8-2022

Project-Based Learning in Introductory Psychology: Modern Adaptations To an Academic Classic

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PROJECT-BASED LEARNING IN INTRODUCTORY PSYCHOLOGY: MODERN ADAPTATIONS TO AN ACADEMIC CLASSIC

A Dissertation Submitted in Partial Fulfillment
of the Requirements for the Degree of
Doctor of Philosophy

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School of Psychological Sciences
Educational Psychology

August 2022

This Dissertation by: Colton R. Olson

Entitled: *Project-Based Learning in Introductory Psychology: Modern Adaptations to an Academic Classic*

has been approved as meeting the requirement for the Degree of Doctor of Philosophy in the College of Education and Behavioral Sciences in the School of Psychological Sciences, Program of Educational Psychology.

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ABSTRACT

Olson, Colton R. *Project-based learning in introductory psychology: Modern adaptations to an academic classic.* Published Doctor of Philosophy dissertation, University of Northern Colorado, 2022.

This study used a quasi-experimental design to examine the effectiveness of a project-based learning (PjBL) course design on meaningful learning, student goal orientation, engagement, and perceived classroom motivational climate in an introductory psychology course. Project-based learning was examined in comparison to a traditional, lecture and multiple-choice exam course design in introductory psychology over the course of one semester (N = 247). Generally, there is limited research examining PjBL in large introductory classes, specifically in relation to concrete outcomes such as meaningful learning and perceived classroom climate (Gurung et al., 2016). Therefore, the purpose of the study was to add to the limited research that exists and work to encourage the use of alternative designs like PjBL in large introductory courses.

I decided to employ a PjBL design in introductory psychology because it is a course that has remained generally unchanged in the last few decades. It typically involves large class sizes, daily lectures, minimal active learning opportunities, and multiple-choice exams once every four weeks. I believe it has become a "classic" as defined by John Dewey (Dewey, 1933). It has become something that people no longer find true wonder or intrigue in and simply recognize it as existing in one way. As an introductory psychology instructor, I quickly realized the affordances of the course and felt the traditionally accepted format was not maximizing these

students' potential benefits. The research that does exist related to PjBL and introductory courses (i.e., Hard et al., 2018) and research that speaks to the power of introductory psychology in general (i.e., Gurung et al., 2016) encouraged me to pursue alternative methods and examine their potential benefits related to valuable academic outcomes such meaningful learning, goal orientation, engagement, and classroom motivational climate.

Findings from the current study yielded no statistically significant differences between the PjBL condition and traditional condition regarding meaningful learning, goal orientation, or engagement (measured through transformative experience), suggesting that other motivational and learning outcomes may want to be examined. However, significant differences were found when examining perceived classroom motivational climate. These differences are in line with existing motivational climate research (i.e., Appleton et al., 2016; Dweck & Leggett, 1988) and speak to the potential value of authentic, autonomy-supportive course designs in improving student climate perceptions.

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CHAPTER I

INTRODUCTION

Rationale for the Study

While I have only served as an instructor in higher education for a few years, being responsible for the learning of hundreds of young students has been a very impactful experience. It is very inspiring to watch students arrive on the first day of class and to see the excitement and anticipation on their faces, especially in the introductory courses. As these courses are primarily composed of first-year students, it seems that they are all arriving with the belief that the experience they are about to have is going to change their life. It is seen as the first step in a long journey toward becoming an adult, or a professional of some sort. As the person in charge of the course, I have always seen it as my responsibility to meet their expectations and significantly impact their lives through the teaching of psychology, a field that has many affordances for people from all walks of life. This is a large responsibility, and one that requires significant attention and hard work if it is to be handled appropriately. Unfortunately, it became evident to me early in my teaching of introductory psychology that the course as it was being taught and has been taught for nearly the last century was not sufficiently impacting students as it should. The course was designed to be almost entirely teacher centered; laden with hour-long lectures, minimal active learning or interaction, and shallow multiple-choice exams meant to show students whether they were measuring up to my standards. This design is the same one that I was subject to during my undergraduate studies, that my parents were subject to, and even that my

grandparents were subject to. Upon realizing this, I couldn't help but fixate on the old a "nothing changes if nothing changes" and began recognizing that if I wanted any aspect of education to be different and for my students, I was going to need to begin making changes in my classroom first.

Since the beginning of my work as an educator, I always found that finding ways to apply material to everyday life and make learning relevant enhanced the student experience. My fascination with doing this led me to discover Pugh's work in transformative experience (Pugh, 2011) and eventually the Teaching for Transformative Experiences in Science (TTES) model (Pugh, 2020; Pugh et al., 2017). Transformative experience and the TTES model are based on the work of John Dewey (1933) and discuss principles such as framing content as ideas, using compelling metaphors, and artistically crafting topic introductions to create anticipation (Pugh et al., 2017). Seeing these concepts showed me there were theories and principles in existence that I could integrate into my course to enhance the experience, which is what I began doing. In addition to using some of the concepts identified in the TTES model such as using compelling metaphors and framing content as ideas, I incorporated more active learning strategies and collaboration into my classrooms. Incorporating these new techniques yielded positive responses from students, but it seemed that the use of multiple-choice exams continued to consume the class. I found that regardless of the methods I used to present material or activities I employed in class, the only concern of the students was acquiring the information that would be on the exam. Realizing this inspired me to investigate new methods of assessment, methods that might increase the perceived value of the active learning strategies used in class while adequately assessing learning in an introductory course. Further research and collaboration with colleagues led me to the work of Krajcik and Blumenfeld and eventually other educators that employed

PjBL in their courses (i.e., Hard et al., 2018; Muehlenkamp et al., 2015). The information presented in these studies showed that PjBL not only has the potential to make introductory classes more enjoyable and interactive, but can improve student learning and positively impact other adaptive motivational factors such as engagement, mastery goal orientation, and motivational climate.

My course has continued to evolve in recent semesters based on discoveries in the literature, discussions with students, collaboration with colleagues, classroom observation, and quantitative data analysis. I have progressed from simply implementing strategies and relying on anecdotal evidence to using literature to identify specific goals (from a learning and motivation perspective) a priori and structuring my course to reach these goals. Prior to the current study, I collected data to study the effects of PjBL in my introductory psychology course on perceived motivational climate, autonomy support, task-value, and self-efficacy. Results showed that the PjBL intervention led to increased perceived autonomy support, task-value, and a more empowering motivational climate compared to courses using a traditional lecture and multiple-choice test format. While these results were encouraging, the significance was marginal and inconsistent across semesters, and a ceiling effect was seen in many of the measures. A consistent ceiling effect and inconsistent results prompted me to reconsider the measures being employed, how the measures were written, and the number of time points at which data were collected throughout the semester. It was determined that reducing the number of times data were collected from three to two and moving away from a strict repeated measures design might help reduce the ceiling effect and that the effects of the PjBL intervention might be captured more effectively through measuring factors like goal orientation, academic self-concept, and press for understanding. Additionally, it was evident that to further test the effectiveness of PjBL

in introductory psychology I needed to see the effects of the intervention on student learning. However, measuring the effect on learning can be difficult when comparing across class sections since the measure of learning would need to be consistent across all conditions and would need to encompass most of the information discussed throughout the semester. With this in mind, it was determined that a unique and effective method of measuring learning throughout a semester would be concept maps. Concept maps have been shown to be a legitimate form of assessment (Beyerbach, 1986; Kinnear et al., 1985; Mintzes & Quinn, 2007; Starr & Krajcik, 1990) and do not favor either traditional or project-based designs as a multiple-choice assessment might. Making the aforementioned changes appears to have strengthened the design and potential power of the study while remaining within the theoretical framework and may lead to an introductory course that has a positive impact on the large number of students it serves.

Making consistent changes driven by personal experience, advice from colleagues, and existing literature have continued to increase my desire to improve introductory psychology and do so in a manner that provides other educators opportunities to put this model to the test and continue refining it. Studying the role of PjBL in enhancing the value of introductory psychology through outcomes such as meaningful learning, engagement, academic self-concept, and perceived motivational climate in a quasi-experimental manner works to accomplish both goals. My hope is that this study provides insight into the power of introductory psychology and the value of being deliberate in focusing on the students and providing them opportunities to engage with the course material in a meaningful way. The following sections will provide a critique of traditional instructional methods, discussions of constructivism, PjBL, additional rationale for the study, and the research questions being used.

Importance and Challenges of Introductory Courses

A common and important pursuit for many educators is to create a positive classroom environment that encourages student engagement and ultimately promotes meaningful learning (Gülpinar & Yeğen, 2005). This pursuit can be quite difficult though, especially in high-enrollment introductory courses that require instructors teach large and diverse bodies of information. Large introductory courses like introductory psychology have been a staple of higher education throughout recent history and will likely remain a staple for years to come. These courses play an important role in higher education because they serve a diverse student population, frequently act as gateways to fields of study, and provide students opportunities to learn valuable academic skills. Many universities require a certain number of liberal arts core (LAC) or general education courses. These requirements are often filled through taking introductory courses and, therefore, serve a large number of students.

Introductory classes may be seen as less important than upper division classes because they are available to anyone who wishes to enroll, are often taken when students are far from graduation, are generally designed to lack depth, and are frequently taught by graduate students or adjunct faculty members (Gurung et al., 2016). In reality though, these classes may be some of the most valuable classes departments offer as they are required by majors, present valuable information for non-majors, present a unique opportunity to teach valuable academic skills, and serve as a marketing opportunity for the department offering them (Gurung et al., 2016). A course like introductory psychology is a hub science course that serves millions of students each academic year and is described by majors and non-majors as having played a major role in shaping their study skills, knowledge, and perspective on the social world. Additionally, research has shown that performance on tasks such as term projects in introductory psychology predicts

project management and study skills as college seniors (Hard et al., 2018). The results that studies such as the one conducted by Hard and colleagues (2018) have found are great displays of the potential power of introductory courses, but currently many introductory courses do not employ the proper pedagogical tools to produce great outcomes. Many introductory courses rely heavily on teacher-centered formats that include long lectures, multiple-choice exams, minimal collaboration between students and instructor, and few active learning strategies.

While there are many ways in which these courses are greatly beneficial for students, they also present a number of difficulties. The number of students traditionally enrolled in these courses alone (often 100 or more) can make interaction, engagement, and learning difficult (Hard et al., 2018), and the vast amount of information that must be taught exacerbates the issues. As a result, instructors often rely on classic lecture formats supplemented with multiple-choice assessments and avoid collaboration, interaction, and other active learning strategies (Schmidt et al., 2015).

Critique of Traditional Methods

What we know as traditional lectures have existed for the better part of human history, many of the great early teachers of human history (i.e., Aristotle and Socrates) relied on lectures as a vessel for knowledge transmission, and the tradition of knowledge for individuals has continued to the current day. Nearly every individual who has had an experience at a college or university has experienced numerous lectures, with traditional lecture formats being especially prominent in large introductory courses. Most people’s first lecture experience likely came on the first day of their higher education experience and likely served as the primary instructional method throughout their higher education experience. Lecturing has evolved as a result of shifts in societal values and epistemological beliefs and has been supplemented by intense note taking

and novel technologies such as overhead projectors and PowerPoint presentations. Novel technologies such as iClickers and Zeetings as well as creative lectures continue to dominate education today, with numerous instructors at every institution using them as the primary method of knowledge transmission. Although these lectures serve some students well, they may be missing the mark in other areas.

