizens (Candy & Crebert, 1991a; Pearlman, 2010; Shubert, 2011). The gaps that exist between varying stakeholders in higher education are substantial. Crawford et al. (2011) conducted a comparative analysis of soft skills asking "What is important for new graduates?" (p. 3). This seminal study provided evidence of significant differences between students, alumni, employers, and faculty perceptions concerning which soft skills will help graduates perform well on the job and have satisfying careers (Crawford et al., 2011). Although this study was limited to students in agriculture, natural resources, and related careers, it provided ample evidence of a need to understand further the divergence between perceptions of skills relevant to student success after college. As an additional conclusion, this study revealed that the responsibility was determined to be *equally shared* by universities and employers to develop students' soft skills by 55% of respondents (Crawford et al., 2011). The breakdown of the remaining 45% of respondents declared the university was *more responsible* (28%) than the employer (14%) (Crawford et al., 2011, p. 22).

Value of competence-based education

Linking educational outcomes to competencies necessary in post-college life is responsible and important (McCain, Hine, & Wolfertz, 1998). These competencies are linked to and sometimes used synonymously with soft skills (Bender et al., 2008). Competence-based education has become a driver of change in higher education by policy-makers, employers, and

alumni (Robles, 2012; Tribble, 2009; Velasco, 2012). Grant (1979) provided an explanation of the tenets of competence-based education:

Competence-based education is defined as that form of education that derives a curriculum from an analysis of a prospective or actual role in modern society and that attempts to certify student progress on the bases of demonstrated performance in some or all of the aspects of that role (p. 44).

Scholars do not agree on this subject categorically, but there is little dispute that higher education does have a responsibility to produce capable and productive members of society (Boyer, 1990; Keniston, 1960). Although the exploration of these differences will continue, it is imperative that the value of competence-based learning be examined through noted high-impact teaching practices in higher education, such as PjBL (Capon & Kuhn, 2004; Kuh, 2008).

The hypotheses of the current study that pertains to 21st century soft skills in higher education are as follows:

H1. As a result of participation in a PjBL experience, students show an improvement in rank for:

a. teamwork/collaboration
b. critical thinking/problem solving
c. oral communication
d. written communication
e. creativity/innovation
f. information technology application

H2. Technical students rank information technology application higher than non-technical students in pretests and posttests as part of a PjBL experience.

Intrinsic motivation

A student's motivational orientation can have a meaningful impact on the attitudes they demonstrate and the quality of the learning they retain (Zhu, 2009). Zhu (2009, p. 18) defined this intrinsic value as the "inherent enjoyment that the individual perceives, while being engaged in the activity." By analyzing and understanding the perceptions of an individual's motivations and behaviors, teachers can develop course content and construct learning environments to increase the autonomy and engagement of the learner (Kuh, 2008). Further, it is increasingly important that institutions for higher education continually evaluate the perceptions of various stakeholders, including students (Lefever & Withiam, 1998). In doing so, they can position themselves to maintain relevance and continue to have a positive impact on society. Intrinsic motivation promotes enthusiasm, passion, and the desire to learn within a student (Weinstein et al., 2011). As a result, educators need to be aware of factors that influence motivation and engagement. A growing number of researchers view academic engagement as an external demonstration of a motivated student (Connell & Wellborn, 1991; Deci & Ryan, 2002; Deci & Ryan, 1985; Skinner & Belmont, 1993). When intrinsic motivation through PjBL is present, learning environments are positively and deeply impacted in the ways described and many more (Larmer & Mergendoller, 2015).

PjBL environments provide opportunities for intrinsic motivation

Intrinsic motivation is a by-product of being involved in a psychologically supportive environment (Skinner & Belmont, 1993). The theoretical framework through which the Intrinsic Motivation Inventory (IMI) emerged was Cognitive Evaluation Theory (Deci & Ryan, 1985). A primary goal of PjBL is to engage the learner's intrinsic motivation to pursue new knowledge and skills (Hmelo-Silver, 2004; Norman & Schmidt, 1992). Hmelo-Silver has also revealed a void of empirical evidence that directly investigates intrinsic motivation (2004).

Intrinsic motivation framework

Studies in education psychology have revealed that learning environments and intrinsic motivation are interconnected (Cantwell, 2005). Intrinsically motivated learners demonstrate better attitudes toward challenges and higher cognitive capacities than students who report not being intrinsically motivated (Deci & Ryan, 2002; Gagné & Deci, 2005; White-Taylor, 2001). Students who report being intrinsically motivated are theoretically having their basic psychological needs met, and they have an appropriate balance between the three factors of intrinsic motivation (Ryan & Deci, 2000). Deci and Ryan (1985) have theorized that the three dimensions of achieving a psychologically supportive environment are autonomy, relatedness, and mastery.

Autonomy

Autonomy is a critical element in PjBL (Larmer & Mergendoller, 2015). The freedom to differentiate allows students to customize their personal learning objectives and go deeper in a specific area (Bell, 2010). This core trait of PjBL can produce intrinsic motivation naturally (Wijnia et al., 2011). Additionally, it satisfies employer's expectations that college graduates to be able to operate independently and with ambiguous instructions (Andrews & Higson, 2008; Bancino & Zevalkink, 2007). When given autonomy, students may get frustrated in the short-term but often develop new efficacy that strengthens their motivation (Gagné & Deci, 2005).

Relatedness

PjBL suggests that projects be tied to course objectives and be relevant within the context of the course (Macías-Guarasa et al., 2006). The relatedness of a project satisfies constructs of both PjBL and intrinsic motivation. Students who are engaged in a project related to future employment or professional achievement are reportedly more inclined to produce stronger results as compared to universal projects (Wijnia et al., 2011). Correspondingly, the relatedness of a

project to their chosen career or degree has been found to increase motivation consistently in medical education (Hmelo, 1998; Lazarus, 2013; Norman & Schmidt, 1992; Vernon & Blake, 1993).

Mastery

Critiques of PjBL highlight its inability to provide students with an objective assessment of what materials they have mastered (Thomas, 2000). However, this criticism is the most appropriate when levied against courses where PjBL is the only assessable material in a class. When PjBL is embedded in a course with additional grading methods and only represents a portion of an overall grade, the criticism made of this practice is trivial (Baer, 2014). Moreover, the elements of desired mastery in PjBL do not follow traditional objective measures (Shubert, 2011) and support the development of soft skills, most notably communication and problem-solving, which are expected of college graduates (Robinson et al., 2007).

Outcomes of Intrinsic Motivation in Learning Environments

When intrinsic motivation is present in education, students set higher goals and pursue more challenging material (Ryan & Deci, 2000). Further, student engagement increases and educators are able to focus on higher-level understanding of material in a shorter amount of time (Skinner & Belmont, 1993). The behaviors associated with intrinsic motivation include higher attendance and more willingness to dedicate time out of class to learning and exploration (Thomas, 2000). Literature supports the notion that students who are motivated intrinsically invest more time and energy in studying and learning activities (Pintrich & Schunk, 1996; Wijnia et al., 2011).

The achievement of the tri-fold nature in a learning environment is one that requires intention and fortitude. An interdisciplinary PjBL offers a framework that can deliver this experience to an educational setting (Wijnia et al., 2011). Moreover, employers consistently find

students with backgrounds in PjBL environments develop the ability to succeed more effectively in the workplace (Holmes, 2012; Lazarus, 2013).

The hypotheses of the current study that pertain to intrinsic motivation are as follows:

H3. Intrinsic motivation will increase:

a. in students as a result of participation in a PjBL experience.
b. more in students participating in an interdisciplinary PjBL experience than in a non-interdisciplinary PjBL experience.
c. more in technical students participating in a PjBL experience than non-technical students.

H4. Students participating in an interdisciplinary PjBL experience will report higher intrinsic motivation than students participating in a non-interdisciplinary PjBL experience before and after their PjBL experience.

Regression Equation

This study examined the effects of PjBL environments on students' rankings of 21st century skills relevant to their success in the workforce and their intrinsic motivation towards completing a class project. The following regression equation was used to analyze the research objectives and hypotheses of this study. The following variables were held constant using dummy coding procedures: Age 20-21, Male, Seniors, Fall 2014, and non-technical students.

$$Y = \beta_0 + \beta_1 X_1(Age\ 18-19) + \beta_1 X_2(Age\ 22-24) + \beta_1 X_3(Age\ 25) + \beta_2 X_4(female) + \beta_3 X_5(Sophomore) + \beta_3 X_6(Junior) + \beta_4 X_7(Interdisciplinary) + \beta_5 X_8(Technical)$$

Summary

PjBL provides the framework that allows for the presence of intrinsic motivation and the development of measureable soft skills expected of college graduates, simultaneously (Carter, 2011). This chapter has presented evidence from other research that prompted the questions that were central to this study. Literature reviewed for this chapter explained the variables and background of PjBL, 21st century skills, and intrinsic motivation.

CHAPTER III

METHODS

This chapter presents the methodology for this study. The research design discusses the objectives and hypotheses that are directed in this study. In addition, the chapter will reveal the population and participants of the study, instrumentation, data collection procedures, and techniques used to analyze the data. Information from previous chapters provide the research model and foundation for the study.

Purpose of the study

The intent of this research was to investigate a Project-Based Learning (PjBL) environment and an interdisciplinary PjBL environment. Moreover, the study examined the effects of these learning environments on students' rankings of 21st century skills relevant to their success in the workforce and their intrinsic motivation toward completing the project.

Research design

This study utilized existing class environments. Therefore, a quasi-experimental study

design was used. The design was chosen due to the fact that existing groups were intact and therefore random assignment of subjects to treatment groups was not possible. Additionally, a Non-Equivalent Group Design (NEGD) was utilized (Shadish, Cook, & Campbell, 2002). Essential elements of NEGD are non-random assignment of subjects to groups and administration of a pretest and posttest to both groups (Gall, Borg, & Gall, 1996).

As stated, the intent of this study was to investigate the effect of PjBL on students' rankings of 21st century skills and their intrinsic motivation. The first observation was a rank-order of 21st century skills according to what students' believed to be most important to their success in the workforce. Administered at this same time was the Activity Perception Questionnaire (APQ), which is an Intrinsic Motivation Inventory (IMI) scale that assesses a participant's intrinsic motivation toward a technology based project (Deci et al., 1994). The APQ was chosen as a suitable IMI scale due to the nature of the project being focused on technology. These observations were administered as a pretest and were stated in present tense (see Appendix A). The second observation was a posttest of the same instruments, but was presented in past tense (see Appendix B). The NEGD is a suggested design when the intent of a study is to investigate the effect of a treatment, such as PjBL, on the independent variables of the ranking differences of 21st century skills and change in intrinsic motivation (Creswell, 2013; Shadish et al., 2002).

The independent variables in this study were students from the four class samples. Treatments were given to each class in the form of PjBL. The same class in two different semesters received both PjBL and Interdisciplinary PjBL, while the three classes in the same semester received the interdisciplinary PjBL only. The dependent variables were the rankings of 21st century skills and the APQ to measure intrinsic motivation.

Validity and reliability

According to Shadish et al. (2002), threats to internal validity include history, maturation, testing, instrumentation, regression, subject selection, mortality, and interaction effects. NEGD research design controls for all of threats with the exception of regression and interaction (Myers, 2004). Whenever a pretest and posttest procedure is used to determine the change as a result of treatment, there is a risk of regression (Shadish et al., 2002). However, this risk can be minimized so long as subjects are not selected based on extreme scores (Shadish et al., 2002). In this study scores of any kind were not used as selection criteria. Therefore, regression effects should not be a serious threat to internal validity in this study (Myers, 2004).

A primary threat posed by interaction in NEGD is the possibility that posttest differences are due to preexistent differences between subjects, rather than differences from the treatment effects (Gall et al., 1996). It is important to recognize the susceptibility of NEGD research to the internal validity threat of selection. This threat may lead to a conclusion that PjBL did not make a difference when it actually did, or that it did have an effect when it did not. Intentional steps were taken to address the threat of interaction to internal validity. First, using multiple classroom settings helped to reduce the risk of interaction (Myers, 2004). Also, the use of gender, classification, age, and major were used as controls to analyze further the effects of the PjBL environment.