The traditional lecture model often creates an environment that is representative of the "banking" model of education in which the instructor is the one in possession of the knowledge and students must work to receive the knowledge from them (Freire, 1970/2018). Unfortunately, this model is employed regularly in higher education. When subjected to this form of instruction, students may feel as though they are being ignored or that the instructor is speaking with little or no regard for the people listening and what they might need. While they listen, they try and piece together statements and facts and determine exactly what it is they are supposed to get out of the lecture, what they should be pursuing. Some individuals will be able to identify the goal of the lecture, but many will not and as a result, are at risk for becoming disengaged and retaining little of the information discussed. In addition to being at risk for little knowledge retention, research has shown that many underrepresented populations may be at a significant disadvantage when they are taught via lecture (Center for Teaching and Learning, 1997). This disadvantage stems from the lecture style often being one dimensional and assuming all people listening are the same instead of supporting and recognizing individual differences. Research in culturally responsive pedagogy has repeatedly shown that students learn better when instructors are understanding of differences and when they feel that material is relevant to their past experiences (Ladson-Billings, 1995). When educational environments fail to adequately acknowledge all individuals in the classroom, students may begin to feel insecure and may perceive the educational

environment as unsafe and as a result, the amount of meaningful learning that occurs may be diminished (Cummins & Griffin, 2012). Unfortunately, many students are experiencing the negative effects of these lectures within the first few hours of their journey through higher education (Schmidt et al., 2015) as their introductory classes are often laden with dense and seemingly disjointed lectures.

Another staple of higher education and particularly introductory courses is the multiple-choice exam. Multiple-choice assessments have been a staple of introductory classes for decades now for a number of reasons, including ease of development, ability to test on large amounts of information in a condensed form, they can be graded and returned to students very quickly (especially now with the advent of new technologies such as Akindi), they provide the perception of purely objective grading, they provide the opportunity for multiple versions to minimize cheating, and they can be reorganized and reused in future classes (Simkin & Kuechler, 2005; Stanger-Hall, 2012). The ease of development, grading, reusability, and mitigation of cheating may be perceived as especially valuable in large introductory courses where enrollments climb into the hundreds. While the reasons listed previously are the rationale instructors provide for their use of those assessments, it is not only instructors who prefer multiple-choice tests, there have been a number of student-identified advantages to multiple-choice tests as well. These advantages include multiple-choice exams not requiring deep understanding of material, ability to guess and get a correct answer, and opportunity to earn partial credit if test is not entirely completed (Bush, 2001; Entwistle & Entwistle, 1992; Simkin & Kuechler, 2005). Given the many perceived advantages of multiple-choice exams, it is no wonder these assessments have remained prevalent in education throughout the years. In many ways, they can serve as an unspoken agreement or common ground between instructors and

students, students expect these types of assessments, and instructors know this and employ them as they were likely employed in their classes when they were a student.

In addition to the perceived benefits and expectation of these assessments, perhaps the most prevalent reason for using multiple-choice assessments is that literature in educational assessment has concluded that multiple-choice exams are adequate for assessing basic understanding, especially when items are chosen or written well (Hancock, 1994; Martinez, 1999). There is other literature contradicting this hypothesis (i.e., Dufresne et al., 2002); nonetheless, multiple-choice assessments remain commonplace in large introductory classes. Perhaps though, it is time instructors (and higher education, in general) move beyond wanting methods of teaching and assessing that are simply adequate. Most educators agree that their goal when teaching a class is not to provide an adequate experience, but it is to create a meaningful learning experience and provide students with skills and knowledge they can apply in future classes or as professionals (Virtue & Hinnant-Crawford, 2019). Traditional multiple-choice exams have been shown to be useful measures of surface-level learning (Hampton, 1993; Scouller & Prosser, 1994); however, the limitations presented by these assessments are significant. Traditional multiple-choice assessments may lead to curriculum being "dumbed down" in order to match up with what the test might contain and similarly students will aim only to identify the information that will be on the test and ignore everything else (leading to the forgetting of a large amount of information), they can significantly harm the self-esteem of students who work hard and still perform poorly, and they may even prevent a student from pursuing a certain career path if they feel they cannot pass the tests or handle the workload they may face in the future (Sacks, 2000). If educators wish to create lifelong learners, encourage students to challenge themselves, and provide opportunity for meaningful learning, multiple-

choice assessments are likely not the answer. To accomplish this goal, there needs to be a shift in the manner by which classes are taught and it should start in introductory courses.

Current epistemological beliefs such as constructivism challenge that classic format and call for educators to shift from this "instructivist" style of education and move toward a more student-centered constructivist style of education that encourages increased attention to student engagement, support, and interaction with peers and instructors through the use of designs such as problem- or PjBL (Ellzey et al., 2019). The incorporation of unique course designs such as PjBL presents a valuable challenge to instructors willing to venture beyond traditional instructional styles. In addition to providing an opportunity for innovative instructors to experiment with unique pedagogical methods, these designs may aid educators in capitalizing on the potential benefits of large introductory classes from social, academic, and motivational perspectives. For this to occur though, innovative instructors are needed to test these methods, present them in the literature, and refine them, a potentially difficult process. Adopting new methods of instruction can be quite daunting, especially in large content-heavy courses, but there are prominent educational psychology theories such as constructivism that may serve as guides through the changing process.

Alternatives to Traditional Methods

The majority of higher education has been slow to change to better serve its students, but introductory courses appear to be changing the slowest, likely due to traditionally large class sizes and the exceptional amount of material they are required to cover (Labov, 2004). While significant change has been slow to come, there have been a few instances of educators overcoming the challenges traditionally presented by introductory courses and altering the objectives and design of their courses (Hard et al., 2018; Muehlenkamp et al., 2015). The studies

examining the effectiveness of alternative formats in introductory psychology traditionally rely on active learning strategies such as problem- or PjBL. In their review of knowledge and skill retention in introductory psychology, Hard and colleagues (2018) found that the use of one end-of-the-semester project that resembled an academic research project led to enhanced project management skills, improved study skills, an increased perceived task value, and greater general course enjoyment. Additionally, Muehlenkamp and colleagues (2015) employed a problem-based design in her introductory course using a backward course design (Fink, 2003) in which each course unit was framed under a relevant problem and students would work to solve the problem throughout the unit. The format used in this study prized classroom discussion, collaboration among students, and the use of critical thinking skills. Results showed that the problem-based design significantly enhanced classroom engagement and critical thinking skills. Studies such as these are valuable in presenting the possible manners in which introductory psychology instructors could strive to be more than adequate in their teaching.

Statement of the Problem

There are course designs and pedagogical alternatives that could potentially work to help instructors increase the effectiveness of introductory courses and help students develop valuable academic skills. Currently, though, research investigating the effectiveness of alternative course formats in introductory psychology is quite limited. In fact, research focused on improving introductory psychology in general is limited (Gurung & Hackathorn, 2018). Literature calling for more research in introductory psychology cites the reason for needing more is the potential power of introductory psychology since it reaches such as large number of students and can provide valuable information to nearly all people who enroll (Gurung & Hackathorn, 2018; Gurung et al., 2016). In addition to the potential for the course to significantly enhance the lives

of many students, another reason more research is needed is to answer questions about how much knowledge students retain from the introductory psychology courses, what the best class format is (in person, flipped, online, hybrid, etc), how textbooks can be improved, and what the optimal techniques for teaching are. It is also evident that introductory psychology can inform teaching and learning in upper-division classes, so the benefits of enhancing the course extend beyond the classrooms in which the course takes place (Gurung & Hackathorn, 2018).

The reasons for the current lack of empirical research dedicated to improving introductory psychology courses are not entirely clear. Perhaps it is because introductory psychology is often taught by graduate students or newer faculty who are not conducting independent research focused on pedagogical strategies or course design or because introductory psychology is quite demanding in that instructors are required to cover a large and diverse body of information, or maybe it is simply ignored. Regardless of the reason for minimal research, it is evident more is needed to investigate methods of improving design, assessments, measures of learning, and enhancing student engagement in the course. The goal of the current study was to contribute to this lacking body of research and improve student experience in an introductory psychology course through the use of a project-based course design. The study aimed to examine the effects of PjBL on perceived meaningful learning, goal orientation, student engagement, and classroom motivational climate using the following research questions:

Q1 Compared to students in a traditional lecture-based course, do students experiencing an active, project-based course display more meaningful learning as assessed using a concept map?

Q2 Is there a difference between a traditional lecture-based course design and a project-based design in terms of mastery goal orientation, transformative experience, and perceived motivational climate as a whole?

Q3 Compared to a traditional course design, does a project-based learning course design have a greater impact on student goal orientation when controlling for initial levels of goal orientation?

Q3a Compared to students in a traditional lecture-based course, are students experiencing an active, project-based design more likely to report a mastery-approach goal orientation at the end of the semester when controlling for initial levels of mastery-approach goal orientation?

Q3b Compared to students in a traditional lecture-based course, are students experiencing an active, project-based design less likely to report a performance-approach goal orientation at the end of the semester when controlling for initial levels of performance-approach goal orientation?

Q3c Compared to students in a traditional lecture-based course, are students experiencing an active, project-based design less likely to report a performance-avoid goal orientation at the end of the semester when controlling for initial levels of performance-avoid goal orientation?

Q4 Compared to students in a traditional lecture-based course, do students experiencing an active, project-based course report higher levels of transformative experience for course material?

Q4a Compared to students in a traditional lecture-based course, do students experiencing an active, project-based design perceive the course as being more transformative when controlling for year in school and initial levels of psychology interest?

Q4b Is there an aptitude treatment interaction in that transformative experience is dependent on goal orientation and psychology interest?

Q5 Compared to students in a traditional lecture-based course, do students experiencing an active, project-based course report a more empowering motivational climate?

Q5a Compared to students in a traditional lecture-based course, do students experiencing an active, project-based course report a more empowering motivational climate when controlling for year in school and initial levels of psychology interest?

Q5b Is there an aptitude treatment interaction in that perception of an empowering motivational climate is dependent on goal orientation and psychology interest?

Summary

Courses such as introductory psychology have been left generally unchanged for decades. They have fallen victim to traditional "instructivist" course formats where students are tasked with attending numerous lectures and memorizing tedious facts. While this remains common in higher education, epistemologies such as constructivism have found their way into higher education, and there has been a paradigm shift toward student-centered education, which allows for more active learning, collaboration opportunities, and use of prior knowledge while learning. With this shift, pedagogical styles such as PjBL have become more common in higher education and have yielded positive results (i.e., Hard et al., 2018; Muehlenkamp et al., 2015), but studies examining PjBL and introductory psychology is still quite limited. Employing pedagogical styles such as PjBL in introductory psychology can work to make important and effective adaptations to a generally unchanged course as well as provide an enhanced educational experience for students. This study is designed to continue to build on the body of literature regarding PjBL as well as contribute to the literature focused on improving introductory psychology.

CHAPTER II

REVIEW OF LITERATURE

This chapter presents a review of literature that is directly related to the frameworks and research questions presented in the previous chapter. The first portion will explore literature related to alternative constructivist models of learning from a theoretical and practical perspective. First, a general overview of key constructivist theories/ideas will be presented (i.e., those developed by Piaget, Vygotsky, and Bruner), then alternative learning models based on those theories will be discussed further, and PjBL models will be discussed at the conclusion of that section as an alternative model. The sections following the discussion of constructivism and PjBL will explore literature related to the outcomes being examined in this study such as classroom motivational climate, the relationship between PjBL and student engagement, and concept maps and meaningful learning experiences.

Constructivist Epistemology

Traditional constructivist theory presents the idea that knowledge is constructed through the pairing of new knowledge with existing knowledge and that knowledge only exists inside our own minds (Hendry et al., 1999). Learning, from the constructivist perspective can occur in any setting at any given time, thus the reason that constructivist epistemology has major implications for all levels of education and all types of classrooms (Olssen, 1996). While constructive learning can occur in any setting, constructivist researchers argue that meaningful learning is more likely in to occur in student-centered, active learning settings where students have the

opportunity to make connections between new and old knowledge and are provided opportunities to apply knowledge in a number of ways (Taber, 2011). Environments that promote active learning may best allow students to make the most of how they naturally learn. The following section will work to summarize constructivist epistemology and then explain some of the pedagogical models derived from this epistemology.

Although traditional teacher-centered lecture-style classrooms are still very prevalent in higher education and particularly in large introductory classes, the current shift toward epistemological beliefs rooted in constructivism are challenging this format. New methods of instruction such as problem- and PjBL present environments that are well-suited to promote meaningful, constructive learning. Through processes such as learning to hypothesize, testing their theories, asking questions, and sharing with each other, students construct their own understanding of the world by accommodating and assimilating new information with their current understanding. Generally, students play a central role in their own learning process and eventually become effective self-regulated learners (Rannikmäe et al., 2020).

The development of constructivist theory is traditionally credited to Jean Piaget through his models of cognitive development. In his theory of development, Piaget posited that knowledge is generally constructed through interaction with the environment and that cognitive development arises and grows increasingly complex through the development of schemas or categories of knowledge that help us interpret and understand the world (Piaget, 1952). Schemas develop and change through the process of assimilation and accommodation. Assimilation is the process of applying our existing schemas to new knowledge or information and working to fit the new information into our existing schemas, whereas accommodation is the process of altering our existing schemas based on new information or experiences to make better sense of the

information we have encountered. This cyclical process of assimilation and accommodation then leads to the construction of knowledge (Piaget, 1952). Piaget's ultimate assumption (based on these concepts), then, is that knowledge is constructed within the mind of each individual based on unique personal experiences.

Following Piaget's development and presentation of constructivism, other similar theories began garnering attention and adding to the literature surrounding constructivism and presenting additional factors that might influence knowledge construction. Vygotsky (1978) emphasized the importance of social interaction in the construction of knowledge. Vygotsky generally agreed that knowledge is constructed by individuals, but argued that development was not a strictly internal process and that social and cultural factors also influence our knowledge development. For example, the language a person speaks and the manner by which other individuals in their society represent knowledge will greatly influence how they construct knowledge. These ideas present the importance of mediated experiences and collaboration in learning, both of which are important aspects of constructivism.

Another important (and more recent) figure in the development of constructivist theory as we know it now is Bruner (1915-2016). Bruner is similar to Vygotsky in that he placed great importance on social interaction in the construction of knowledge, believing that prior knowledge is individual, but students actively construct new knowledge through experiences and social interaction with others (Bruner, 1966). Furthermore, Bruner suggested that the basis for learning within social context was activity so students must be actively engaged in the learning process and provided opportunity to engage with other students, that students use many different thinking strategies and classrooms should provide opportunities for students to explore as many as possible, and that recognizing patterns and regularities are another important aspect of

learning and teachers should actively guide this process (Capel et al., 2000). Bruner's ideas can be recognized as social constructivism and provide great insight into how constructivist ideas can be employed in classroom settings.

Constructivist Pedagogy

Constructivist theories such as those presented by Piaget (1952), Vygotsky (1978), and Bruner (1966) have led certain educators to examine the theories from a pragmatic perspective and work to determine the instructional and environmental factors that best align with constructivist epistemology. A more general shift that has gained significant traction over the last decade that has deep ties to constructivism is student-centered education. Student-centered education emphasizes a shift away from traditional "sage on the stage" or "banking style" models where the main focus of the class is on the instructor and receiving the information from them and places importance on collaboration, discussion, and more authentic learning experiences (Fyrenius et al., 2005). More specific pedagogical styles that have emerged with links to constructivism include problem-based learning, PjBL, inquiry learning, and flipped classroom (Fink, 2003). All of these styles encourage the use of prior knowledge to develop new knowledge while also encouraging more active forms of learning that allow students to take ownership of the material they learn and collaborate with instructors and other students (Wright, 2011). These changes in education have had significant impacts on the experiences of students and teachers alike causing shifts in lecture/instruction format, assessment style, and the outcomes pursued in the classroom.

While constructivist theory seems to focus primarily on learners and their role as active agents in their own learning, teachers are also seen as having a specific role. Teachers are not seen as much as experts in possession of a wealth of knowledge to share with students (although

they are to an extent), but as an active facilitator of student learning. Jordan and colleagues (2008) provided a thorough but concise summary of the role of the instructor in a constructivist setting; they describe the instructor as someone who:

> (a) Uses approaches recognizing students' prior knowledge, instead of following a textbook presentation or curriculum content;
>
> (b) Needs to ensure flexibility in the development of student inquiry;
>
> (c) Provides a motivational and inspiring environment for student interactions;
>
> (d) Relies heavily on open-ended questioning, student hands-on problem-solving though promoting inquiry-based learning, creating situations where the students are motivated, to ask questions and reflect on their learning;
>
> (e) Scaffolds students' development (within groups or with teacher support) so as to encourage them to seek to perform just beyond the limits of their ability when working alone;
>
> (f) Triggers extensive dialogue and collaboration to expose the learner to alternative viewpoints and multiple perspectives among their fellow students, supporting collaboration in constructing knowledge, rather than in competition;
>
> (g) Nurtures students' natural curiosity and seeks to promote their motivation, autonomy and self-regulation;
>
> (h) Utilizes formative and embedded assessment.
>
> (pp. 63-64)

Project-based learning is a specific constructivist learning model that exemplifies many of the qualities described by Jordan et al. (2008). Project-based learning is increasing in popularity and now possesses an extensive research backing. Below I will describe the roots of PjBL, more

important qualities of PjBL, as well as some important studies that display the benefits of employing project-based designs.

Project-Based Learning

Project-based learning has roots that extend back nearly 100 years and are thought to have begun with John Dewey, an educator and philosopher who had a laboratory-dedicated inquiry. Many of Dewey's most well-known works focused on experience and how education could influence out of school experience (Dewey, 1938), but he also made significant contributions in helping educators understand factors influencing student engagement in the classroom and proposed that student engagement is significantly enhanced when they are provided opportunities to participate in activities that are representative of the activities of professionals in a field. Since then, researchers have continued to refine Dewey's ideas and present them in the literature (Bransford et al., 1999).

Project-based learning as discussed presently was first introduced into the literature in the 1990s (Blumenfeld et al., 1991; Krajcik et al.,1994), and the idea was built on further in the following decade (Blumenfeld et al., 2000; Schneider et al., 2002). Project-based learning is defined as being a form of situated learning (Greeno, 2006) and is based on the constructivist idea that learners gain deeper understanding of material when they construct meaning through actively working with and using ideas (Krajcik & Blumenfeld, 2006). Project-based learning is most directly related to social constructivism (Kukla, 2000) as it prizes the classic components of constructivism that emphasize the importance of constructing knowledge through active engagement with information and use of prior knowledge as well as the importance of learning through social interaction. The social aspect of PjBL is also what allows PjBL to associate itself with situated learning, as it promotes learning through social interaction (interaction between

students, teachers, and a learning community as a whole). Through this collaboration, students gain deeper understanding through sharing and challenging each other's ideas, which is central to creating an effective community of learners and promoting meaningful learning (Greeno, 2006).

Compared to traditional classroom structures, classrooms that employ a project-based design allow students to spend time investigating questions, explore new ideas, propose hypotheses, and collaborate with classmates while working to solve problems and develop products. These central tenets of PjBL are not just great ideas, but have been proven to yield beneficial academic and effective results when employed in the classroom (Lee et al., 2014; Marx et al., 2004; Muehlenkamp et al., 2015). These studies have shown that students in PjBL courses have higher test scores than students in traditional courses, and they develop better critical thinking skills and enhanced course engagement.

Project-based learning is not defined only by the use of projects in a class though. Using projects in class is absolutely a critical aspect of PjBL, but PjBL is a unique approach to designing academic courses and requires instructors to employ unique methods of curriculum design, lesson planning, teaching, and assessment. Project-based learning environments typically incorporate a set of specific elements (Blumenfeld et al., 1991; Krajcik et al., 1994).

The first element of a PjBL environment is that they start with a driving question, a problem to be solved. These questions or problems are used to frame the context in which students will be learning and serve to guide the work that will be done and further questions that will be asked. Additionally, driving questions should help students build the foundations for the products they will eventually create. In exploring the initial driving questions, they should become familiar with important terms, key concepts, principles, and practices relevant to the discipline they are studying. To ensure this happens and that students are intrigued by the driving

questions, it is not uncommon for students and teachers to develop driving questions together (Scardamalia & Bereiter, 2006; Schneider et al., 2002); however when doing this, instructors may need to provide scaffolding as students often aren't equipped to develop driving questions with the necessary properties to drive PjBL (Krajcik & Blumenfeld, 2006). The second element is students exploring the driving question through participation in authentic, situated inquiry. Exploration is conducted in a manner that resembles the processes professionals in the field would use, and through this exploration students learn and apply important ideas in the discipline. The inquiry process differs from what is traditionally seen in classrooms where students are provided with shallow or short-term questions that are accompanied by explicit directions. Situated inquiry is much more authentic and often involves more sophisticated problem-solving procedures similar to what is done by discipline experts, providing students opportunities to practice scientific processes.

Next, students, teachers, and community members engage in collaborative activities to find solutions to the driving question. This mirrors the complex social situation of expert problem solving and provides unique opportunity for collaborative learning. Collaborative learning further promotes the development of a community of learners in which students and teachers work together to create questions, test hypotheses, form conclusions, and even share findings. As seen in the other aspects of PjBL, working as a community of learners mirrors the activities of professionals in the discipline and helps create shared understanding. Additionally, while engaged in the inquiry process students are scaffolding with learning technologies that help them participate in activities normally beyond their ability. Having the opportunity to help students expand their zone of proximal development can lead to more meaningful learning and engagement (Vygotsky, 1978). Technology also allows for more sophisticated methods of

presenting findings and helps instructors foster future inquiry. Finally, students create a set of tangible products that address the driving question. These are shared artifacts, publicly accessible external representations of the class's learning. It is important that these products serve as a culminating event, must address the driving problem, display understanding, as well as support the learning objectives of the course/project (Krajcik & Blumenfeld, 2006).

All of these elements emphasize the importance of constructing knowledge in an active manner as well as learning through collaboration and inquiry. Generally, the PjBL process involves many of the hallmarks of constructivism and provides a potentially useful framework for incorporating constructivist principles into large, introductory courses. Significant connections can even be drawn between PjBL (as described above) and constructivist learning as first discussed by Piaget. Piaget (1952) explained learning through the process of accommodation and assimilation, explaining that we develop schemas that represent our current understanding of the world and these schemas become increasingly complex as we develop and learn more. Project-based learning can create a structure that allows learning to take place through accommodation and assimilation consistently over time. Exploring a problem or theme provided by the instructor in a collaborative manner facilitates learning by beginning the process of accommodation through hypothesizing, experimenting, and testing conclusions in an active manner. Finally, with continued scaffolding from the instructor and technology, students create a final product that represents the knowledge they have newly acquired. This product represents a new and likely more sophisticated schema students have developed. After the completion of the project and unit, the process can be repeated, and students can continue to develop more sophisticated knowledge networks.