In addition to internal validity other factors must be controlled for in NEGD research design (Shadish et al., 2002). This study involved three different classes and four instructors for the interdisciplinary treatment and involved a co-teaching arrangement in one class for the non-interdisciplinary treatment. Additionally, PjBL was used consistently amongst the classes and scores were weighted similarly for each class within its own grading scale. Further, this study used an existing and ongoing interdisciplinary PjBL setting in its fourth iteration. All instructors

are familiar with the tenets of PjBL and designed their independent classrooms to support and foster the interdisciplinary learning environment. Throughout the project, there are numerous inter-classroom work sessions between students and instructors. Lastly, collaborators include two outside observers that are experts in education psychology and education technology.

When an instrument does not produce consistent results or if it has been altered from a previous reliable version, it is considered unreliable (Myers-Lipton, 1994). The threat to reliability can be minimized by conducting pilot tests of amended instruments (Thompson, 2004). Prior to conducting this research, pilot tests of the amended APQ were run, and alpha levels of .87 and .83 were reported. These reliability coefficient levels exceed the .80 threshold that are generally accepted in social science research (Nunnally & Bernstein, 1978).

Research objectives and questions

This study compared an interdisciplinary PjBL environment and a non-interdisciplinary PjBL environment. The following research objectives came from the research design and articulate the control variables used to minimize the threat of interaction to internal validity.

1. Determine the relationship between treatment, age, major, classification, or gender is a significant predictor of students' rankings of which 21st century skills are most important to their success in the workforce.

2. Determine the relationship between treatment, age, major, classification, or gender is a significant predictor of intrinsic motivation.

The following research questions led to the hypotheses and analysis on which the results of the effect of PjBL was determined:

1. To what extent does a PjBL environment affect students' rankings of which 21st century soft skills are most important to their future success in the workforce?

2. To what extent does a PjBL environment affect students' intrinsic motivation toward completing the class project?

3. To what extent does an interdisciplinary PjBL environment produce intrinsic motivation toward completing the class project?

Statement of hypotheses

This study used the following directional hypotheses to determine the effect of the PjBL environments on students' rankings of 21st century skills and their intrinsic motivation. The hypotheses were tested using a multivariate regression and multiple regressions explained later in this chapter.

H1. As a result of participation in a PjBL experience, students show an improvement in rank for:

a. teamwork/collaboration
b. critical thinking/problem solving
c. oral communication
d. written communication
e. creativity/innovation
f. information technology application

H2. Technical students rank information technology application higher than non-technical students in pretests and posttests as part of a PjBL experience.

H3. Intrinsic motivation will increase:

a. in students as a result of participation in a PjBL experience.

b. more in students participating in an interdisciplinary PjBL experience than in a non-interdisciplinary PjBL experience.

c. more in technical students participating in a PjBL experience than non-technical students.

H4. Students participating in an interdisciplinary PjBL experience will report higher intrinsic motivation than students participating in a non-interdisciplinary PjBL experience before and after their PjBL experience.

Sampling frame

College students made up the population of interest in this study. The data were collected from students involved in two different PjBL experiences during the course of two semesters at a large Mid-Western public university. Participants were selected from independent class samples in three different courses on campus. The PjBL experience in the first semester was an interdisciplinary project that focused on mobile application (app) development in the hospitality industry and included classes in Computer Sciences (CS), Graphic Art Design (GD), and Hospitality Management (HOSP). The PjBL experience in the second semester was a non-interdisciplinary experience that also was focused on mobile app development in the hospitality industry. However, the second semester did not include a collaboration of interdisciplinary work. Students in HOSP worked independently from any other class and articulated the purpose and design of their mobile app for the final result rather than receiving a functional *beta* version of the app as in the interdisciplinary PjBL experience. The participant populations by class for the inter-disciplinary PjBL experience were; HOSP (34), CS (14), GD (9). Participant population for the non-Interdisciplinary PjBL experience was 40 in the HOSP course.

Overview of the learning environment

For purposes of this study, HOSP students were classified as non-technical and CS and GD students were considered technical. In CS and GD, there is a rapidly growing demand from enterprise and interest from society for people proficient in mobile app development. Similarly, in the field of HOSP, there is a substantial need for a technologically savvy workforce (Dunlap, 2005; Lefever & Withiam, 1998). Moreover, the developments of increasingly efficient management techniques, as well as the ability to collect and synthesize data from guests accurately, securely, and effectively, are consistent professional issues. All disciplines require a workforce that can deal with these technological demands while being productive members of a team that can extrapolate, innovate, and communicate professionally (Crawford et al., 2011).

Key to this collaboration was the implementation of a quality-learning environment for students in CS, GD, and HOSP. This particular application of PjBL simultaneously served a real-world need and satisfies the demand for a skilled technological workforce. Students from CS, GD, and HOSP were working together and independently toward a series of common objectives. Their tasks were specific to their disciplines while also generating auxiliary learning opportunities in critical thinking, creativity/innovation, communication, and collaboration.

During the interdisciplinary PjBL intervention, students worked together to create *beta* versions of mobile apps that were designed to function in a hospitality business. During the first one-half of the PjBL experience, students in HOSP worked in teams to determine best business practices and technical needs of a particular mobile app that could function in a hotel. During this time, students in CS and GD learned how to work in the iOs development platform to create and design actual mobile apps. At the mid-point of the semester, the HOSP class became the *client*, and the CS and GD classes became the *contractors*, which emulated common partnerships in the workplace. Through the remainder of the course and semester, the three classes worked together

to create and refine a working version of the app desired by the HOSP students. The project concluded with the technical teams demonstrating their project creations to non-technical teams.

Although the classes were all separate from each other and distinct, they took place on the same days and at similar times. This permitted students and faculty to collaborate actively in each other's classes when appropriate. Furthermore, students from CS and GD were able to be present when students from HOSP communicated their ideas for a mobile app through a series of presentations. Similarly, students from HOSP were able to be present when CS and GD students presented the working versions of their apps in a public setting.

Student groups consisted of approximately 10 members total during the interdisciplinary PjBL and 6 during the non-interdisciplinary PjBL, with each student serving a unique role (Davis & Miller, 1996). This cornerstone of PjBL provides stronger connections to 21st century skill awareness and motivational influences (Holmes, 2012). The teams were not self-selected, but were assigned semi-randomly through the auto select group feature within the learning management platform. Instructor intervention was minimal in arranging groups, and limited to determining volunteer team leaders. Once teams were identified, students identified roles and created job descriptions. In addition, students agreed to a timeline for completion that was communicated to all classes and student teams. The project required students to negotiate conflicts between client needs and desires and technical limitations as they naturally arose through the development process. Thus, CS and GD students had the chance to further develop technical skills in their respective disciplines, while students from all three disciplines were prompted to develop the soft skills needed to negotiate the client-contractor relationship.

At the onset of the courses, the project was described as part of the required coursework. An instrument was developed and in accordance with the ethical principles guiding human subject research, forms were completed for approval from the University's Institutional Review

Board (IRB). A copy of the approval letter can be found in Appendix C. During the third week of classes, students were informed that there was a research interest in their perceptions of the PjBL experiences, and their consent to participate in this study was requested. A copy of the approved to use consent form is provided in Appendix D.

Questionnaire

A multi-part questionnaire was administered as part of this ongoing PjBL environment. Next, the questionnaire details will be followed by a section that describes the complete data collection process. The complete questionnaires for both the pretest and posttest is provided in Appendix A and Appendix B.

Twenty-first Century Skills

Casner-Lotto and Barrington (2006) cultivated a 20-item list of 21st century skills. This list distinguishes nine basic knowledge skills and eleven applied/soft skills. For the purpose of this study, students and employers were asked to rank order their perceived importance of the 20-item list. The list of 20-items with a brief description was provided and participants clicked and arranged them in order of perceived importance from top to bottom. The Casner-Lotto and Barrington (2006) study provided the list and definitions of items used in this study. A sample of items includes:

Critical Thinking/Problem Solving - Exercise sound reasoning and analytical thinking; use knowledge, facts, and data to solve workplace problems; apply math and science concepts to problem solving.

Information Technology Application - Select and use appropriate technology to accomplish a given task, apply computing skills to problem solving.

Intrinsic motivation inventory

The IMI was developed to assess participants' subjective experience related to experimental tasks (Ryan & Deci, 2000). Specifically, it is used in intrinsic motivation laboratory experiments in which participants have worked on an interesting activity within some experimental condition, and the IMI assesses their level of interest/enjoyment; perceived competence; effort; value/usefulness; felt pressure and tension; and perceived choice, while they were performing the activity (Ryan & Deci, 2000). Past studies have revealed strong reliability with the IMI scales, reporting consistent and acceptable alphas of greater than .80 (McAuley, Duncan, & Tammen, 1989; Tsigilis & Theodosiou, 2003). The following statements made up the APQ sub-scale of the IMI and were measured using a 7-point summated scale (1 = not at all true and 7 = very true). To analyze results, reverse scoring was done on appropriate questions in accordance with instruction regarding using the IMI scales (Deci & Ryan, 2001). The APQ used in this study was modified slightly from the original to fit this study, as suggested from research (Deci & Ryan, 2001). The revised version was pilot tested to ensure strong reliability. The revised APQ used in this study maintained similarly strong alphas as indicated in other research during these pilot tests. The slight revisions were necessary to convert the questionnaire to be used as a pretest and posttest. The full survey instruments can be found in Appendix A and Appendix B. A sample of the items include:

- I believe that doing this activity could be of some value for me.
- I would describe this activity as very enjoyable.

Data collection procedure

Data collection occurred over two successive semesters from the Fall 2014 semester to the Spring 2015 semester. As noted earlier, in the Fall semester, the PjBL was a collaborative and

interdisciplinary project that involved students in three courses; CS, GD, and HOSP. Conversely, in the Spring, the PjBL was an identical non-interdisciplinary project involving only hospitality management students. All pretest data for the first observation were collected the second week of classes each semester at the onset of students learning of the PjBL design of the class. The second observation occurred the final week of classes after the final PjBL public presentation occurred.

Questionnaires to students were administered as part of the ongoing PjBL course structure. The questionnaires were delivered, via a personalized email link, to each student at the onset of the PjBL experience by the primary researcher and their course instructor. A copy of all emails sent to students for pretests and posttests is provided in Appendix E. Questionnaires were once again administered, in the same way, at the conclusion of the PjBL experience. Both sets of questionnaires were administered using Qualtrics. Although students were required as part of their course to complete the questionnaires, only those who gave appropriate consent were used in the data analysis. As part of the university's IRB protocol, instructors were not aware of consenting students until after final grades were posted in the grade collection system. The primary researcher was not listed as an instructor of record for any of the courses, but was involved with delivering and collecting survey responses along with the instructors for each course.

Data analysis

Pretest and posttest data from the ranking of 21st century soft skills were analyzed using two multivariate regressions. The multivariate regressions are appropriate because the ranking of 21st century soft skills contains multiple dependent variables, and the items are interrelated (Bodenhausen & Curtis, 2016; Brown et al., 2011). Also, the inclusion of categorical demographic variables may be responsible for change scores and therefore interrelated compared to the outputs as well. Using a multivariate regression lessens the threat for committing a type I or

type II error (Brown et al., 2011). Results of the APQ subset of Interest/Enjoyment were analyzed using a multiple regression and a multivariate regression. Prior to conducting the multiple regression for the APQ an exploratory factor analysis was completed to determine the unidimensional nature of the Interest/Enjoyment subscale (Thompson, 2004). The factor analysis used Statistical Package for Social Sciences (SPSS) 23.0 for mac. The Interest/Enjoyment subscale within the APQ, measures intrinsic motivation (Ryan & Deci, 2000). These procedures are appropriate when analyzing two or more dependent variables, while also controlling for multiple additional variables of age, classification, major, and gender (Myers, 2004). After the exploratory factor analysis, additional statistical analyses were conducted using SPSS 23.0 for mac. Calculating frequency distributions completed an examination of the sample characteristics. Complete descriptive and inferential statistics are presented in the next chapter.

Summary

This chapter presented the methods utilized to answer the research questions. In addition, the research questions and hypotheses were restated in this chapter. Further, the chapter described the procedures, research design, population and sample, questionnaires, data collection procedures, and data analysis. The results are presented in the following chapter.