Use and Effectiveness of Project-Based Learning in Introductory Courses

While the potential benefits of PjBL have been presented consistently in the literature in recent decades (Blumenfeld et al., 1991; Hallermann et al., 2011; Markham et al., 2003; Thomas, 2000; Thomas et al., 1999; Tseng et al., 2013), there is surprisingly limited research formally examining its effects, particularly in higher education and introductory classes. Much of the formal PjBL research that does exist has been conducted in STEM fields, often in subjects such as engineering and mathematics (Chen & Yang, 2019). It appears that PjBL is more common in STEM fields than in social science courses because fields such as engineering and mathematics tend to be more problem oriented than others. For example, Hassan et al. (2014) conducted a study examining the effect of an integrated, multicourse PjBL methodology in an electronic engineering course in Spain, and Fernandes (2014) used a project-led model to aid in student engagement (Kokotsaki et al., 2016). Project-based learning research is becoming more common in the United States, but remains more frequent in Asian and European countries (Kokotsaki et al., 2016). Studies by Stolk and Harari (2014) examining the impact of PjBL designs in engineering courses in the United States are among the few available studies. A meta-analysis conducted by Helle et al. in 2006 concluded that there were only 28 studies published by educational researchers that focused on the implementation and effect of PjBL in higher education. Of those 28 reported, 18 were deemed purely descriptive and did not include any evaluation of the effectiveness of PjBL. Furthermore, of the remaining 10 that were not purely descriptive, only 2 provided evidence regarding effect on learning outcomes. While there are other papers published by innovative teachers, the majority of them are simply course descriptions that did not investigate any legitimate outcomes (Helle et al., 2006). Kokotsaki et al.

(2016) also reported that very few PjBL studies included the random allocation of subjects to intervention or control conditions. It was often one instructor that chose to experiment with a different course design that reported findings only on their section.

However, there have been a couple of influential PjBL studies conducted in large introductory classes in the United States in recent years. Huysken and colleagues (2019) conducted a study that focused on examining the benefits of a project-based course design on DFW rates, student semester GPA, class attendance, and scores on related assessments in introductory geoscience and biology courses. Both courses involved in the study consisted of lecture and laboratory portions, and the laboratory portions were adapted to use a project-based design. Students were separated into groups of 3-4 and tasked with completing three authentic projects (i.e., discussing potential environmental issues related to human interference with a local water source) and then presenting their findings to the class. The project focused heavily on encouraging student collaboration and learning through the use of the scientific method instead of studying for traditional laboratory practical exams. Results showed that the implementation of a project-based design led to a decrease in DFW rates over time, an increase in GPA, and an increase in related exam scores. Course instructors also reported increased engagement and excitement related to course material, better general performance on course assignments and discussions, and increased feelings of excitement from the instructors. While those results were purely anecdotal, they speak to the potential value of project-based designs for students and instructors alike. Also, it is important to mention that the authors of this study served as instructors for the courses that used PjBL and many taught multiple sections of the same course, therefore having the opportunity to compare a project-based design to a traditional design, an uncommon experimental design (in studies examining PjBL) (Huysken et al., 2019).

Another impactful study that examined PjBL in an introductory course was conducted by Muehlenkamp and colleagues in 2015. One of the few studies examining the effect PjBL in introductory psychology (using a quasi-experimental design), this study examined the impact of a project-based design on student critical thinking skills and course engagement compared to a traditional lecture format. To implement this design, the author divided the semester into four separate units, each characterized by a specific problem that would be investigated throughout the unit (the driving question). While only one major problem or question was posed for the unit, each unit consisted of three to five related general psychology content areas. Class periods were structured to provide students with maximal opportunities to discuss the problem, incorporate new information into their existing work, and discuss the concepts/questions with the instructor. Students were separated into groups of 3-4 and assigned a concept to study and teach their peers each class period following the introduction of the content area. Following each unit, students were then asked to examine a new question, critique the information reported, explain the information through the integration of concepts learned, and provide a conclusion or final opinion about the topic. Additionally, chapter quizzes were provided so general learning could be assessed and compared to a traditional lecture section of introductory psychology. Results showed that students in a project-based course reported significant improvements in critical thinking, engagement, and ability to integrate and analyze psychological concepts in a meaningful way compared to students in a traditional course. These results further demonstrate the benefits of PjBL and indicate that PjBL is not only feasible in introductory psychology but can promote the development of valuable skills and meaningful learning (Muehlenkamp et al., 2015).

The two aforementioned studies provide two examples of how PjBL can look in introductory classes. While many PjBL studies follow a similar format, there are a number of potential models that can yield benefits (i.e., Fernandes, 2014; Hassan et al., 2014; Stolk & Harari, 2014). Some models include the use of technology such as class wiki pages for project development, the use of one large question to drive a project for an entire semester, and collaborative multi-course models that involve the development of a few projects. Generally, different models are employed to achieve different results. As many of the courses that employ PjBL are STEM courses, the desired outcomes may involve student engagement, problem-solving skills, critical thinking, or desire for a career in STEM fields. The current study aims to employ a project-based design that is based on the model presented by Krajcik and Blumenfeld (2006), but places more emphasis on promoting student autonomy. Often project-based designs can be quite structured, and students are given one specific question to examine as a community and then develop products or a number of products that represent a solution to the driving question (Krajcik & Blumenfeld, 2006). In this study, though, students are presented with unit "themes" that guide instruction and eventually the projects, but students are provided autonomy in the manner by which they develop the final product and represent their knowledge. More guidance is provided during the early part of the semester, and then autonomy is gradually increased as students become more familiar with the project process. In addition to providing more autonomy, this model allows students to follow personal interests and engage with material more relevant to their personal/professional lives and allows student to leverage academic strengths. Additionally, a less structured model works well with the multidimensional introductory psychology curriculum. Introductory psychology is designed to explore nearly

every aspect of the field and can often feel disjointed and, therefore, an intensely structured project-based model might mitigate the potential impact of the course.

As mentioned above, even though there is evidence of the potential value of PjBL, there is limited research examining PjBL (particularly in the social sciences and introductory courses). The reasons for the scarcity of legitimate PjBL literature is not entirely clear, but it is possible that there is a shortage of studies because the implementation of PjBL models requires more time, effort, and support than traditional classroom models. When implementing a PjBL design, it is likely instructors will have to change the way material is presented in class, the schedule of the course (to provide adequate work time and discussion with students), and the manner in which knowledge is assessed. All these factors can be intimidating and may be seen as unnecessary adaptions to courses that instructors teach (Kokotsaki et al., 2016). Additionally, working to continually motivate and scaffold students' learning over the course of a year or semester when using a PjBL design can be difficult and require frequent adjustments and increased workload for students and teachers. Proper scaffolding and exciting, high quality learning experiences can help reduce cognitive load and enable students to work within and beyond their zone of proximal development (Bell, 2010; Hmelo-Silver et al., 2007). Allowing students to work in this manner can optimize the learning experiences and permit students and teachers to maximally benefit from the PjBL experience. Furthermore, introductory level social science courses primarily focus on introducing a large (typically diverse) body of students to an entire field, one that is often composed of dozens of sub-fields. This format can make it difficult for instructors to design and implement a project-based design.

Benefits of Project-Based Learning in Introductory Psychology

While many fields and courses might benefit from the legitimate studying of PjBL, psychology and particularly introductory psychology might be well poised to benefit the most. Introductory psychology is unique in that it is offered by most colleges in the U.S., and 98% of colleges require the course for psychology majors (Gurung & Hackathorn, 2018; Stoloff et al., 2009). Furthermore, introductory psychology is a "hub science" that is deeply interconnected with other major sciences such as economics and medicine, making it a popular and potentially useful course for students of all backgrounds and majors (Hard et al., 2018). Along with reaching a very large and diverse student population, introductory psychology has shown to be important in the development of study skills, communication skills, and approaches to course work later in college (Hard et al., 2018). Furthermore, psychological science has a demonstrated track record of enhancing human functioning at both micro and macrolevels (e.g., American Psychological Association [APA] Presidential Task Force on Enhancing Diversity, 2005). Even with these benefits being known, the potential benefits of introductory psychology are not maximized through the use of innovative designs or assessment strategies, and research investigating the best possible adaptions to the course is rare. Research has been conducted examining the use of technological tools in the classroom, but research is needed to find the most effective ways to design and teach introductory psychology courses (Gurung & Hackathorn, 2018). Conducting studies that aim to test novel course designs, teaching and assessment methods has the potential to not only work toward maximizing the benefits of introductory psychology but can promote the development of important academic skills for undergraduate students.

The Current State of Project-Based Learning in Introductory Courses

Recent years have shown an increase in research regarding PjBL, not only in higher education, but in introductory classes (Huysken et al., 2019). Furthermore, there has been more research examining specific outcomes related to PjBL and not just simple descriptions of courses or instructors using a project-based design. Some of the outcomes measured in recent studies include learning and engagement. For example, Muehlenkamp et al. (2015) examined the effects of PjBL on learning and critical thinking in an introductory classroom and found that students in the PjBL section retained more knowledge and performed better on knowledge assessments than students in a traditional lecture-based classroom. Additional studies (Bédard et al., 2012; Johnson & Delawsky, 2013) have found that students involved in project-based courses report increased levels of engagement during class and outside of class. While these studies provide insight into the value of PjBL in regard to general constructs such as learning and engagement, more research is needed to examine more specific outcomes related to learning and engagement. This study aims to examine learning through the lens of meaningful learning (Ausubel, 1963), motivational climate as a concept containing aspects of goal orientation and self-determination theory (Appleton et al., 2016), and engagement through the lens of transformative experience (TE) (Pugh, 2011). Meaningful learning was initially conceptualized by Ausubel (1963) as a form of learning that extends beyond traditional rote learning, and new knowledge is integrated into prior knowledge (similar to the ideas presented by constructivist learning theory). Meaningful learning is often measured using assessments other than multiple-choice exams such as concept maps, essays, or projects/presentations (Koh, 2017). Classroom motivational climate is examined through concepts such as autonomy support, task vs ego-involving activities, and authenticity of activities (Appleton et al., 2016). Transformative experience (Pugh, 2011) is

described as a form of engagement that exists both in the classroom and beyond and is defined by three characteristics: expansions of perception, motivated use, and experiential value. Transformative experience is traditionally measured using the transformative experience questionnaire (TEQ) (Pugh, 2004) at the beginning and conclusion of semesters or units. The following sections will further discuss meaningful learning, classroom motivational climate, and TE as they relate to this project.

Classroom Motivational Climate

Motivational climate is generally defined as a social psychological environment that is created by a coach, teacher, or another person in a position of power and has an impact on individuals' cognitions, affect, and behaviors (Appleton et al., 2016). The concept of a motivational climate is a result of theories that stem from achievement goal theory (AGT) and self-determination theory (SDT), focusing on how the structure of a given environment might influence an individual's perception of and responses to achievement-related activities as well as how the meeting (or failing to meet) psychological needs can influence perception. Achievement goal theory aims to explain student motivation by focusing on their purposes for engaging in tasks as well as through their beliefs about competence (Patrick et al., 2011). Research in AGT tends to focus on two types of goal orientations: mastery and performance. A mastery goal orientation is characterized by a desire to develop competence in an area, and a performance orientation is characterized by a desire to demonstrate competence. Oftentimes, individuals demonstrating a performance orientation will place great importance on comparing well socially and avoiding failure, whereas those with a mastery orientation are less concerned with social comparison and more with developing understanding or competence, regardless of outcome. Achievement goal theory does not simply rely on individual factors to account for goal

orientation though; environmental factors are also important influences of orientation (Ames, 1992; Maehr, 1984). Nicholls (1989) discussed the difference between ego-involvement and task-involvement in regard to goal orientation, with ego-involvement representing instances in which individuals seek to demonstrate competence in comparison to others, and task-involvement being instances in which individuals seek to demonstrate ability but without the desire to compare to others. Task-involved individuals tend to provide more effort when engaging in tasks, which often leads to more mastery and high ability, whereas ego-involved individuals will likely base their effort level on the ability of others and how they perceive their ability to compare, which can lead to sporadic effort, self-handicapping, and withdrawal. Task-involving and ego-involving states are further discussed in regard to classroom activities and environment. The manner in which a teacher organizes and presents class assignments, assessments, discussions, and routines may be perceived as ego-involving or task-involving by students. For example, a teacher using a semester-long project that involves students turning in small pieces every few weeks at low stakes, receiving feedback, and implementing the feedback incrementally to develop a final project may be perceived as being more task-involving as it promotes the development of understanding with formative feedback and does not encourage performance-oriented behaviors. Typically, designs like this are perceived as being more authentic, meaningful, and challenging, provide more choices for students, and authority is typically shared with the students. Additionally, students may feel as though they are recognized more often for displaying effort rather than just exam performance, and they are evaluated in a criterion-referenced manner based on effort and students are not compared to one another (Patrick et al., 2011). Creating a task-involving environment has been shown to promote the development of a mastery goal orientation as well as the development of personal intrinsic

motivation (Appleton et al., 2016; Kaplan & Midgley, 1999; Tessier et al., 2013; Wolters, 2004). Conversely, an ego-involving climate has been linked to performance-goal orientations and a diminished sense of competence (Appleton et al., 2016; Patrick et al., 2011).

Motivational climate also relies on SDT as an important aspect of the overall climate. Goal theory focuses on perceptions of tasks and the impact of those perceptions on goal orientation, while SDT adds a more affective, psychological needs perceptive to motivational climate. Self-determination theory (Deci & Ryan, 2000) posits that the development or thwarting of intrinsic motivation is a result of meeting three psychological needs: competence, autonomy, and relatedness. Competence is defined as feeling talented and skilled in whatever you are doing, that you are making significant contribution to the environment. In an educational setting, this might be students feeling as though they are making progress in understanding course material and displaying this progress appropriately. Autonomy is feeling like you are the origin of your own behavior, that you have a say in what you do and what occurs around you. Autonomy might be supported in the classroom by sampling providing multiple assignment or assessment options. Relatedness is defined by feelings of connectedness to others in your environment, a sense of belonging and that individuals mutually care for each other in a given setting. Relatedness can be improved in the classroom through the encouragement of collaboration between students and instructors.

Deci and Ryan's (2000) theory presents motivation on a spectrum ranging from amotivation to intrinsic motivation (with extrinsic motivation in the middle), with corresponding forms of regulation being paired to each stage of motivation. Amotivation and intrinsic motivation both house one form of regulation, while extrinsic motivation is comprised of four types of regulation: external, introjected, identified, and integrated. As one moves farther from

amotivation and closer to intrinsic motivation, regulatory processes become more internal and integrated into personal values. For example, someone who is in the “middle stages” of extrinsic motivation might show identified regulation, which means they are likely engaging in tasks because they are personally important or relevant to valuable personal goals and, therefore, perceive the task as being personally valuable (Deci & Ryan, 2000). Ideally, through the support of the three psychological needs, individuals will develop intrinsic motivation and integrated regulation in which they become increasingly autonomous and readily internalize new behaviors as they are presented (Ryan, 1982). Significant research has shown that the facilitation of intrinsic motivation is an important factor in promoting meaningful learning, achievement, engagement, self-esteem, and cognitive flexibility at all ages (e.g., Baker et al., 2004; Deci & Ryan, 1985; Elliot & Dweck, 2005; Gottfried, 1985;).

In recent years motivational climate research began combining SDT and AGT more readily as it has been shown they share a positive relationship (Quested & Duda, 2010; Reinboth & Duda, 2004). The study conducted by Quested and Duda (2010) showed that perceptions of a task-involving climate positively predicted satisfaction of the three psychological needs, perceptions of an autonomy-supportive climate were positively related to satisfaction of autonomy and relatedness, and perception of an ego-involving climate was negatively correlated with the satisfaction of autonomy and relatedness needs. Additionally, it was found that even in instances where psychological needs are met, it can negatively impact climate or produce undesirable motivational consequences if the manner in which needs are promoted are perceived as being ego-involving (Ntoumanis & Standage, 2009), further displaying the connection of the two theories. The integration of these two theories has added the dimension of social support to

the already existing task and ego-involving dimensions that compose motivational climate (Appleton et al., 2016).

The research discussed shows that motivational climate is an important factor in promoting a positive educational experience and increasing meaningful learning. While it is generally examined exclusively through the lens of AGT in higher education (e.g., McInerney et al., 2005.), the incorporation of SDT allows for the capturing of another dimension of the student experience that significantly impacts learning and personal motivation. Additionally, the theories underlying motivational climate fit well under the constructivist paradigm and are well suited to capture the effects of active-learning classrooms. Motivational climate is an important factor in the current study as it is viewed as being a precursor to the other outcomes being measures. I examined student perceptions of motivational climate to see if students then perceive the project-based design as more autonomy supportive, collaborative, and task-involving. Additionally, I investigated outcomes directly related to learning and engagement.

Classroom motivational climate will be measured using four constructs: autonomy support, task-involving activities, collaboration, and authenticity of activities. These constructs are based on the work of Appleton et al. (2016) and their work on motivational climate in athletic/physical education settings but have been adapted to suit an educational setting and align with the objectives of this project. Generally, a positive classroom motivational climate has been shown to promote deeper level learning that enhances adaptive motivation patterns such as mastery orientation and interest in students (Corkin et al., 2017). In this study I examined student perceptions of classroom motivational climate to gain greater understanding of their perceptions of a project-based design, specifically to see if they perceive a project-based course as being more autonomy supportive, authentic, collaborative, and task-involving than traditional lecture-

based courses. Climate was measured at the conclusion of the semester using a questionnaire, as recommended by Appleton et al. (2016).

Meaningful Learning

The Oxford dictionary states the definition of learning as "the acquisition of knowledge or skills through experience, study, or by being taught." In educational settings we often view the teacher or professor as the person responsible for guiding the acquisition of knowledge, or more simply, transmitting knowledge to the students in their classroom. Then, once the knowledge has been sufficiently transmitted, students are required to demonstrate their newly acquired knowledge through the completion of some sort of assessment, and if the students perform well on a given assessment, it can be determined that they have learned the material. This very traditional and "by the book" view of learning is still maintained and pursued by many, but some people seek more than basic learning. Meaningful learning (Ausubel, 1963) is a form of learning that goes beyond temporary and often isolated rote learning and occurs when new knowledge is integrated with existing knowledge structures. Ausubel further posited that for meaningful learning to occur, three requirements must be met: the material that is to be learned can be practically related to existing cognitive structures, the individual that is learning possess the appropriate cognitive structures to relate to the new material, and that the individual has the desire to do this.

Ausubel (1963) identified a number of main characteristics of meaningful learning that work to describe the process and/or forms of meaningful learning. The main characteristics identified by Ausubel that describe the process by which meaningful learning may occur are derivative subsumption, correlative subsumption, superordinate learning, and combinatorial

meaning. Additional characteristics that are more teacher-focused include progressive differentiation, integrative reconciliation, and advance organizers (Trehan, 2015).

Subsumption is defined as the process of incorporating new materials into existing cognitive structures and is characterized by two stages. The first stage involves the anchoring of new material into some existing concept, or the subsuming of a concept, and the second stage involves the details of the new material being learned becoming integrated and eventually indistinguishable from existing concepts. Ausubel (1968) defined the first stage of subsumption as subsuming the concept and the second stage as obliterative subsumption. Furthermore, there are two main forms of subsumption: derivative and correlative. Derivative subsumption involves learning new material that is an instance or direct extension of a previously learned concept, and correlative subsumption is learning a new concept that is related to a previously learned concept but is not a direct extension of it. The final two processes Ausubel identified as being involved in meaningful learning are superordinate learning and combinatorial meaning. Superordinate learning is unique in that it does not involve the integration of new information into existing knowledge, but it is the process of consolidating several existing concepts underneath a newly introduced umbrella concept (Ausubel, 1968). An example of this might be students recognizing that attribution theory, mindset theory, and self-efficacy theory exist as sub-theories of a general motivation construct called expectancy theory. Combinatorial learning occurs when individuals are not able to superordinate new concepts into existing frameworks and the new knowledge is essentially combined with other ideas that are related to a broad background of similar concepts (Ausubel & Robinson, 1969). Meaningful learning as presented by Ausubel & Robinson (1969) has some striking similarities to Piaget's ideas of assimilation and accommodation and, therefore, fits well under the umbrella of constructivism.

In recent years, researchers have further conceptualized meaningful learning and worked to define it using novel, measurable dimensions such as cooperative, active, and authentic learning activities (Howland et al., 2012). Ghazali and Nordin (2019) even validated a model of meaningful learning that included cooperative learning, active learning, authentic learning, constructive learning, and intentional learning using CFA. Even with recent findings in research though, meaningful learning can be a difficult concept to assess in a classroom setting. A promising theory that has been used in conjunction with Ausubel's theory to measure meaningful learning, though, is Novak's (1993) theory of human constructivism and meaningful learning. Novak's theory is built upon Ausubel's theory of meaningful learning and further emphasizes the importance of prior knowledge, assimilation, and hierarchical organization of cognitive structures (Trehan, 2015). Furthermore, Novak discussed the importance of using learning strategies and assessments that emphasize the hierarchical and relational nature of concept learning and encouraged the use of concept maps to accomplish this.

Measuring Meaningful Learning

Concept maps were first introduced into the literature by Novak and colleagues in 1984 and are defined as graphical tools for organizing and representing knowledge. Concept maps generally rely on three fundamental qualities: hierarchical structure, progressive differentiation (learning process in which learners differentiate between concepts as they learn more about them), and integrative reconciliation (suggests learners view relationships between concepts and do not compartmentalize the concepts, assessed through complexity of connections and verbal connections made) (Novak et al., 1984, p. 97). Links between concepts are shown by the hierarchical structure in which the lower concepts are subsumed beneath those which appear in higher levels, and the superordinate concepts are more general than the subsumed concepts. Two

or more concepts linked together by words create a proposition. The propositions, along with arrows indicating the direction of each relationship, help to more precisely develop the connections between linked concepts (Starr & Krajcik, 1990). Concept maps have been employed as both assessments (e.g., Beyerbach, 1986; Kinnear et al., 1985) and methods of curriculum design (Ellis et al., 2004; Irvine, 1995; Mintzes & Quinn, 2007) and have proven to be effective in both roles. Just as Ausubel's theory of meaningful learning pairs well with constructivist theory, concept maps also mirror constructivist beliefs by focusing on using overarching concepts to establish prior knowledge and then building on that knowledge through the introduction of newer, related subordinate concepts.

As mentioned previously, concept maps have been employed effectively as assessments in higher education, but might be especially effect in measuring meaningful learning in a project-based classroom as they can allow instructors to see the knowledge connections students are making without relying on multiple-choice or essay/short-answer exams particularly because more traditional exams focus more on shallow knowledge of many concepts whereas PjBL is geared more toward deeper understanding of a few concepts, which can be illustrated through nodes and connections on a concept map (Schwendimann, 2015). Previous student experiences and psychology knowledge may influence their ability to create concept maps, though. To account for this, self-efficacy for learning (Bandura, 1982) will be used as a covariate when measuring meaningful learning. Self-efficacy has been shown to be a significant predictor of learning (Schunk, 1996; Zimmerman, 2000); therefore, will be an adequate method of controlling for student differences in knowledge and experience.

When engaging in activities that promote meaningful learning, students are often provided more opportunities to reflect on the knowledge they have learned, make important

connections, and then apply the knowledge to new situations (Din et al., 2012; Hamdan et al., 2015). When compared to rote learning (what might be seen in traditional course formats that employ multiple-choice exams), meaningful learning results in greater knowledge retention and increased intellectual curiosity, which may result in increased engagement in activities related to course material (Ali et al., 2017). Seeing as PjBL provides students more opportunities to engage with material relevant to their lives and encourages them to pursue deeper understanding, meaningful learning is an important outcome to be tracked when studying project-based design. Meaningful learning will be assessed using a holistic concept map scoring technique first proposed by Besterfield-Sacre et al. (2004) that is meant to better serve maps encompassing whole course or field content.