CHAPTER IV

FINDINGS

The intent of this research was to investigate a Project-Based Learning (PjBL) environment and an interdisciplinary PjBL environment. Moreover, the study examined the effects of these learning environments on students' rankings of 21st century skills relevant to their success in the workforce and their intrinsic motivation toward completing a course project. The participants of this study consisted of 97 students enrolled in four different courses over two semesters. The PjBL experience in the first semester was an interdisciplinary project that focused on mobile application (app) development in the hospitality industry and included classes in Computer Sciences (CS), Graphic Art Design (GD), and Hospitality Management (HOSP). The PjBL experience in the second semester was a non-interdisciplinary experience that also was focused on mobile app development in the hospitality industry. Participants in this study were not selected randomly, therefore, a nonequivalent group design was used to organize the study and analyze the results. This chapter will describe the data collected and provide the reports of the statistical analyses regarding demographics and hypotheses testing.

Profile of participants

A total of 193 questionnaires were completed by 97 participants and used to test the hypotheses. Additional questionnaires were completed as part of the course but not all respondents provided consent to the study. Additionally, 12 of the 193 surveys were incomplete. Final analysis was completed with 85 participants for a response rate of 88%. Table 2 reveals the demographic variables of gender, race, class rank, and age.

Table 2

Gender, Ethnicity, Class rank, and Age for Groups by Semester

Variable	Fall 2014		Spring 2015		TOTAL
	f	%	*f*	%	
Gender					
Male	23	40	7	18	30
Female	33	58	33	83	66
Prefer not to respond	1	2	0	0	1
Race					
African American/Black	3	4	0	0	3
Asian/Pacific Islander	17	3	8	20	25
Hispanic/Latino	2	3	0	0	2
Multiracial	1	2	2	5	3
Native American/American Indian	3	5	2	5	5
White	31	54	27	68	58
Prefer not to respond	2	3	1	3	3
Class rank					
Sophomore	1	18	6	15	7
Junior	21	37	24	60	45
Senior	31	54	8	20	39
Graduate Student	4	7	2	5	6
Age					
18-19	2	35	4	10	6
20-21	31	54	28	70	59
22-24	17	30	7	18	24
25 and above	7	12	1	3	8

Note. Participant numbers include only students listed on class rosters who chose to participate in the study.

The results revealed that participants were predominantly female in both semesters, Fall (58%) and Spring (83%) (see Table 2). Similarly, a majority of respondents were white in each semester, Fall (54%) and Spring (68%). The majority of participants were classified as a senior in the Fall group (54%) and a junior in the Spring group (60%). The predominant age group of all participants was 20-21 in each semester, Fall (54%) and Spring (70%). Prior to completing regression analyses, subjects were removed who only completed either the pre or post survey, but did not complete both. This decision was prudent based on the research questions and hypotheses seeking to understand the change in ranking and intrinsic motivation as a result of participating in a PjBL, as measured by the differences in posttests and pretests.

Research objectives and questions results

Research objectives were related to the control variables used to minimize threats of interaction and internal validity. These objectives are revealed and answered in conjunction with the analyses of the research questions and hypotheses. Dummy coding was used to control for potential variance which might influence results. The strategy of using dummy coding allows for conditions to be held constant and maximize the accuracy and influence of the intended test variable (Cohen, Cohen, West, & Aiken, 2013). The research objectives were as follows:

1. Determine the relationship between treatment, age, major, classification, or gender is a significant predictor of students' rankings of which 21st century skills are most important to their success in the workforce.

2. Determine the relationship between treatment, age, major, classification, or gender is a significant predictor of intrinsic motivation

The research questions were as follows:

1. To what extent does a PjBL environment affect students' rankings of which 21st century soft skills are most important to their future success in the workforce?

2. To what extent does a PjBL environment affect students' intrinsic motivation towards completing the class project?

3. To what extent does an interdisciplinary PjBL environment produce intrinsic motivation towards completing the class project?

Effect of PjBL on ranked importance of 21st century soft skills

To answer the first research question, an analysis of the impact PjBL had on the change in ranking difference from pretests to posttests was completed. The first hypothesis associated with this question is:

H1. As a result of participation in a PjBL experience, students show an improvement in rank for:

g. teamwork/collaboration
h. critical thinking/problem solving
i. oral communication
j. written communication
k. creativity/innovation
l. information technology application

The first analysis was a means test to determine the direction and amount of the change in rank. Three of the variables had an improvement for rank as hypothesized, while the other three did not improve in rank. Teamwork/collaboration had the largest improvement in rank at -1.68

(see Table 3). Table three reveals the differences in means ranking for all six variables as well as their standard deviations.

Table 3

Mean Differences from Pretests to Posttests

Dependent Variable	μ	*SD*
1a - Teamwork/Collaboration	-1.68	5.23
1b - Critical Thinking/Problem Solving	.07	5.04
1c - Oral Communication	.62	5.55
1d - Written Communication	-.06	5.71
1e - Creativity/Innovation	-.14	5.72
1f - Information Technology Application	1.07	5.69

(n = 85)

To determine the significance of the change in mean differences from pretests and posttests, the variables were analyzed further. The variables were deemed interrelated due to change in rank positioning in pretests and posttests. To account for the interrelated nature of measurements, a multivariate regression was used to evaluate the six dependent variables while simultaneously controlling for the potential of highly correlated demographic and treatment variables. The independent variables were students in each of the different classroom environments. The independent variable groupings were non-technical students made up of students in a HOSP and technical students in a CS and a GD course. The multivariate regression was used to test the hypothesis while controlling for influence from these additional variables and decreasing the chance for error. The histograms in figure four show the distribution of the difference scores from pretests to posttests for the dependent variables. These images reveal the data met the assumptions of normality.

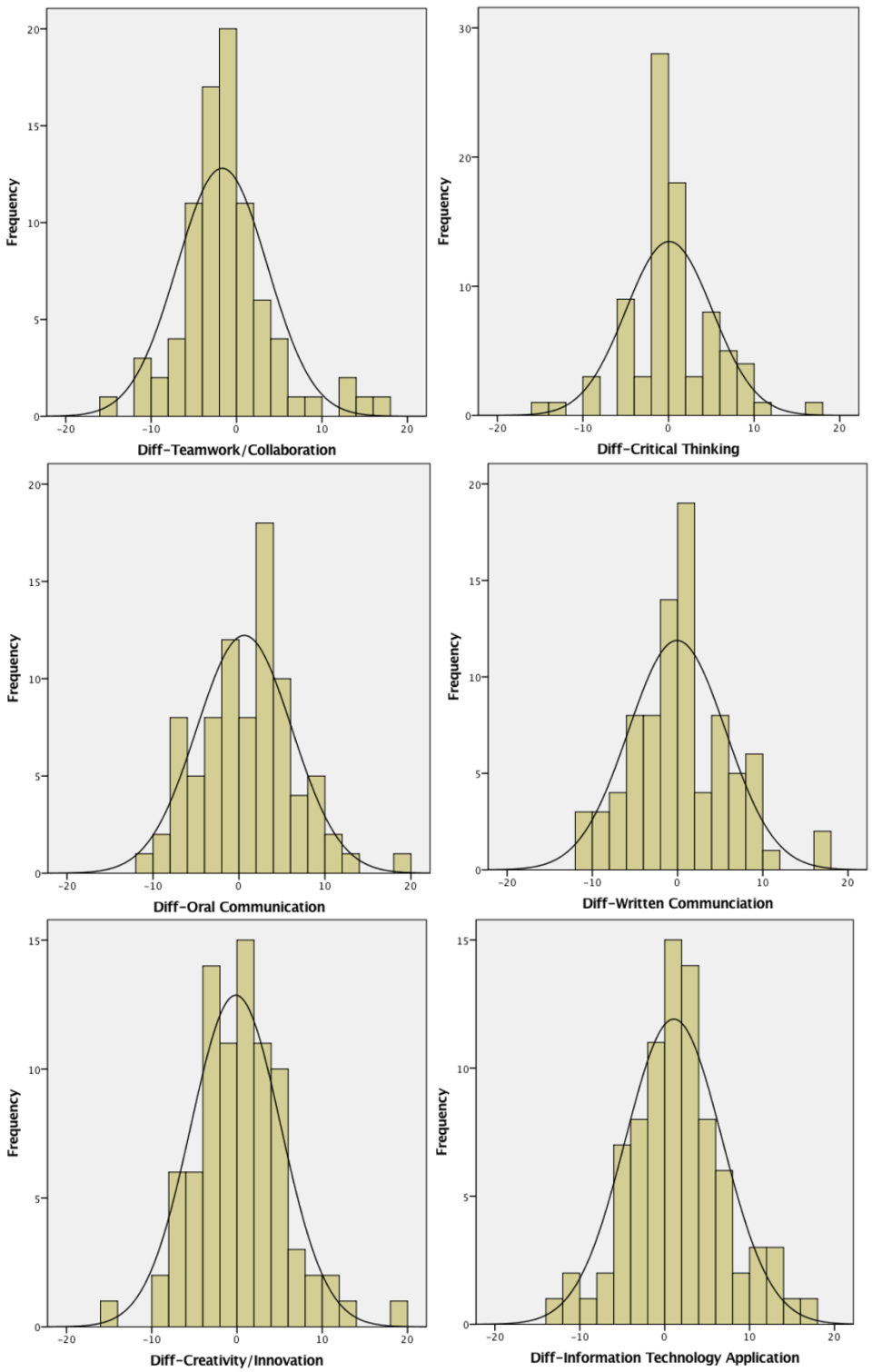

Figure 4. Histograms of the differences in pretest and posttests results for soft skills (dependent variables)

The multivariate regression analysis revealed an overall statistically significant main effect for students based on their status as a technical or non-technical student, Wilks' $\lambda = .840$, $F = (6, 71) = 2.256$, $p = .048$ (see Table 4). Two of the coefficient predictor variables were statistically significant in this model at the .05 level, and two additional variables at the .10 level. Table four reveals the results of the multivariate test.

Table 4

Multivariate results of effects of PjBL on ranked importance of 21st century skills

Independent Variable	Wilks λ	*F*	Hypothesis df	Error df	*p* value	Partial eta squared
Treatment (semester)	.799	2.980	6.00	71.00	.012*	.201
Age (18-19)	.970	0.365	6.00	71.00	.899	.030
Age (22-24)	.849	2.109	6.00	71.00	.063**	.151
Age (25+)	.935	0.819	6.00	71.00	.559	.065
Technical status (major)	.840	2.256	6.00	71.00	.048*	.160
Class rank (Sophomore)	.930	.895	6.00	71.00	.503	.070
Class rank (Junior)	.854	2.022	6.00	71.00	.074**	.146
Gender	.917	1.076	6.00	71.00	.385	.083

Note. The following variables were held constant using dummy coding procedures: Fall 2014, Age 20-21, Non-technical students, Seniors, and Males (n = 85)
*$p < .05$, **$p < .10$

The next six sub-sections will review each variable and the specific results of each univariate regression analyses. Each univariate test was tested for significance at the .05 level.

Teamwork/Collaboration

The first hypothesis tested was, H_{1a}, students show an improvement in rank for teamwork/collaboration as a result of the PjBL experience. Significant univariate main effects

were examined for teamwork/collaboration for all students, $F = (1, 8) = 1.762$, $p = .098$, and explains 15.6% of the variance in rank change. Based on the results, it is determined that there is not a statistically significant effect on the rank change of teamwork/collaboration as a result of participation in a PjBL experience. Therefore, *fail to reject* was assigned to H_{0a}.

Critical Thinking/Problem Solving

The second hypothesis tested was, H_{1b}, students show an improvement in rank for critical thinking/problem solving as a result of the PjBL experience. Significant univariate main effects were examined for teamwork/collaboration for all students, $F = (1, 8) = 1.513$, $p = .167$, and explains 13.7% of the variance in rank change. Based on the results, it is determined that there is not a statistically significant effect on the rank change of critical thinking/problem solving as a result of participation in a PjBL experience. Therefore, *fail to reject* was assigned to H_{0b}.

Oral Communication

The third hypothesis tested was, H_{1c}, students show an improvement in rank for oral communication as a result of the PjBL experience. Significant univariate main effects were examined for oral communication for all students, $F = (1, 8) = 1.247$, $p = .284$, and explains 11.6% of the variance in rank change. Based on the results, it is determined that there is not a statistically significant effect on the rank change of oral communication as a result of participation in a PjBL experience. Therefore, *fail to reject* was assigned to H_{0c}.