Transformative Experience

Recent decades have shown a significant increase in literature surrounding student engagement and its impact on achievement (Fredricks et al., 2004; Günüç, 2014; Lei et al., 2018; Northey et al., 2018; Reyes et al., 2012). Generally, increased student engagement is linked to positive academic outcomes such as meaningful learning and is, therefore, becoming a popular construct in education at all levels (Kahu, 2013), levels of engagement have also been shown to be significant predictors of student retention and persistence through an undergraduate program (Kahn, 2014). With these potential benefits of increased student engagement known, it can be argued that it is potentially a construct of great value in large introductory classes as they serve the largest and most diverse body of students and have the potential to shape the rest of an individual's experience in higher education (Hard et al., 2018).

As it is examined in this study, engagement is defined as the intensity and emotional quality of students' involvement (Fredricks et al., 2004). Engagement is a multidimensional

construct that includes behavioral, affective, and cognitive components. Behavioral engagement refers largely to participation or being an active agent in one's educational experience, including participation in extracurricular activities (social or academic) which have shown to be significant predictors of positive academic outcomes and can greatly reduce the likelihood of students dropping out. Emotional engagement refers to positive and negative reactions to academics, classmates, instructors, and school in general and is important as it is thought to create ties to an institution and, therefore, increase student willingness to complete the work necessary to complete a degree. Lastly, cognitive engagement focuses on student investment in their educational experience. Greater personal investment in education is linked to thoughtfulness and willingness to dedicate the proper resources necessary to comprehend difficult concepts and complete difficult tasks (Fredricks et al., 2004). This holistic model of engagement is a result of years of research and many individual components of engagement including task-specific behavior (Karweit, 1989), student attitudes (Epstein & McPartland, 1976), interest (Eccles et al., 1983), and motivation and self-regulation (Boekaerts et al., 2000). Not only is there a significant amount of literature addressing each component individually, but researchers have validated this three-factor model of student engagement using first and second order confirmatory factor analyses (Awang-Hashim & Sani, 2008).

While engagement has been relevant in the literature for decades, it remains increasingly popular as it has continued to merge bodies of literature such as motivation and affective components of learning and has been shown to be a malleable, evolving concept (Fredricks et al., 2004; Pugh, 2011). As the landscape of education has continued to change and adopt new forms of technology, pedagogical strategies, and becomes increasingly available to students from many different backgrounds, the focus on and measurement of engagement has become more intense

and diverse. An important evolution in the study of engagement is increased attention to studying engagement out of school instead of only in the classroom. An important construct that has become relevant in the engagement literature is that of transformative experience (Pugh, 2002, 2004, 2011). Transformative experience is recognized as a form of engagement that exists in the classroom, but also extends into the out-of-school realm. Pugh (2004) defined TE as being an integrated construct characterized by three interrelated qualities: motivated use, expansion of perception, and experiential value. Generally, these qualities of TE align with the above-mentioned dimensions of engagement (behavioral, cognitive, and emotional) (Fredricks et al., 2004). Motivated use aligns with the behavior dimension of engagement and is a form of knowledge transfer than involves the application of material learned in a context in which it is not necessarily required. For example, a student in a psychology class might work to increase their chances of landing a date with a person of interest by being increasingly present in the other person's life because they learned about the mere exposure effect when discussing attraction during a social psychology unit. This student is not required to use this principle outside of class, but does so on their own volition. Expansion of perception aligns with the cognitive dimension of engagement and is defined as seeing and understanding aspects of the world in novel ways. This may involve new perspectives on current events, societal issues, or simply an object that is encountered on a regular basis. Expansion of perception serves as the cognitive aspect of motivated use. An example of this might be a student viewing the development of their young cousin through the lens of Piaget's stages, noticing when the child struggles with the concepts of conservation or egocentrism in their daily life. Finally, experiential value aligns with the emotional dimension of engagement and refers to the valuing of content for its usefulness in everyday experience; this construct is closely tied to utility or task value and personal interest

(Eccles & Wigfield, 1995). Experiential value may be displayed in the form of a student sharing with their instructor how after learning about Weiner & colleagues (1976) attribution theory during their motivation unit they no longer view excuses for poor performance as simple excuses, but they look deeper and work to understand the locus of causality of the individual they are interacting with. In order to have TE, an individual must express all three of the components; without all three present, it is difficult to differentiate between a TE from other motivational experiences such as interest. When a TE does occur, though, all the components combine to create a unique experience that incorporates cognitive, affective, and behavioral factors that culminate in deep level engagement (Pugh, 2011).

Research has shown that TE is linked to positive academic outcomes beyond just increased levels of engagement, including interest in a particular domain and deeper understanding. Much of the research in TE has been done in science domains, but many studies have shown TEs lead to an increase in interest in science (Girod et al., 2010; Pugh et al., 2017) and increase the likelihood that students' understanding of the material learned will persist over time (Girod et al., 2010; Pugh, 2002). Additionally, students who undergo TEs display increased ability to transfer their knowledge and apply their learning to novel situations (Pugh et al., 2010). Outcomes such as deeper level and long-lasting understanding, knowledge transfer, and ability to apply learned material to new situations are in line with the goals of this study, and PjBL in general (Greeno, 2006; Krajcik & Blumenfeld, 2006). Making a course like introductory psychology more transformative through the use of PjBL may further enhance the value of the course and improve the experience for a large number of students.

The main goals of PjBL include answering a driving question, exploring the driving question in an authentic manner, and working in a collaborative fashion. In addition to promoting

deeper level learning, learning in this format might be more likely to encourage students to seek out and use new, relevant information in their daily lives (Filippatou & Kaldi, 2010). Seeking, seeing, and using information from the course (and beyond) in everyday life are central tenets of TE theory. While PjBL (in general and as it is employed in this project) does not follow the teaching for TEs model (Pugh, 2020), it is well suited to enhance the likelihood of students having a TE during this course, especially when compared to traditional lecture-based courses. Providing students opportunities to engage in collaborative inquiry and seek out relevant information in an autonomous fashion while learning course material allows for opportunities to see real-world value and use this in the information being examined (Corkin et al., 2017). While these connections are evident, there is limited research examining the relationship between PjBL and TE. The current study aims to provide further evidence of the ability of PjBL to enhance the quality of student engagement and establish a relationship between PjBL and TE.

Examining engagement through the lens of TE theory affords unique insight into the true level of engagement students are experiencing in a classroom while maintaining the traditional theoretical perspective that incorporates cognitive, behavioral, and affective aspects of engagement. Additionally, while it is not uncommon for researchers to examine how out-of-class engagement might be impacted by the use of supplemental technology (e.g., Günüç & Kuzu, 2014; Krause et al., 2003; Leese, 2009), it is far less common to examine engagement on a spectrum of in-class to out-of-class as TE does. When measuring TE, responses are examined and analyzed on a spectrum that allows researcher to determine how “transformative” a classroom setting might be. A class might be seen as minimally transformative if students report only some in-class engagement, whereas it might be transformative if students report strong out-of -class engagement and evidence of the three components of TE. This method of analysis

provides researchers with great insight into the impact of their course on student engagement at multiple levels instead of a more binary result. Additionally, using TE as a measure of engagement is especially appropriate for this study as its components relate well to the climate outcomes being measured. For example, a student that perceives the classroom motivational as being more autonomy supportive, collaborative, or authentic might be more likely to find examples of or use the information discussed in class in their daily life.

Transformative experience was measured at the conclusion of the semester using the Transformative Experience Questionnaire (TEQ) (Koskey et al., 2018). The TEQ is designed to measure engagement on a continuum of in-class engagement to out-of-class engagement, with items ranging from easy to difficult to endorse. Additionally, interest (Fredricks et al., 2004) was used as a control variable when measuring TE at the conclusion of the semester. Interest was measured at the beginning of the study and then used as a control at the end. Interest was included as a control in this study because the two constructs not only closely intertwined, but have been shown to have a reciprocal relationship (Pugh et al., 2010); therefore, baseline levels of interest in psychology may significantly impact the experience students may have.

Mastery Goal Orientation

In addition to the main outcome variables being examined in this study, another construct of importance in this study is a mastery goal orientation. A mastery orientation is defined by a desire to increase knowledge, skill, and competence in a given domain with minimal focus on social comparison or the appearance of failing (Senko & Harackiewicz, 2002). In academic realms a mastery orientation has been linked to positive outcomes such as academic achievement, deeper level learning, and self-regulation (Ames, 1992; Hsieh et al., 2007). In this

study mastery orientation is relevant as an outcome and interaction variable as it is hypothesized to share a relationship with many of the variables being examined in the study.

In their early research Dweck and Leggett (1988) demonstrated that learning oriented tasks (tasks designed to show students are learning new information, and they might make mistakes during the process) were more effective in promoting a mastery orientation in students than performance-oriented tasks (tasks designed to demonstrate competence), showing the impact that a student's learning environment (instruction, student-teacher interactions, and assessments) can have. Seeing as PjBL provides students increased opportunity to explore information through the use of open-ended questions in a collaborative and authentic manner, it is likely to promote a mastery orientation similar to the way the tasks in Dweck and Leggett's study did (Yildirim, 2004). Project-based learning has been shown to promote the development of a mastery orientation when employed in introductory-level university courses (Corkin et al., 2017; Kalyuga, 2009; Stolk & Harari, 2014) largely as a result of the autonomy supportive and collaborative nature of project-based designs (Karabenick & Knapp, 1991).

Research examining the interaction between mastery orientation, PjBL, and other outcomes is quite limited, though. The relationship between PjBL and mastery orientation is often examined purely as an outcome, as seen in the studies mentioned above. The current study sought to investigate the effect of PjBL on the development of a mastery orientation as well as how PjBL and a mastery orientation interact on motivational climate, learning, and transformative experience.

When examined independently, PjBL and positive, autonomy supportive motivational climates are shown to promote the development of a mastery orientation (Appleton et al., 2016; Stolk & Harari, 2014). There is limited research examining the impact of PjBL on perceived

classroom motivational climate, but seeing as PjBL promotes authentic, active learning through the use of open-ended questions and product development, it is well poised to promote the development of an empowering, autonomy supportive motivational climate (Appleton et al., 2016). In this study, it was hypothesized that PjBL will work to promote the development of a mastery orientation and an empowering motivational climate and that baseline mastery orientation and experiencing a project-based design will increase the likelihood of perceiving the climate as being empowering.

Having a mastery goal orientation has been shown to have a significant impact on the manner in which students engage in academic behaviors (Huang, 2012). Generally, students who present a mastery goal orientation will seek out tasks that might be more challenging with the primary goal of gaining knowledge or "mastering" a topic (Senko et al., 2011). When students engage with material in this fashion, it is more likely that learning will be more meaningful and that the information will be processed beyond just the surface level (Elliot et al., 1999). Seeing as PjBL allows for more autonomous learning that allows students to collaborate in the classroom, use prior knowledge to solve problems, and interact with material in an authentic manner, it is likely to promote increased meaningful learning (Din et al., 2012). Furthermore, it was hypothesized that students engaging in PjBL that present a mastery orientation will experience increased meaningful learning.

The link between mastery goal orientation and TE has been established in the TE literature. Pugh and colleagues (2010) conducted a study that examined the relationship and found that a mastery goal orientation was positively associated with TE. Seeing as a mastery orientation is linked to an increased desire to learn in a genuine fashion and become competent in a subject, it is appropriate that presenting a mastery orientation would increase the likelihood of

having a TE (Pugh et al., 2010). Since PjBL allows for authentic exploration and opportunity to seek knowledge in alternative fashions, it iwas hypothesized that students presenting a mastery orientation and engaging in PjBL are increasingly likely to have a TE.