Written Communication

The fourth hypothesis tested was, H_{1d}, students show an improvement in rank for written communication as a result of the PjBL experience. Significant univariate main effects were examined for written communication for all students, $F = (1, 8) = 1.077$, $p = .388$, and explains 10.2% of the variance in rank change. Based on the results it is determined that there is not a

statistically significant effect on the rank change of written communication as a result of participation in a PjBL experience. Therefore, *fail to reject* was assigned to H_{0d}.

Creativity/Innovation

The fifth hypothesis tested was, H_{1e}, students show an improvement in rank for creativity/innovation as a result of the PjBL experience. Significant univariate main effects were examined for creativity/innovation for all students, $F = (1, 8) = .642$, $p = .740$, and explains 6.3% of the variance in rank change. Based on the results, it is determined that there is not a statistically significant effect on the rank change of creativity/innovation as a result of participation in a PjBL experience. Therefore, *fail to reject* was assigned to H_{0e}.

Information Technology Application

The sixth hypothesis tested was, H_{1f}, students show an improvement in rank for information technology application as a result of the PjBL experience. Significant univariate main effects were examined for information technology application for all students, $F = (1, 8) = 1.228$, $p = .295$, and explains 11.4% of the variance in rank change. Based on the results, it is determined that there is not a statistically significant effect on the rank change of information technology application as a result of participation in a PjBL experience. Therefore, *fail to reject* was assigned to H_{0f}.

In conclusion, for the first hypothesis, there is an overall statistically significant multivariate main effect, but there is a lack of univariate statistical significance. Further, the data do not support the claims that a change in rank was a result of the PjBL experience, and the null hypothesis cannot be rejected.

Information technology application importance based on technical status of students

To investigate the second hypothesis, a multivariate regression was conducted to examine the rank differences of technical and non-technical students regarding the importance of information technology application. As stated previously, the hypothesis was:

> H2. Technical students rank information technology application higher than non-technical students in pretests and posttests as part of a PjBL experience.

The histograms in figure five show the distribution of scores on pretests and posttests for the dependent variables. These images reveal the data met the assumptions of normality.

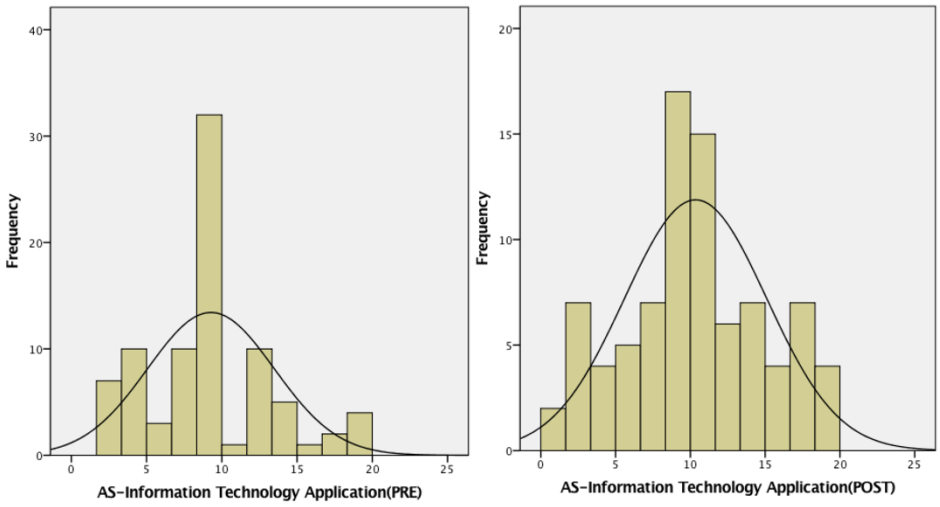

Figure 5. Histograms of the pretest and posttests score for Information Technology Application (dependent variables)

The regression model used the pretest ranking mean and the posttest ranking mean as the dependent variables, and used a significance test level of .05. The overall model was found to be

statistically significant, Wilks λ = .884, F (2, 75.00) = 4.905, p = .010. The technical status of students was the only predictor found to be significant in this regression model for both pretests and posttests. Table five reveals the results of the multivariate tests of all coefficients for pretest and posttest ranked differences for the 21st century skill, information technology application.

Table 5

Summary of Multivariate Regression for Analyses of Pretest and Posttest Mean Ranked Differences by Student Technical Status for 21st Century Skill, Information Technology Application

Information Technology Application	Wilks λ	*F*	Hypothesis df	Error df	*p* value	Partial eta squared
Treatment (semester)	.960	1.568	2.00	75.00	.215	.040
Age (18-19)	.939	2.434	2.00	75.00	.095**	.061
Age (22-24)	.984	.623	2.00	75.00	.539	.016
Age (25+)	.980	.763	2.00	75.00	.470	.020
Technical status (major)	.884	4.905	2.00	75.00	.010*	.116
Class rank (Sophomore)	.963	1.457	2.00	75.00	.239	.037
Class rank (Junior)	.994	.230	2.00	75.00	.795	.006
Gender	.999	.047	2.00	75.00	.954	.001

Note. The following variables were held constant using dummy coding procedures: Fall 2014, Age 20-21, Non-technical students, Seniors, and Males (n = 85)
*$p < .05$, **$p < .10$

As a result of the overall test, a review of the univariate tests was completed for each dependent variable. Each univariate test was tested for significance at the .05 level.

Significant univariate main effects were examined for the mean of all students' pretest rank of information technology application, F = (1,8) = 4.295, p = .042, and explains 10.7% of the variance. Based on the results, it is determined that difference between technical and non-

technical students pretest ranking of information technology application is statistically significant at the .05 level.

Significant univariate main effects were examined for the mean of all students' posttest rank of information technology application, $F = (1,8) = 6.863$, $p = .011$, and explains 24.7% of the variance. Based on the results, it is determined that difference between technical and non-technical students' posttest ranking of information technology application is statistically significant at the .05 level.

In conclusion, this study revealed that technical students rank information technology application higher than non-technical students in both pre and posttests. Compared to all other coefficients, the technical status of students is the only statistically significant predictor of this difference, even though, there is statistically significance for students in the age range of 18-19.

Effect of PjBL on students' intrinsic motivation

The second research question dealt with how participating in PjBL affects students' intrinsic motivation. To determine the level of intrinsic motivation, a modified version of the Activity Perception Questionnaire was utilized (APQ), which is a sub-scale of the Intrinsic Motivation Inventory (IMI). Of the three common factors of this scale, only one has been effective as a self-report of measuring intrinsic motivation, this subscale is called the Interest/Enjoyment factor (Deci & Ryan, 2001). One of the eight items was worded negatively and required reverse scoring. This reverse score was completed prior to analysis.

Confirming model fit

Prior to conducting hypotheses testing, an exploratory factor analysis was completed on the Interest/Enjoyment subscale to test the unidimensional nature of this factor. First, the 8 items of the Interest/Enjoyment factor were examined to determine their factorability. In order to make

this determination several criteria were used. Cronbach's alpha for internal consistency of the Interest/Enjoyment factor tested at .89. Maximum likelihood was used for extraction as this was a test of the unidimensional nature of the theoretical model. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was .933, well above the commonly recommended value of .6, and Bartlett's test of sphericity was significant (χ^2 (28) = 1338.534, $p < .001$). Table six reveals the communalities were all above .3, except the negatively worded item that was reverse scored, confirming that all other items of the Interest/Enjoyment subscale shared some commonalities with each other.

Table 6

EFA Factor Loadings and Communalities for the 8-item Intrinsic Motivation Scale

Variable	Factor Loading	Communalities
Item 3 – Thinking and enjoyment	.786	.636
Item 5 – This project was fun to do	.891	.775
Item 7 – Enjoy doing very much	.918	.819
Item 11 – Enjoy while doing project	.913	.798
Item 12 – Think boring	.006	.030
Item 15 – Think interesting	.740	.548
Item 18 – Describe enjoyable	.889	.770
Item 24 – Describe very fun	.891	.773

(n = 193)

Table seven reveals the Eigenvalues for eight items. The Eigenvalues indicated that the univariate factor explained 68.18% of the variance. There was an additional factor that exceeded an Eigenvalue of one. Figure six reveals the scree plot showing these Eigenvalues and shows that the bend of the elbow of the second factor is after one.

Table 7

Eigenvalues and Variance Percentage Intrinsic Motivation Scale

Factor	Eigenvalue	Variance %
1	5.454	68.176
2	1.009	12.607
3	.503	6.290
4	.318	3.970
5	.246	3.073
6	.172	2.150
7	.161	2.017
8	.137	1.718

(n = 193)

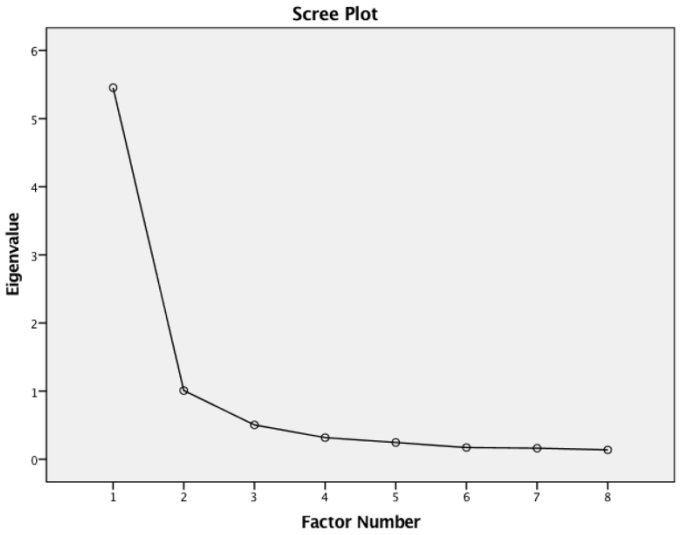

Figure 6. Scree plot showing Eigenvalues for Interest/Enjoyment sub-factor

As revealed in table six, one of the items did not share similarity with other items. The item that did not fit was item 12, which asked the participant to scale the statement: *I think this project was a very boring activity*. Item 12 was the only item worded negatively that also had to be reverse scored. According to Edward Deci who co-founded Self-Determination Theory and cultivated the questionnaires, this is not uncommon and it is acceptable to drop this item when

completing further analysis (personal communication, June 15, 2016). After removing the negatively worded item, a second exploratory factor analysis was conducted for the remaining items.

Because the initial factor analysis resulted in the removal of an item it is prudent to respecify the model (Hair, Black, Babin, Anderson, & Tatham, 2010). Cronbach's alpha for internal consistency of the revised Interest/Enjoyment factor tested at .95. The KMO measure of sampling adequacy was .915, well above the commonly recommended value of .6, and Bartlett's test of sphericity was significant (χ^2 (21) = 464.215, $p < .001$). Table eight reveals the communalities were all above .3, confirming further that the revised set of items of the Interest/Enjoyment subscale shared some commonalities with each other.

Table 8

EFA Factor Loadings and Communalities for the Revised 7-item Intrinsic Motivation Scale

Variable	Factor Loading	Communalities
Item 3 – Thinking and enjoyment	.715	.511
Item 5 – This project was fun to do	.852	.726
Item 7 – Enjoy doing very much	.861	.741
Item 11 – Enjoy while doing project	.866	.749
Item 15 – Think interesting	.759	.577
Item 18 – Describe enjoyable	.870	.757
Item 24 – Describe very fun	.850	.723

(n = 193)

Table nine reveals the Eigenvalues for seven items. The Eigenvalues indicated that the univariate factor explained 72.66% of the variance. No other factors exceeded a measure of one. Figure seven reveals the scree plot showing these Eigenvalues and shows that the bend of the elbow is before one.