The information presented above suggests that a mastery goal orientation and PjBL may interact in a powerful manner and enhance the outcomes each present when examined independently. However, research is limited examining the interaction between PjBL and mastery goal orientation; therefore, the current study aimed to solidify these potential links and add to the literature surrounding PjBL and goal orientation.

Summary

This chapter focused on highlighting the literature regarding alternative constructivist models, PjBL, and key research in PjBL in higher education, motivational climate, meaningful learning, student engagement, and mastery goal orientation. Project-based learning is generally examined using the framework presented by Krajcik and Blumenfeld (2006) and is more commonly employed in STEM courses. Research has shown that PjBL is useful in promoting the development of real-world skills such as problem solving and collaboration, while also increasing student engagement, course efficacy, self-regulated learning, and general academic achievement when compared to traditional instruction (Guo et al., 2020). Although there have been some studies that examined PjBL in large introductory courses (outside of STEM fields) and yielded positive outcomes (e.g., Huysken et al., 2019; Muehlenkamp et al., 2015), research examining PjBL in non-STEM introductory courses is quite limited (Guo et al., 2020). More research is needed to examine the feasibility and potential benefits of PjBL in social science and introductory courses. Increased research in PjBL in courses such as introductory psychology could work to increase the academic experience of a large body of students through the

promotion of authentic learning and development of adaptive motivation patterns that are linked to general academic success, while also improving a course (introductory psychology) that has remained unchanged for a number of decades.

Research in motivational climate is continuing to shift towards examining motivational climate as a more wholistic construct that has roots in achievement goal theory and self-determination theory. Recent studies have shown that the promotion of a task-involving climate positively predicts the satisfaction of the three psychological needs that comprise SDT (competence, autonomy, and relatedness) and that when climates are perceived as being ego-involving, there is a negative relationship with perceived autonomy and relatedness (Quested & Duda, 2010). Furthermore, it has been found that ego-involving climates can produce negative motivational consequences even if psychological needs are met (Ntoumanis & Standage, 2009). This research shows that examining motivational climate as a wholistic construct that includes elements of AGT and SDT affords more insight into student motivation and classroom perception, which can lead to more effective methods of improving motivation and promoting meaningful learning.

Meaningful learning has evolved from Ausubel's (1968) original theory of meaningful learning to include more holistic, measurable constructs including cooperative, active, and authentic learning (Ghazali & Nordin, 2019; Howland et al., 2012). Generally, meaningful learning involves anchoring and integrating new material or knowledge into some existing knowledge. This can occur through combining new information with existing frameworks to create broad related networks (combinatorial learning) or through the consolidation of existing concepts underneath a newly learned umbrella concept (superordinate learning) (Ausubel, 1968). While meaningful learning can be difficult to measure, one promising theory that has been used

to assess meaningful learning for many years is Novak's (1993) theory of human constructivism and meaningful learning which employs concept maps as a measure of meaningful learning. Novak's theory is built upon Ausubel's theory of meaningful learning and further emphasizes the importance of prior knowledge, assimilation, and hierarchical organization of cognitive structures (Trehan, 2015). Concept maps have been employed effectively as assessments in higher education, but might be especially effective in measuring meaningful learning in a project-based classroom as they can allow instructors to see the knowledge connections students are making without relying on multiple-choice or essay/short-answer exams. Recent research has shown that meaningful learning is important for promoting interest, engagement, deep-level understanding, and task-value (Ali et al., 2017; Hamdan et al., 2015).

In this study engagement is defined as the intensity and emotional quality of students' involvement and is seen as a multidimensional construct that includes behavioral, affective, and cognitive components (Fredricks et al., 2004). Engagement has been relevant in literature for decades, and the importance of engagement in relation to positive motivational and academic outcomes is well documented (Boekaerts et al., 2000; Eccles et al., 1983; Epstein & McPartland, 1976; Fredricks et al., 2004; Karweit, 1989;); however, it is an ever-changing concept (Pugh, 2011). As the landscape of education and the incorporation of new forms of technology and learning continue, it is important that our understanding of engagement and the ways in which engagement is measured continue to evolve. Transformative experience theory is a theory of engagement that has become relevant in the last decade and represents a method of examining engagement both in and out of the classroom (Pugh, 2002, 2011). Transformative experience theory is composed of three interrelated qualities (motivated use, expansion of perception, experiential value) that work to capture the level of a student's engagement in school and out of

school. Examining student engagement through the lens of TE affords more insight into the true level of engagement students are experiencing in a classroom while maintaining the traditional theoretical perspective that incorporates cognitive, behavioral, and affective aspects of engagement. Research in TE has shown that the more "transformative" a class is perceived as being transformative, the more likely students are to see increased in adaptive motivational outcomes such as mastery goal orientation, interest, and deep-level understanding (Pugh et al., 2010).

A mastery orientation is defined by a desire to increase knowledge, skill, and competence in a given domain with minimal focus on social comparison or the appearance of failing (Senko & Harackiewicz, 2002). In academic realms, a mastery orientation has been linked to positive outcomes such as academic achievement, deeper level learning, and self-regulation (Ames, 1992; Hsieh et al., 2007). Generally, learning oriented tasks (tasks designed to show students they are learning new information and they might make mistakes during the process) were more effective in promoting a mastery orientation in students than performance-oriented tasks (tasks designed to demonstrate competence), showing the impact that a student's learning environment (instruction, student-teacher interactions, and assessments) can have. Project-based learning is well suited to promote the development of a mastery orientation as it provides students opportunities to explore information in a collaborative, authentic fashion, and research has supported this claim (Corkin et al., 2017; Stolk & Harari, 2014). However, there is limited research examining the potential power of the interaction between PjBL and mastery goal orientation in classroom settings. The current study aimed to draw on existing literature displaying the impact of PjBL and mastery goal orientation on motivational climate, learning, and TE and explore the interaction effect of PjBL and mastery goal orientation on the same outcomes.

CHAPTER III

METHODOLOGY

Participants

The study aimed to examine the effects of PjBL on perceived meaningful learning, goal orientation, student engagement, and classroom motivational climate using a quasi-experimental design. Participants included 247 undergraduate students (75 experimental and 172 control) who were enrolled in an introductory psychology course at a mid-sized university during the fall semester of 2021. Students were recruited from five sections, and approximately 65% of all students agreed to participate, with some sections yielding higher rates of participation than others. Failure to participate was a result of class absences, incomplete surveys, and a small number of students (~3%) declining to participate. Demographic information was collected as part of the surveys at both time points; demographics assessed were year in school, major, ethnicity, and gender. There were no significant differences regarding demographic information between conditions.

Statistical Power

Prior to collecting data and conducting any analyses, an a priori power analysis was conducted using G*Power 3.1.9 do determine adequate sample size given desired alpha level, power, and effect size. Seeing as one-way ANCOVA linear regression will be the primary analyses used, power analyses were conducted for both. Generally, for this study an alpha level of .05 was used for all analyses, a small effect size was desired (.25), and high statistical power was desired (.95). Given these statistics, the required total sample size to achieve the desired

results when employing a one-way ANOVA (and ANCOVA) with two groups was 210. The participant number ended up being 247, which is adequate based on the power analysis.

Context

The current study took place in an introductory psychology course at a mid-size university (N = ~13,000). During the fall of 2021 this university offered five sections of introductory psychology, all of which were taught in person and had between 55 and 90 students. Introductory psychology is a 16-week course and is designed to provide an overview of the field of psychology. All courses were taught using a face-to-face format. These courses consist of primarily freshman students (>70%), and all students self-select into sections prior to the beginning of the fall semester. The author of this paper taught one section of PSY 120, and the remaining four sections were taught by graduate students and one faculty member. The author's section was used as the project-based intervention condition. On the first day of class all students were informed that the section in which they were currently enrolled was would be using a project-based design as a part of a research study. At that point, students were informed that if they did not wish to be a part of the project-based section, they were welcome to switch to one of the other sections that used a traditional course design with multiple-choice exams. The other PSY 120 instructors were aware of the project, and students in the four traditional sections were informed of the project-based section and research project during the second week of classes when data collection began.

Intervention and Comparison Conditions

Comparison Condition (Traditional Instruction)

The traditional structure courses involved either 50- or 75-minute lectures two or three days a week with a 50-question multiple-choice exam at the conclusion of each unit. There were

four units over the course of the semester, each lasting three to four weeks long, with a final exam at the conclusion of the semester. There were no sections dedicated exclusively to honors students or psychology majors, so each section followed a similar trajectory and were comparable in student performance (assessment scores in each section are usually within 1 SD of each other). While the traditional sections were more lecture heavy and relied on multiple-choice exams for assessments, they did include active learning opportunities for students as well. During at least one class period each week students had opportunities to participate in activities such as think-pair-share, kahoot quizzes, or small-group case studies. In the traditional section these active learning opportunities were used to provide students with additional opportunities to apply their knowledge.

Intervention Condition (Project-Based Learning)

The project-based section implemented the use of unit projects instead of exams and an additional final project at the conclusion of the semester. The project-based design also involved the use of unit "themes" that were presented at the beginning of each unit and then used to drive lectures, class activities/assignments, and eventually unit projects. While the unit projects served as the main assessment for each unit, the in-class activities and assignments were used to ensure that students engaged with as much material as possible from each unit and did not just focus on information they thought might be relevant to their project. These activities involved active learning opportunities such as group case study analyses, debates, or short psychology experiments conducted by the class. Additionally, the class period prior to the project due date was dedicated exclusively to working on unit projects and was designed to provide opportunities for the students and instructor to discuss ideas, collaborate, critique, and finalize unit projects. Table 1 provides an outline of the unit/project schedules. Similar to exams, each project was

worth 100 points (accounting for 30% of the total course grade) and carried the same weight in regard to percentage of final grade.

Table 1

Outline of the Project-Based Learning Course Content

Weeks/Unit	Theme	Psychology Content Areas Included
Weeks 1-4; Unit 1	Think like a scientist	History of psychology, research strategies, consciousness, thinking, brain structures.
Weeks 5-7; Unit 2	Making sense of the world	Neural and hormonal systems, theories of emotions, stress and illness, conditioning, learning & memory.
Weeks 8-11; Unit 3	What makes us human, inside and out	Human development, social thinking, antisocial and prosocial behavior.
Weeks 12-15; Unit 4	What can psychology do for you?	Concepts of psychological disorders, motivation, sport/performance psychology, benefits of sleep, applications of psychology.

Although one of the main purposes of the current project was to enhance the autonomy of students regarding assessments and the material they wished to focus on more intensely, the instructor provided project guidelines in the early weeks of the unit, so students had time to develop ideas/products to pursue on workdays. Additionally, providing guidelines earlier allowed students to view the material presented during lecture through a lens more relevant to their lives and work on additional class assignments/in-class activities with projects in mind. Scaffolding was also more intense during the early part of the semester and was slowly removed as time went on. One major benefit of project workdays was that they allowed the instructor to provide different levels of scaffolding and project recommendations to students according to their previous experiences in psychology, familiarity with material, and current level of

understanding. An additional description of the project delivery process as well as a discussion of typical project products turned in by students is presented in Appendix A.