Table 9

Eigenvalues and Variance Percentage for Revised 7-item Intrinsic Motivation Scale

Factor	Eigenvalue	Variance %
1	5.086	72.663
2	.555	7.924
3	.407	5.813
4	.339	4.842
5	.244	3.485
6	.201	2.879
7	.168	2.394

(n = 193)

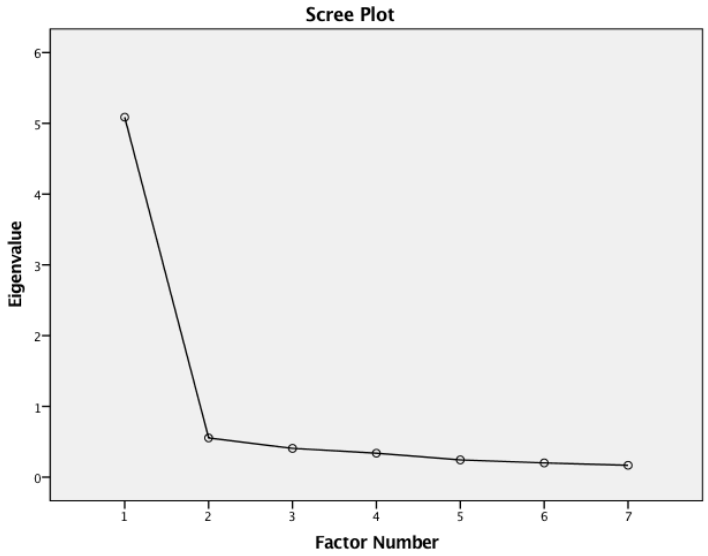

Figure 7. Scree plot showing Eigenvalues for an adjusted Interest/Enjoyment sub-factor

Overall, the analyses indicated that the revised intrinsic motivation scale was unidimensional.

Determining the effect of PjBL on students' intrinsic motivation

After confirming the fit of the instrument for the second research question, further analysis was conducted. The third hypothesis of the study that is associated with the second research question was:

H3. Intrinsic motivation will increase:

a. in students as a result of participation in a PjBL experience.
b. more in students participating in an interdisciplinary PjBL experience than in a non-interdisciplinary PjBL experience.
c. more in technical students participating in a PjBL experience than non-technical students.

A multiple linear regression was utilized to determine the predictability of intrinsic motivation change based on differing student groups and PjBL learning environments. The multiple linear regression is appropriate for this study due to the nature of potential collinear relationships amongst variables and to understand better the impact PjBL has on intrinsic motivation while considering these variables. The dependent variable in this regression was the change in intrinsic motivation from pretests and posttests associated with the PjBL learning environment. The independent variable groupings were the non-technical students in HOSP and the technical students in CS and GD. The unstandardized coefficients and standardized coefficients were examined to determine the contribution of the independent variables in explaining the change in motivation while controlling for all other variables in the model. The hypothesis was tested for significance at the .05 level.

Tests to see if the data met the assumption of collinearity indicated that multicollinearity was not a concern. The range of variance inflation factor (VIF) values is 1.150 minimum to a maximum of 1.661, well below the acceptable and common threshold of 10 (Hair et al., 2010).

This reveals that the variables are not interacting with each other to predict intrinsic motivation. Additionally, the data met the assumption of independent errors, Durbin-Watson value = 2.214. The data also met the assumption of non-zero variances with all variance values being greater than zero. The descriptive statistics presented indicate data The histogram in figure eight shows the difference in mean scores for intrinsic motivation from pretests to posttests, which served as the dependent variable. The image reveals the data met the assumption of normality.

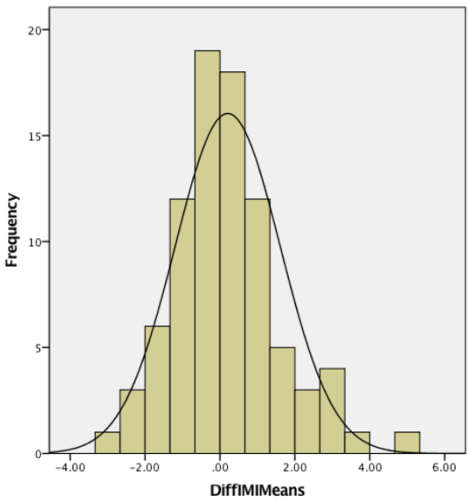

Figure 8. Histogram of the difference in intrinsic motivation (dependent variable)

The overall model was found to not be statistically significant, F (6, 78) = 1.339, p = .250, and explains 9.3% of the variance in the data. The data do not support the claim that intrinsic motivation would increase as a result of participation in a PjBL experience. Therefore, *fail to reject* was assigned to the null hypothesis. The following two sections continue this investigation by presenting the additional regression output for a narrower view of the effect of PjBL on intrinsic motivation. Table 10 reveals the coefficient and model data for the regression.

Table 10

Summary of Multiple Linear Regression Analysis for Change in Intrinsic Motivation Based on Student Demographic Controls

Variables	*B*	*SE B*	*β*	*p*	Tolerance	VIF
Age 18-19	-.426	.602	-.084	.482	.832	1.202
Age 22-24	.531	.461	.152	.253	.670	1.493
Age 25+	-.922	.879	-.121	.297	.868	1.152
Gender (Female)	-.508	.365	-.161	.167	.869	1.150
Sophomore Class Rank	.836	.675	.164	.219	.663	1.508
Junior Class Rank	-.131	.390	-.047	.738	.602	1.661
R^2 change	.093					
F change	.250					

Note. The following variables were held constant using dummy coding procedures: Age 20-21, Seniors, and Males (n = 85)

Effect of interdisciplinary PjBL on intrinsic motivation

The next layer of regression dealt with the difference of effect between students participating in an interdisciplinary PjBL compared to students participating in a non-interdisciplinary PjBL. As stated previously, the hypothesis was:

> H_{3b}. Intrinsic motivation will increase more in students participating in an interdisciplinary PjBL experience than in a non-interdisciplinary PjBL experience.

Tests to see if the data met the assumption of collinearity indicated that multicollinearity was not a concern. The range of variance inflation factor (VIF) values was 1.159 minimum to a maximum of 1.822, well below the acceptable and common threshold of 10 (Hair et al., 2010). This reveals that the variables were not interacting with each other to predict intrinsic motivation. Additionally, the data met the assumption of independent errors, Durbin-Watson value = 2.214. The data also met the assumption of non-zero variances with all variance values being greater

than zero. The descriptive statistics presented indicate data that are reliable to use in analyzing the regressions further.

The analysis reveals that participation in this interdisciplinary PjBL was not a significant predictor of having a higher increase in intrinsic motivation as compared to students in a non-interdisciplinary PjBL experience, F (7, 77) = 1.137, p = .349, which explains 9.4% of the variance in the data. Therefore, data do not support the claim that intrinsic motivation would increase more in students participating in an interdisciplinary PjBL than students participating in a non-interdisciplinary PjBL experience. Therefore, *fail to reject* was assigned to the null hypothesis. Table 11 reveals the coefficient and model data for the regression

Table 11

Summary of Multiple Linear Regression Analysis for Change in Intrinsic Motivation Based on Student Demographic Controls and Interdisciplinary Treatment

Variables	*B*	*SE B*	*β*	*p*	Tolerance	VIF
Age 18-19	-.434	.608	-.085	.477	.826	1.210
Age 22-24	.539	.467	.154	.252	.662	1.511
Age 25+	-.933	.887	-.123	.296	.863	1.159
Gender (Female)	-.500	.370	-.158	.181	.853	1.173
Sophomore Class Rank	.875	.721	.172	.228	.589	1.699
Junior Class Rank	-.111	.411	-.040	.788	.549	1.822
Interdisciplinary treatment	-.055	.341	-.020	.872	.804	1.244
R^2 change	.000					
F change	.872					

Note. The following variables were held constant using dummy coding procedures: Fall 2014, Age 20-21, Seniors, and Males (n = 85)

Comparisons of intrinsic motivation change amongst student groups

Next, the multiple regression analyzed the difference in motivation based on the technical status, previously defined as major, for students involved in a PjBL experience. As previously stated, the hypothesis is:

> H_{3c}. Intrinsic motivation increases more in technical students participating in a PjBL experience than non-technical students.

Tests to see if the data met the assumption of collinearity indicated that multicollinearity was not a concern. The range of variance inflation factor (VIF) values is 1.187 minimum to a maximum of 2.110, well below the acceptable and common threshold of 10 (Hair et al., 2010). This reveals that the variables are not interacting with each other to predict intrinsic motivation. Additionally, the data met the assumption of independent errors, Durbin-Watson value = 2.214. The data also met the assumption of non-zero variances with all variance values being greater than zero. The descriptive statistics presented indicate data that is reliable to use in further analyzing the regressions.

The analysis reveals that the technical status of students did significantly predict a higher increase in intrinsic motivation as compared to non-technical students, $F(6, 78) = 2.296$, $p = .029$, which explains 19.5% of the variance in the data. Therefore, the data suggests that technical status of students predicted an increase in intrinsic motivation as compared to non-technical students. Table 12 reveals the coefficient and model data for the regression.

Table 12

Summary of Multiple Linear Regression Analysis for Change in Intrinsic Motivation Based on Student Demographic Controls, Interdisciplinary Treatment, and Technical Student Status

Variables	*B*	*SE B*	*β*	*p*	Tolerance	VIF
Age 18-19	-.536	.578	-.105	.357	.823	1.214
Age 22-24	.378	.446	.108	.399	.653	1.532
Age 25+	-.302	.866	-.040	.728	.814	1.228
Gender (Female)	-.380	.354	-.120	.286	.842	1.187
Sophomore Class Rank	1.053	.686	.207	.129	.584	1.711
Junior Class Rank	.367	.419	.131	.384	.474	2.110
Interdisciplinary treatment	.340	.348	.121	.331	.695	1.440
Technical status	1.500	.486	.419	.003*	.576	1.736
R^2 change	.101					
F change	.003					

Note. The following variables were held constant using dummy coding procedures: Fall 2014, Age 20-21, Non-technical students, Seniors, and Males (n = 85)
*$p < .05$

In conclusion, overall intrinsic motivation did not increase at a significant level as a result of participation in a PjBL experience. Likewise, a closer review of the data reveals that students participating in an interdisciplinary PjBL experience did not experience a significant increase in intrinsic motivation as compared to students in a non-interdisciplinary PjBL experience. However, technical students did report an increase in intrinsic motivation as a result of participating in a PjBL, as compared to non-technical students. In particular, for every one point increase in intrinsic motivation for all students, technical students will increase .419 more in motivation score than non-technical students.

Effect of interdisciplinary PjBL on students' intrinsic motivation

The third and final research question deals with the difference in intrinsic motivation before and after a PjBL. Of particular interest is whether intrinsic motivation is higher in students

participating in an interdisciplinary PjBL as compared to students participating in a non-interdisciplinary experience. The regression model used the pretest intrinsic motivation mean and the posttest intrinsic motivation mean as the dependent variables. As previously stated the fourth hypothesis is:

> H4. Students participating in an interdisciplinary PjBL experience will report higher intrinsic motivation than students participating in a non-interdisciplinary PjBL experience before and after their PjBL experience.

In order to investigate the final hypothesis a multivariate regression was conducted to examine the intrinsic motivation of students from pretests and posttests associated with a PjBL experience. The hypothesis was tested for significance at the .05 level. The histograms in figure nine show the distribution of scores on pretests and posttests for the dependent variables. These images reveal the data met the assumptions of normality.

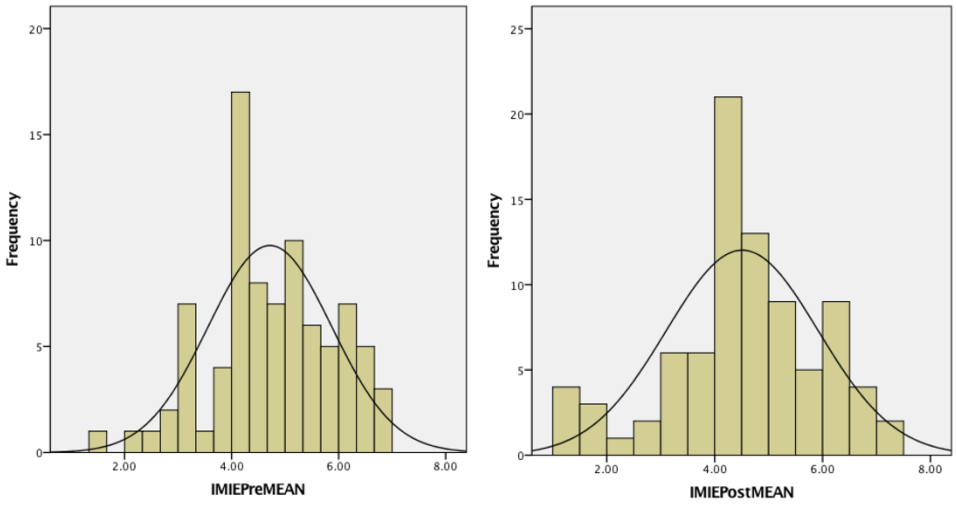

Figure 9. Histograms of the pretest and posttests mean for intrinsic motivation (dependent variables)

The regression revealed a significant multivariate main effect for students, Wilks' λ = .749, F = (2, 75.00) = 12.564, *p* = .001. Table 13 reveals the overall results of the model. The data suggests that students participating in an interdisciplinary PjBL experience reported an increase in intrinsic motivation, more than students participating in a non-interdisciplinary PjBL. The interdisciplinary nature of the PjBL was found to be significant in this regression model for both pretests and posttests.

Table 13

Summary of Multivariate Regression for Analyses of Pretest and Posttest Mean Differences of Intrinsic Motivation

Variables	Wilks λ	*F*	Hypothesis df	Error df	*p* value	Partial eta squared
Treatment (semester)	.749	12.564	2.00	75.00	.001*	.242
Age (18-19)	.961	1.526	2.00	75.00	.224	.039
Age (22-24)	.990	.376	2.00	75.00	.688	.010
Age (25+)	.993	.252	2.00	75.00	.778	.007
Technical status (major)	.758	11.963	2.00	75.00	.001*	.251
Class rank (Sophomore)	.957	1.668	2.00	75.00	.196	.043
Class rank (Junior)	.989	.401	2.00	75.00	.671	.011
Gender	.983	.646	2.00	75.00	.527	.017

Note. The following variables were held constant using dummy coding procedures: Fall 2014, Age 20-21, Non-technical students, Seniors, and Males (n = 85)
**p < .05*

As a result of the overall test a review of the univariate tests was completed for each dependent variable. Each univariate test was tested for significance at the .05 level.

Significant univariate main effects were examined for the mean of all students' pretest score of intrinsic motivation, $F = (1,8) = 2.183$, $p = .038$, and explains 18.7% of the variance. Based on the results it is determined that the pretest mean difference of intrinsic motivation between students participating in an interdisciplinary PjBL and students participating in a non-interdisciplinary PjBL is significant at the .05 level.

Significant univariate main effects were examined for the mean of all students' posttest score of intrinsic motivation, $F = (1,8) = 5.408$, $p < .001$, and explains 36.3% of the variance. Based on the results it is determined that the posttest mean difference of intrinsic motivation between students participating in an interdisciplinary PjBL and students participating in a non-interdisciplinary PjBL is significant at the .05 level.

In conclusion, the data suggests that both students in an interdisciplinary PjBL experience and technical students report a higher increase in intrinsic motivation before and after a PjBL experience as compared to non-technical students in a non-interdisciplinary PjBL experience.

Summary

The findings of this study provided information regarding PjBL learning environments, and their effect on students' rankings of 21st century skills relevant to their success in the workforce and their intrinsic motivation toward completing a course project. This chapter revealed the results of testing the four hypotheses associated with the three research questions. The next chapter will explore these findings in more detail and provide recommendations for future related studies.

CHAPTER V

CONCLUSION

Introduction

This chapter summarizes and concludes this research. A discussion of key findings is followed by conclusions derived from the results of the study. In addition, this chapter reveals implications based on the research and acknowledge limitations of the study. Lastly, this chapter discusses opportunities to engage in practice and research as a continuation of and in response to findings from this study.

Discussion

The intent of this research was to investigate a Project-Based Learning (PjBL) environment and an interdisciplinary PjBL environment. Moreover, the study examined the effects of these learning environments on students' rankings of 21st century skills relevant to their success in the workforce, and their intrinsic motivation toward completing a course project.

Research of PjBL environments have provided educators with empirical evidence to help shape the way learning environments are structured (Larmer & Mergendoller, 2015). However,

according to Baer (2014), the overall review of PjBL research demonstrates that results are mixed and there are numerous studies with insignificant findings. Evidence supports that there are strong correlations between improving perceptions of the value of soft skills over basic knowledge skills when PjBL constructs are followed (Pearlman, 2010). Likewise, PjBL environments are purported to have the potential to produce higher intrinsic motivation in students when the core constructs of PjBL are in place (Barell, 2010).

Research conducted in various educational settings conclude that teamwork/collaboration, critical thinking/problem solving, oral communication, written communication, creativity/innovation, and information technology application are consistently connected with PjBL. (Andrews & Higson, 2008; Baer, 2014; Bancino & Zevalkink, 2007; Carter, 2011; Hughes, 2012). Results from previous research influenced the development of the hypothesis in this study that participation in a PjBL experience would improve the ranking of these six soft skills. As reported in the previous chapter, the results of this study indicated that teamwork/collaboration, written communication, and creativity/innovation improved while critical thinking/problem solving, oral communication, and information technology application did not show improvement. PjBL was not found to be a statistically significant predictor of change for any of the soft skills. These results do not necessarily conflict with the previous research mentioned, as this study utilized rank order of the skills and previous research only noted which soft skills may have a strong connection to PjBL. Nevertheless, the findings of this study offer some opportunities for reflection.

Of the six items, Teamwork/Collaboration had the largest improvement in rank. This result may indicate that students underestimate the role of Teamwork/Collaboration in PjBL. A possible reason for this is the influence of their past educational experiences. Students who have not experienced collaborative or interdisciplinary learning environments may underestimate the importance of working with others to complete a project. This conclusion seems to align with

previous research that students may not grasp what skills are needed to perform successfully in today's diverse and collaborative workplace (Casner-Lotto & Barrington, 2006; Holmes, 2012; Mitchell, Skinner, & White, 2010). Information Technology Application as a soft skill decreased the most in rank after the PjBL experience. This result may suggest that prior to the experience, students in this study perceived this skill would be important to be able to successfully complete the project based on its technical nature. However, after participation in this project, they may have realized that other soft skills not related to technology were more important. This might demonstrate that even though previous research states Information Technology Application has a natural connection to PjBL (Bancino & Zevalkink, 2007; Britton, 2013; Dunlap, 2005), in this study, student perceptions may have been influenced by the nature of the specific project they are experiencing.

Additionally, in relation to the effect of PjBL on students' perceptions of the importance of soft skills, it was expected that technical students would rank Information Technology Application higher than non-technical students. As mentioned in the previous chapter, the results confirmed this hypothesis. This aligns with other research claiming that students naturally tend to affiliate learning environment objectives with their own interests or areas of specialty (Dunlap, 2005; Harris & Rogers, 2008). Further, it supports the notion that technical students might place higher value on their area of interest as compared to non-technical students. This finding may seem insignificant, as it affirms what some may claim to be common sense. Still, it provides evidence that supports the notion that student interest and connection to the eventual project may strengthen the process and outcomes of PjBL (Barell, 2010).

According to Self-Determination Theory (SDT) an environment that promotes autonomy, relatedness, and mastery will naturally be psychologically supportive (Deci & Ryan, 1985). A benefit of a psychologically supportive environment is intrinsic motivation in the student (Gagné & Deci, 2005). Previous research indicates that PjBL may have an effect on increasing students'

intrinsic motivation (Bartscher, 1995; Doppelt, 2003; Hung, Hwang, & Huang, 2012; Solis, 2010; Worry, 2011). Conversely, Wijnia et al. (2011) looked at specific elements within PjBL environments and lecture-based environments and concluded that PjBL does not always lead to higher intrinsic motivation. The aforementioned and other studies compare intrinsic motivation between groups, but there is a void of research to date that has studied the change in intrinsic motivation as a result of a learning environment. These studies were the impetus for the second and third research questions of this study.

An element of this study was to determine the effect of PjBL environments on students' intrinsic motivation by measuring the difference of mean scores from pretest to posttest. Results of this study indicate that the increase in students' intrinsic motivation cannot be attributed to PjBL when considering all students. In addition, when considering whether or not the student was engaged in an interdisciplinary PjBL or non-interdisciplinary PjBL, the results also were not conclusive. This realization aligns with other findings of inconclusive results related to intrinsic motivation and PjBL relationships (White-Taylor, 2001; Yancy, 2012). A shared key construct between intrinsic motivation and PjBL is an authentic task (Deci & Ryan, 2002; Larmer & Mergendoller, 2015). A majority of the students in this study were classified as non-technical (81.2%). These results could represent that the project was not authentic enough to a majority of the students. One of the findings in this study confirms that this may be the case, as there was a statistically significant finding related to the effect of PjBL on an increase in intrinsic motivation when considering the technical status of students. Results indicate that technical students had a stronger connection to the project, based on the focus of the project being connected to their chosen field of study. Conversely, the project may not have been tied directly to the non-technical students in a meaningful a way.

Research regarding workplace readiness points to the need to involve future professionals in authentic or 'real-life' experiences to better prepare them for success after college (Coll &

Zegwaard, 2006; Dunlap, 2005; Pearlman, 2010). Further, some research has determined that authentic learning environments may support stronger intrinsic motivation in students (Bender et al., 2008; Walker & Leary, 2009). This study included an examination of the effect of interdisciplinary PjBL on the intrinsic motivation of students to complete the class project. Results confirmed that students in this interdisciplinary PjBL experience reported stronger intrinsic motivation than students in the non-interdisciplinary, both in pretests and posttests. This finding confirms a potential relationship between authentic learning environments and stronger student intrinsic motivation through interdisciplinary PjBL. The analysis of this topic used several coefficient variables and interdisciplinary PjBL. The purpose of this study was to determine which variables may have actually influenced the intrinsic motivation scores of students in the PjBL experiences. The results indicated that the interdisciplinary PjBL experience was significant. Moreover, this result reveals the possibility that when students are engaged in PjBL learning environments that are authentic and 'real-life', they will have stronger motivation towards the project.

Conclusion

Colleges and universities spend significant time, energy, and resources preparing students for success in their chosen field of study. Twenty-first century soft skills have been determined to be essential in achieving early career success and often more desirable to employers than basic knowledge of a subject matter (Casner-Lotto & Barrington, 2006). Likewise, student motivation influences learning, retention, and independent action (Lei, 2010). The results of this research suggests that PjBL may have an effect on the perceived level of importance for 21st century soft skills, such as Information Technology Application, and students' intrinsic motivation is improved when the project is interdisciplinary and tied to a students' area of interest.

To improve learning, a PjBL experience in higher education is encouraged to be constructed to focus on a project closely aligned with students' interests. Further, students may benefit from PjBL experiences designed to be authentic and applicable to activities students are likely to experience in the workplace, when appropriate. If PjBL environments adhere to these two constructs, based on this research, it is possible to expect students to report a stronger awareness of the importance of soft skills and report higher intrinsic motivation. In doing so, educators may foster a richer learning environment that provides the opportunity for students to flourish and develop their soft skills that could have a positive impact on their future success after college.

Implications

Implications from this research are that interdisciplinary learning environments that include an authentic and personal focus could have a positive impact on students' motivation. Research of a related nature has implied that motivated employees are more productive, healthier, and less likely to terminate employment or be terminated (Busteed, 2014; Gagné & Deci, 2005). Comparably, students that experience authentic to 'real-life' workplace scenarios through PjBL may be well-equipped to assimilate into the workplace and have success, based on increased levels of motivation. In addition, these experiences may also lead them towards a satisfying, meaningful, and productive career after college (Davis & Miller, 1996). Students that have experienced learning environments that stimulate intrinsic motivation may be more inclined to find a career that is meaningful to them and that continues to stimulate their motivation.

Based on findings from this study, educators are encouraged to be thoughtful as to the nature and project focus of PjBL environments. It can be inferred from this study that authentic projects that are of personal interest to a student population may develop appropriate perceptions of soft skills and have higher levels of intrinsic motivation. Therefore, if educators design PjBL

environments accordingly, the influence of the environment may be positive to students, and they may produce better results. Furthermore, experiencing these benefits may better prepare them for workplace success and personal happiness.

Limitations

The limitations to this study include issues with the PjBL environment, as well as data collection and analysis. A limitation in this study was the size of the sample. The sample size of this study was small and not balanced between technical and non-technical students. The small sample size of all students, and especially technical students, make it difficult to generalize the findings for the population (Brown et al., 2011). The questionnaire completed by students also presents limitations worth acknowledging. First, the ranking of the twenty items that are known as 21st century skills was a rank-order instrument. Using forced rank data to measure pretests and posttests results was restrictive. This conclusion is based on the fact that variables ranked high in pretests could not improve much when comparing results from the posttests. For example, Written Communication was highly ranked during the pretest and actually improved in ranking after the PjBL experience. However, because it was ranked high to begin with, there was not a possibility for significant variance to be realized. The ranked order of the items also presented some challenges in data analysis and imposed limitations as to the methods that could be used to adequately analyze the results. Lastly, all data were unobserved data. Even though careful consideration was used to ensure individual responses by way of specific links to the survey distributed individually via email, researchers cannot independently verify the students completed the survey personally. Self-reported data are also limited by a lack of control for personal bias. The limitations from this self-reported survey is no more than other research.

Regarding the learning environment, there is ample research regarding PjBL but comparably only a small amount of literature investigating interdisciplinary PjBL. This presents

some challenges to being able to compare and contrast findings from this study with other research. Also, PjBL constructs are well articulated in literature, but the implementation and execution of PjBL can vary widely even with well-designed elements (Barnthouse, 2013). This presents a limitation to drawing strong connections between research regarding PjBL environments. Similarly, much of the research on student intrinsic motivation as a result of PjBL is completed using a wide array of findings to measure motivation. A range of studies used subject specific scales, while others used observable variables, homework completion that may not correlate with motivation, and even qualitative self-reports. This provides a limitation to being able to compare findings regarding intrinsic motivation of this study with past studies.

Future Practice

Interdisciplinary PjBL learning environments can have a positive impact on college students' soft skill development and awareness, as well as their intrinsic motivation. Interdisciplinary PjBL often include an authentic and *real-life* project focus that simulates the workplace. Though workforce readiness is not the only objective of higher education, it is still an essential purpose that must have attention. College faculty members and administrators are encouraged to place more emphasis on teaching practices that promote and foster the natural development of soft skills awareness and motivation. PjBL has been identified as promoting soft skill development, as well as increasing intrinsic motivation. However, these outcomes may be improved upon if PjBL experiences are designed to be interdisciplinary. In addition, educators and administrators are encouraged to design curriculum around the integration of basic knowledge and soft skill development through interdisciplinary application. PjBL is not the only instructional design that can accomplish interdisciplinary application, nevertheless its existing elements can naturally foster this integration. Further, it is suggested that educators design and organize learning environments to be psychologically supportive and to have a positive impact on students' development in the area of concentration for the class.

PjBL is a method of instruction that is not without its challenges. University administrators should consider offering professional development opportunities to faculty members who would like to utilize this teaching strategy. This approach could also include helping faculty learn how to collaborate across departments and campuses using PjBL. This strategy could have a positive impact on both higher education and college graduates in the future.

Future Research

This study indicates that interdisciplinary PjBL may be a learning environment that has an impact on students' perceptions of the importance of soft skills to workforce success. Additionally, interdisciplinary PjBL experiences that include an authentic project focus of personal interest to a student may create stronger motivation. More research is needed to strengthen these claims. Future research could be done with larger student groupings and over a period of time. Longitudinal data using the same instructional design may provide additional evidence to support the findings of this research, or provide indications that necessary adjustments could be made to improve outcomes of PjBL experiences. The evidence that an interdisciplinary PjBL is more effective at producing higher intrinsic motivation in students than a non-interdisciplinary PjBL is interesting, but may be strengthened with more research of interdisciplinary activity in education. The review of literature for this study revealed a small but growing number of studies regarding interdisciplinary learning environments in higher education. PjBL environments have been well tested for many decades (Pearlman, 2010). Correspondingly, well-articulated and useful constructs have been identified and implemented during this time (Larmer & Mergendoller, 2015). PjBL environments can be dynamic and complicated (Barnthouse, 2013). This understanding provides a wealth of opportunity for researchers and educators.

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APPENDICES

A. Pretest questionnaire

B. Posttest questionnaire

C. IRB Approval

D. Informed consent

E. Emails sent to students

APPENDIX A: Pretest questionnaire

The list and descriptors below represent skills necessary to thrive in the twenty-first century. As a participant in the #OKSTATEHASANAPP4THAT learning initiative you are asked to rank the importance of skills within the set. All of these skills are important. Therefore, the ranking is not important versus un-important, but simply the ranked order of importance, in your opinion, of all 20 skills. Skills are listed in a random order, therefore, their current position does not indicate a previous rank.

When you graduate which skills do you believe will be most important to your success in the workforce? Of the 20 items below please rank (drag from place to place) in order from most important (top position) to those of lesser importance (bottom position).

21st Century Skills Ranking

_____ Critical Thinking/Problem Solving—Exercise sound reasoning and analytical thinking; use knowledge, facts, and data to solve workplace problems; apply math and science concepts to problem solving. (1)
_____ Creativity/Innovation—Demonstrate originality and inventiveness in work; communicate new ideas to others; integrate knowledge across different disciplines. (2)
_____ Diversity—Learn from and work collaboratively with individuals representing diverse cultures, races, ages, gender, religions, lifestyles, and viewpoints. (3)
_____ English Language (spoken) - Exercise effective command of speaking the english language. (4)
_____ Ethics/Social Responsibility—Demonstrate integrity and ethical behavior; act responsibly with the interests of the larger community in mind. (5)
_____ Government/Economics - Demonstrate understanding of the system by which the United States is governed, and the relationship between its governance and economic capabilities. (6)
_____ Humanities/Arts - The study of how people process and document the human experience, through philosophy, literature, religion, art, music, history and language. (7)
_____ Information Technology Application—Select and use appropriate technology to accomplish a given task, apply computing skills to problem-solving (8)
_____ Leadership—Leverage the strengths of others to achieve common goals; use interpersonal skills to coach and develop others. (9)
_____ Lifelong Learning/Self Direction—Be able to continuously acquire new knowledge and skills; monitor one's own learning needs; be able to learn from one's mistakes. (21)
_____ Mathematics - Demonstrate mastery of basic elements of arithmetic, such as, quantity (numbers), structure, space, and change. (11)
_____ Oral Communications—Articulate thoughts, ideas clearly and effectively; have public speaking skills. (12)
_____ Professionalism/Work Ethic—Demonstrate personal accountability, effective work habits, e.g., punctuality, working productively with others, and time and workload management. (13)
_____ Reading Comprehension - Effectively read text in English, process it and understand its meaning. (14)
_____ Science - Have a general awareness of the enterprise that builds and organizes knowledge in the form of testable explanations and predictions about the universe. (15)
_____ Teamwork/Collaboration—Build collaborative relationships with colleagues and customers; be able to work with diverse teams, negotiate and manage conflicts. (16)
_____ Writing (Typing) in English - Effectively use grammar, spelling, and appropriate tense of the English language when writing (or typing). (22)
_____ Written Communications—Write memos, letters and complex technical reports clearly and effectively. (23)
_____ History / Geography - the study of the human, physical, fictional, theoretical, and "real" geographies of the past. (19)
_____ Foreign Languages - Use of non-english languages as a tool for understanding other nations, markets, and cultures. (20)

Activity The following items concern your anticipated experience with the project. Please answer all items by sliding the mark to your preferred answer. For each item, please indicate how true the statement is for you, using the scale above the items as a guide:

_____ I believe that doing this project could be of some value for me. (1)
_____ I believe I have some choice about doing this project. (2)
_____ While I do this project, I will be thinking about how much I enjoy doing it. (3)
_____ I believe that doing this project is useful for improved concentration. (4)
_____ This project will be fun to do. (5)
_____ I think this project is important for my improvement. (6)
_____ I will enjoy doing this project very much. (7)
_____ I really did not have a choice about doing this project. (8)
_____ I am doing this project because I want to. (9)
_____ I think this is an important project. (10)
_____ I feel like I will enjoy the project while doing it. (11)
_____ I think this project will be a very boring activity. (12)
_____ It is possible that this project could improve my study habits. (13)
_____ I felt like I had no choice but to do this project. (14)
_____ I think this will be a very interesting project. (15)
_____ I would be willing to do a similar project to this because I think it is somewhat useful. (16)
_____ I would describe this project as very enjoyable. (17)
_____ I feel like I have to do this project. (18)
_____ I believe doing this project could be somewhat beneficial to me. (19)
_____ I am doing this project because I have to. (20)
_____ I believe doing this project could help me do better in school. (21)
_____ While doing this project I felt like I have a choice. (22)
_____ I would describe this project as very fun. (23)
_____ I feel like it is not my own choice to do this project. (24)
_____ I would be willing to do this project again because it has some value for me. (25)

SX Sex/Gender

- ❍ Male (1)
- ❍ Female (2)
- ❍ Transgender (3)
- ❍ Prefer not to respond (4)

Eth Race/Ethnicity

- African American/Black (1)
- Asian/Pacific Islander (2)
- Hispanic/Latino (3)
- Multiracial (4)
- Native American/American Indian (5)
- White (6)
- Not Listed (please specify) (7)
- Pre not to respond (8)

Class Class Status:

- Freshman (1)
- Sophomore (2)
- Junior (3)
- Senior (4)
- Graudate Student (5)
- Professional Student (6)
- Continuing Education Student (7)

Clg College/Department/School

- Human Sciences / Hotel and Restaurant Administration (1)
- Arts and Sciences / Computer Science (2)
- Other (3)

Age Age

- Under 18 (1)
- 18-19 (2)
- 20-21 (3)
- 22-24 (4)
- 25 and above (5)

Res Are you considered an in-state or out-of-state student for tuition purposes?

- In-State (1)
- Out-of-state (2)

Off hours How many hours do you work for pay OFF campus?

- None (1)
- 1-10 hours/week (2)
- 11-20 hours/week (3)
- 21-30 hours/week (4)
- more than 30 hours/week (5)

On hours How many hours do you work for pay ON campus?

- None (1)
- 1-10 hours/week (2)
- 11-20 hours/week (3)
- 21-30 hours/week (4)
- more than 30 hours/week (5)

APPENDIX B: Posttest questionnaire

The list and descriptors below represent skills necessary to thrive in the twenty-first century. As a participant in the#OKSTATEHASANAPP4THAT learning initiative you are asked to rank the importance of skills within the set. All of these skills are important. Therefore, the ranking is not important versus un-important, but simply the ranked order of importance, in your opinion, of all 20 skills. Skills are listed in a random order, therefore, their current position does not indicate a previous rank.

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_____ Creativity/Innovation—Demonstrate originality and inventiveness in work; communicate new ideas to others; integrate knowledge across different disciplines. (2)
_____ Diversity—Learn from and work collaboratively with individuals representing diverse cultures, races, ages, gender, religions, lifestyles, and viewpoints. (3)
_____ English Language (spoken) - Exercise effective command of speaking the english language. (4)
_____ Ethics/Social Responsibility—Demonstrate integrity and ethical behavior; act responsibly with the interests of the larger community in mind. (5)
_____ Government/Economics - Demonstrate understanding of the system by which the United States is governed, and the relationship between its governance and economic capabilities. (6)
_____ Humanities/Arts - The study of how people process and document the human experience, through philosophy, literature, religion, art, music, history and language. (7)
_____ Information Technology Application—Select and use appropriate technology to accomplish a given task, apply computing skills to problem-solving (8)
_____ Leadership—Leverage the strengths of others to achieve common goals; use interpersonal skills to coach and develop others. (9)
_____ Lifelong Learning/Self Direction—Be able to continuously acquire new knowledge and skills; monitor one's own learning needs; be able to learn from one's mistakes. (21)
_____ Mathematics - Demonstrate mastery of basic elements of arithmetic, such as, quantity (numbers), structure, space, and change. (11)
_____ Oral Communications—Articulate thoughts, ideas clearly and effectively; have public speaking skills. (12)
_____ Professionalism/Work Ethic—Demonstrate personal accountability, effective work habits, e.g., punctuality, working productively with others, and time and workload management. (13)
_____ Reading Comprehension - Effectively read text in English, process it and understand its meaning. (14)
_____ Science - Have a general awareness of the enterprise that builds and organizes knowledge in the form of testable explanations and predictions about the universe. (15)
_____ Teamwork/Collaboration—Build collaborative relationships with colleagues and customers; be able to work with diverse teams, negotiate and manage conflicts. (16)
_____ Writing (Typing) in English - Effectively use grammar, spelling, and appropriate tense of the English language when writing (or typing). (22)
_____ Written Communications—Write memos, letters and complex technical reports clearly and effectively. (23)
_____ History / Geography - the study of the human, physical, fictional, theoretical, and "real" geographies of the past. (19)
_____ Foreign Languages - Use of non-english languages as a tool for understanding other nations, markets, and cultures. (20)

The following items concern your experience with the project. Please answer all items by sliding the mark to your preferred answer. For each item, please indicate how true the statement is for you, using the scale above the items as a guide:

_____ I believe that doing this project was of some value for me. (1)
_____ I believe I had some choice about doing this project. (2)
_____ While I did this project, I was thinking about how much I enjoy doing it. (3)
_____ I believe that doing this project was useful for improved concentration. (4)
_____ This project was fun to do. (5)
_____ I think this project was important for my improvement. (6)
_____ I enjoyed doing this project very much. (7)
_____ I really did not have a choice about doing this project. (8)
_____ I did this project because I wanted to. (9)
_____ I think this is an important project. (10)
_____ I feel like I enjoyed the project while doing it. (11)
_____ I think this project was a very boring activity. (12)
_____ It is possible that this project improved my study habits. (13)
_____ I felt like I had no choice but to do this project. (14)
_____ I think this was a very interesting project. (15)
_____ I would be willing to do a similar project to this because I think it is somewhat useful. (16)
_____ I would describe this project as very enjoyable. (17)
_____ I feel like I had to do this project. (18)
_____ I believe doing this project was somewhat beneficial to me. (19)
_____ I did this project because I have to. (20)
_____ I believe doing this project helped me do better in school. (21)
_____ While doing this project I felt like I had a choice. (22)
_____ I would describe this project as very fun. (23)
_____ I feel like it was not my own choice to do this project. (24)
_____ I would be willing to do this project again because it has some value for me. (25)

SX Sex/Gender

- ❍ Male (1)
- ❍ Female (2)
- ❍ Transgender (3)
- ❍ Prefer not to respond (4)

Eth Race/Ethnicity

- African American/Black (1)
- Asian/Pacific Islander (2)
- Hispanic/Latino (3)
- Multiracial (4)
- Native American/American Indian (5)
- White (6)
- Not Listed (please specify) (7)
- Pre not to respond (8)

Class Class Status:

- Freshman (1)
- Sophomore (2)
- Junior (3)
- Senior (4)
- Graudate Student (5)
- Professional Student (6)
- Continuing Education Student (7)

Clg College/Department/School

- Human Sciences / Hotel and Restaurant Administration (1)
- Arts and Sciences / Computer Science (2)
- Other (3)

Age Age

- Under 18 (1)
- 18-19 (2)
- 20-21 (3)
- 22-24 (4)
- 25 and above (5)

Res Are you considered an in-state or out-of-state student for tuition purposes?

- In-State (1)
- Out-of-state (2)

Off hours How many hours do you work for pay OFF campus?

- None (1)
- 1-10 hours/week (2)
- 11-20 hours/week (3)
- 21-30 hours/week (4)
- more than 30 hours/week (5)

On hours How many hours do you work for pay ON campus?

- None (1)
- 1-10 hours/week (2)
- 11-20 hours/week (3)
- 21-30 hours/week (4)
- more than 30 hours/week (5)

APPENDIX C: IRB Approval

Oklahoma State University Institutional Review Board

Date:	Tuesday, August 12, 2014
IRB Application No	HE1455
Proposal Title:	#OKStateHasanAPPforThat

Reviewed and Processed as: Exempt

Status Recommended by Reviewer(s): Approved Protocol Expires: 8/11/2017

Principal Investigator(s):

David W Davis
210Y HS
Stillwater, OK 74078

Blayne Mayfield
100 Telecom Center
Stillwater, OK 74078

Penny Thompson
210 Willard Hall
Stillwater, OK 74078

Jane S. Vogler
424 Willard
Stillwater, OK 74078

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1.Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval. Protocol modifications requiring approval may include changes to the title, PI advisor, funding status or sponsor, subject population composition or size, recruitment, inclusion/exclusion criteria, research site, research procedures and consent/assent process or forms
2.Submit a request for continuation if the study extends beyond the approval period. This continuation must receive IRB review and approval before the research can continue.
3.Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of the research; and
4.Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Dawnett Watkins 219 Cordell North (phone: 405-744-5700, dawnett.watkins@okstate.edu).

Sincerely,

Tamara Mix, Interim Chair
Institutional Review Board

APPENDIX D: Informed consent

STATEMENT OF INFORMED CONSENT
OKLAHOMA STATE UNIVERSITY

PROJECT TITLE: OK State Has an App for That!

INVESTIGATORS
David W. Davis
Clinical Lodging Instructor, School of Hotel and Restaurant Administration
210Y Human Sciences West, Oklahoma State University, Stillwater, OK 74078

Blayne Mayfield
Associate Professor of Computer Science
232 MSCS, Oklahoma State University, Stillwater, OK 74078

Jane S. Vogler, Ph.D.
Assistant Professor, School of Applied Health and Educational Psychology
424 Willard Hall, Oklahoma State University, Stillwater, OK 74078

Penny Thompson
Assistant Professor of Educational Technology
210 Willard Hall, Oklahoma State University, Stillwater, OK 74078

PURPOSE:
This research project will examine how students learn in a project-oriented university course. You are invited to participate in this study because you were randomly selected from among students enrolled in either HRAD 3543 or CS 4153 this semester. If you agree to participate in this part of the study, you will be asked to meet with the researchers and about five of your peers to discuss what you learned in this course and how the course activities did or did not support your learning. There are no right or wrong answers, as we are interested in hearing about your experiences, learning from you, and improving future courses based on your perceptions of how this semester went. The focus group meeting will be audio recorded.

PROCEDURES:
As a part of your course you will be asked to complete multiple scales or inventories that allow your instructors to better construct learning environments around your motivational orientation and customize your learning experience. Participation in these self-reporting scales is required as part of the course. However, whether your data is used in research or not us up to you. Data will be compiled for research purposes as an entire class and not as individuals. Your instructors will not be aware of your consent or declination of consent until after final grades are posted.

RISKS OF PARTICIPATION:
There are no known risks associated with this project which are greater than those ordinarily encountered in your daily life as students.

BENEFITS OF PARTICIPATION:
There are no direct benefits to you as a participant in this study. Your participation, however, will help us learn more about how students learn in project-oriented classes such as this one, which will help us improve this course and similar courses for future students.

CONFIDENTIALITY:
The records of this study will be kept private. Any written results will discuss group findings and will not include information that will identify you. All identifiable research records will be stored on a password protected computer in a locked office and only researchers and individuals responsible for research oversight will have access to the records. The focus group meeting will be audio recorded, and the audio recordings transcribed for analysis. During the transcription process your names will be replaced by pseudonyms so that we do not see your real names when analyzing the data. No information linking your name to the pseudonym will be retained.

COMPENSATION :
You will not receive any compensation for your participation in this study.

CONTACTS:
You may contact any of the researchers at the following addresses and phone numbers, should you desire to discuss your participation in the study and/or request information about the results of the study:

David Davis[1]	Blayne Mayfield[1]	Jane Vogler	Penny Thompson
210Y HSW Oklahoma State University Stillwater, OK 74078	232 MSCS, Oklahoma State University, Stillwater, OK 74078	242 Willard Hall Oklahoma State University Stillwater, OK 74078	210 Willard Hall Oklahoma State University Stillwater, OK, 74078
david.w.davis@okstate.edu	Blayne.mayfield@okstate.edu	jane.vogler@okstate.edu	penny.thompson@okstate.edu
(405) 744-7499	(405) 744-5683	(405) 744-9441	(405) 744-8042

[1]Please note that Davis & Mayfield will not have access or knowledge of who participated in the focus groups or what was said in those sessions until after final course grades have been submitted to the Registrar.

If you have questions about your rights as a research volunteer, you may contact the IRB Office at 219 Cordell North, Stillwater, OK 74078, 405-744-3377 or irb@okstate.edu

PARTICIPANT RIGHTS:
I understand that my participation is voluntary, that there is no penalty for refusal to participate, and that I am free to withdraw my consent and participation in this project at any time, without penalty.

CONSENT DOCUMENTATION:
I have been fully informed about the procedures listed here. I am aware of what I will be asked to do and of the benefits of my participation. I also understand the following statements:

- I affirm that I am 18 years of age or older.
- I have read and fully understand this consent form. I sign it freely and voluntarily.
- A copy of this information has been provided to me.
- I hereby give permission for my participation in this study.

Participant Name (Printed)	Participant Signature	Date

I certify that I have personally explained this document before requesting that the participant sign it.

Signature of Researcher	Date

APPENDIX E: Emails to students

Pretest email from Fall 2014

Dear Students in ART 4460, CS 4153, and HRAD 3543,

The link below will you take you to a survey that is part of your experience in our inter-disciplinary learning environment (#OKSTATEHASANAPP4THAT). The two elements of the survey will provide your instructors the chance to better understand your thoughts and feelings regarding key elements of the PjBL experience you are embarking on. The more we know about your honest feelings regarding these subjects the better we can meet your needs as teachers. If you have any questions don't hesitate to let me know!

Sincerely,

The #OKSTATEHASANAPP4THAT Instructors

Follow this link to the Survey:
Take the Survey

Posttest email from Fall 2014

Dear Students in ART 4460, CS 4153, and HRAD 3543,

The link below will take you to a "post project" survey. This survey is part of the learning environment study being conducted with our collaborative classes as well as a regular part of the course. Your collective answers are used to better understand the "auxiliary" learning that occurs during project-based learning and improve the process for future initiatives. While there are some points associated with completing this survey as part of your course it is not a graded assignment. You receive the full points for simply completing the survey in its' entirety and are expected to answer truthfully. If you have any questions, please direct them to your Instructor of Record.

Sincerely,

The #OKSTATEHASANAPP4THAT Instructors

Follow this link to the Survey:
Take the Survey

Pretest email from Spring 2015

Dear Students in HRAD3543,

The link below will you take you to a survey that is part of your experience in our project-based learning environment (#OKSTATEHASANAPP4THAT). The two elements of the survey will provide your instructors the chance to better understand your thoughts and feelings regarding key elements of the PjBL experience you are embarking on. The more we know about your honest feelings regarding these subjects the better we can meet your needs as teachers. If you have any questions don't hesitate to let me know!

Sincerely,

The #OKSTATEHASANAPP4THAT Instructors

Follow this link to the Survey:
Take the Survey

Posttest email from Spring 2015

Dear HRAD Student,

The link below will take you to a "post project" survey. This survey is part of the learning environment study being conducted as a regular part of the course. Your collective answers are used to better understand the "auxiliary" learning that occurs during project-based learning and improve the process for future initiatives. While there are some points associated with completing this survey as part of your course it is not a graded assignment. You receive the full points for simply completing the survey in its' entirety and are expected to answer truthfully. If you have any questions, please direct them to your Instructor of Record.

Sincerely,

The #OKSTATEHASANAPP4THAT Instructors

Follow this link to the Survey:
Take the Survey

VITA

David Wayne Davis

Candidate for the Degree of

Doctor of Philosophy

Thesis: EXAMINING THE EFFECTS OF INTERDISCIPLINARY PROJECT-BASED LEARNING ON STUDENTS' TWENTY-FIRST CENTURY SKILL DEVELOPMENT AWARENESS AND INTRINSIC MOTIVATION ORIENTATION
Major Field: HUMAN SCIENCES

Major Field: Human Sciences

Biographical:

Education:

Completed the requirements for the Doctor of Philosophy in Human Sciences at Oklahoma State University, Stillwater, Oklahoma in December, 2016.

Completed the requirements for the Master of Science in Hospitality Management at University of Houston, Houston, Texas in 2006.

Completed the requirements for the Bachelor of Science in Restaurant, Hotel, and Institutional Management at Texas Tech University, Lubbock, Texas in 1999.

Experience:

Clinical Lodging Instructor for the School of Hotel and Restaurant Administration at Oklahoma State University.

General Manager of the Atherton Hotel and Ranchers Club at Oklahoma State University.

General Manager and various other management positions for John Q. Hammons Hotels, Inc.

Professional Memberships:
American Hotel and Lodging Association; Oklahoma Hotel and Lodging Association; International Council on Hotel, Restaurant and Institutional Education