To further describe the project process, consider the example of an early semester project requiring students to analyze some of the most famous scientific experiments conducted throughout human history. The Unit 1 theme was "Think Like a Scientist," and one of the main focus of the first unit was understanding the scientific method, scientific attitudes, research methods, and critical thinking processes (what inhibits and promotes critical thinking). Seeing as many of the students had not been exposed to the scientific method or critical thinking processes prior to this course (at least not with much depth), having them identify these processes and the results they yielded in a well-known and successful experiment theoretically helped solidify their understanding of the processes and work toward developing the ability and confidence to conduct their own scientific thinking. The guidelines for Project 1 were very clear and primarily required the identification of the methods used along with a very brief discussion of what they discovered and whether the process was interesting/exciting for them. This initial project provided intense scaffolding and was designed to introduce students to the project process while requiring students to elaborate on the knowledge acquired during Unit 1. Additionally, since this project was conducted during the beginning of the semester, it was more structured than others occurring later in the semester to ensure students understood the goals of the project, the grading system, and the process of completing one of these projects before attempting one entirely on their own. A complete description of the Unit 1 project assignment is provided in Appendix B.

When conducting the actual projects, students were provided the option to work in groups (of no more than four) or individually. Often with class projects, students are required to work in groups, and group dynamics are not always beneficial to all parties involved; I believed that it

might benefit some individuals to have the opportunity to work on their own if they wanted. Once students decided how they were going to work on the project, they were required to report the topic they chose for the project and initial written plans were submitted online prior to the first workday. In addition to working individually on project ideas, students spent 10 minutes discussing/critiquing these ideas with classmates to promote collaborative learning. Throughout the workday student progress was continually monitored, instructor feedback was provided, and any final adjustments to project topic or format were employed. Following the workday, students turned in their work and a self-evaluation online, there was a general class discussion about the project process, and students set general goals for the next unit/project. This process was used for four of the five course projects. For the last project, students were required to create a cumulative project in which they discussed the three-four course topics most salient or impactful to their lives. Each project was graded by the course instructor using a preset rubric and scored on a scale of 0-100. Projects were graded on expression of conceptual understanding, meeting a time/length requirement, understanding/display of effect of concept on thinking and behavior, and examination/exploration of different viewpoints. A copy of the general project rubric can be found in Appendix C.

Procedure

Data collection occurred at two time points throughout the semester. The first round of data collection was done during the third week of the semester (immediately following the drop date), and the 2nd round of data collection occurred during the 15th week of the semester (the week prior to final exams). Data collection procedures were identical both times with volunteers administering surveys at the beginning of a class period; however, additional measures were used

at Time Point 2. When collecting data at Time Point 1, goal orientation, psychology interest, and self-efficacy (specific to the introductory psychology course) were measured. At Time Point 2, perceived motivational climate and transformative experience (TE) were measured, and goal orientation was measured again (using the same items). A table displaying the procedure timeline is presented in Appendix D (Table 4). To recruit students, members of the same research lab as the author of this paper visited each section of introductory psychology, provided a description of the study, and then encouraged students to participate in a survey directly following the discussion (during the first 5-10 minutes of the class period). Students were strongly encouraged to complete the survey during the provided class time when the researcher was present, but in the instances when students were absent or unable to complete the survey during that time, the survey was open and available for them to complete for the three following days to ensure data collection was maximized. The author of this paper did not visit the classes personally to avoid any potential bias or coercion to participate. Additionally, students were incentivized to participate using extra credit. Prior to the recruitment of students for participation and distribution of survey materials, all procedures were approved by the University Institutional Review Board (IRB); the IRB approval letter for this project is provided in Appendix E.

Measures

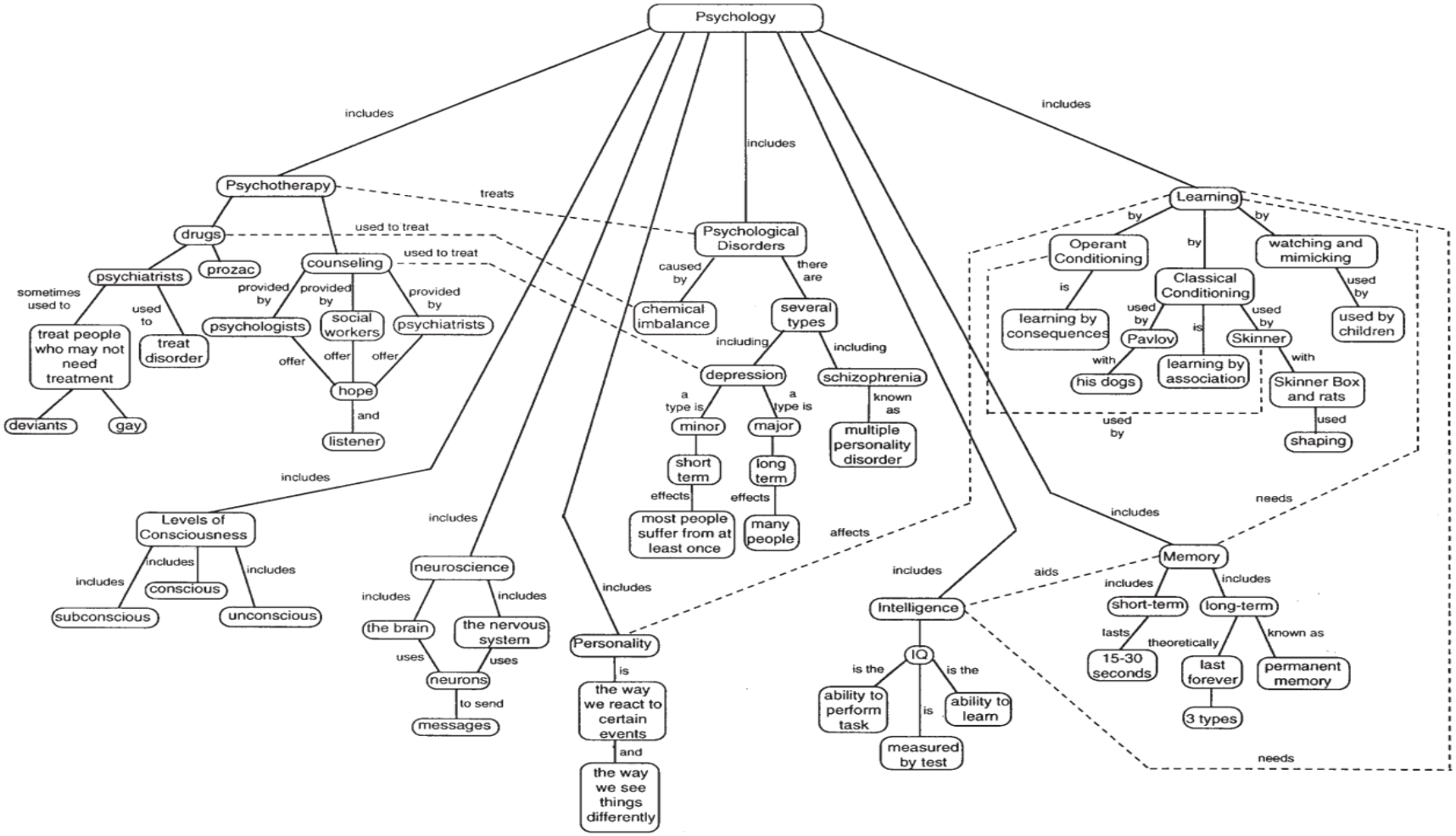
Meaningful Learning

Meaningful learning was measured through the use of concept maps. While concept maps are often used as active learning strategies or for designing curriculum, they have also been shown to be an effective measurement tool (Trehan, 2015). Concept maps consist of concepts placed in nodes that are connected by links with connections identifying the relationship between

the nodes (concepts) (Novak & Cañas, 2008). Furthermore, Fraser (2006) identified six characteristics that all concept maps should contain: (1) they should be hierarchical in nature, (2) linking words should exist on the lines connecting concepts, (3) content flows from the top of the page to the bottom, (4) maps represent an individual's understanding (therefore, maps will likely differ by individual), (5) meaningful cross-linkages in different sections indicate a more sophisticated level of understanding, and (6) emotions/affect can be expressed on concept maps. When used as assessment tools, they work to differentiate between those who express having learned the course concepts or material in a deeper-level, more meaningful fashion and those who merely retained surface level knowledge (Hay et al., 2010). Students displaying more meaningful learning will present concept maps with a larger number of concepts, a multitude of connections with many working to integrate concepts that may seem unrelated on the surface, as well as clear connections between prior knowledge and new knowledge, whereas a concept map displaying surface-level learning will have limited concepts and linkages beyond the obvious ones, few complex linkages, and minimal connection between prior knowledge and new knowledge (Hay et al., 2010). A complex concept map representing introductory psychology is presented in Figure 1. Seeing as introductory psychology covers many different subfields and concepts in psychology, maps can be quite complex, but generally include concepts such as important figures in psychology and their contributions, theories of development or learning, memory, etc.

Figure 1

Complex Concept Map Representing Introductory Psychology



Note. Adapted from “Concept maps as assessment tools in psychology courses” by J.M. Jacobs-Lawson and D.A. Hershey, 2002, *Teaching of Psychology*, *29*(1), 25-29.

In the current study, students were asked to create a concept map representative of introductory psychology. Prior to creating concepts maps, students were provided basic instruction as to how to create an appropriate concept map. Students were shown a basic example of a concept map that represented theory of a concept map and the general purpose was explained; the concept map instructions along with images are provided in Appendices F and G. Following the explanation and examples, students were provided class time to create a concept map (roughly 45 minutes), which was turned in as an assignment at the conclusion of the class period. It was believed that if instructions were too specific or if instructors were given the opportunity to provide additional examples, students in that section might perform significantly better as they would be more prepared; therefore, instructions for the concept map were left vague on purpose to avoid any bias across class sections.

Concept maps were scored using a holistic scoring system proposed by Besterfield-Sacre and colleagues (2004). This system rates concept maps based on four components: comprehensiveness (which is comprised of depth and breadth ratings), organization, and correctness. Comprehensiveness is rated using two different components. The first is breadth, which examines the degree to which the participant is able to define the subject area, or how much course information they are able to include. In this project participants would need to demonstrate the inclusion of four major course topics to receive a full points on breadth. The second component is depth, which examines how well students are able to display understanding of course material. Depth is represented by the number of sub-concepts presented per overarching topic on the map. In this project, participants would need to include at least three sub-concepts per overarching concept to receive full points on depth. Organization examines general map organization/clarity and the sophistication of the map structure. Full points in

organization requires clear organization, extensive connections, and the presence of cross-linkages and feedback loops. The final rating component is correctness, which examines the accuracy of the information presented in the map. To receive full points in correctness, the participants would need to present accurate overarching concepts, accurate sub-concepts within the overarching concepts, and use correct course terminology. Component scores range from 1 to 3, with overall scores ranging from 4 to 12. A score of 4 would indicate the lowest score in which a participant received a 1 on each component, and a 12 would indicate the highest possible score in which a participant received a 3 on each component.

Seeing as there were more than 170 concept maps to score, multiple raters were used. All raters were trained in scoring concept maps to increase efficiency and interrater reliability in scoring the maps. Raters were recruited from the psychological sciences department and the author's university at the beginning of the Spring 2022 semester. Three total raters were employed. Following recruitment, there were two training sessions (roughly 45 minutes each) during which the raters were introduced to concept maps, the scoring system, and spent time scoring maps and comparing them to one another's. Following the final training session, each rater was given four identical concept maps to score individually, then the raters reconvened and compared scores as one final reliability check. After the final score comparison, it was determined raters were similar in scoring (interrater reliability of .90, above the acceptable threshold of .70 (Markow & Lonning, 1998)) and prepared to rate maps individually. The holistic scoring system being used has been shown to be an accurate measure of knowledge retention when examining whole-course or whole-subject content and has been employed at the university level multiple times (i.e. Besterfield-Sacre et al., 2004; Watson & Barrella, 2017;

Watson et al., 2016). Final map scores were determined through average score across raters. For examples of concept maps completed by students in the current study, reference Appendix H.

Transformative Experience

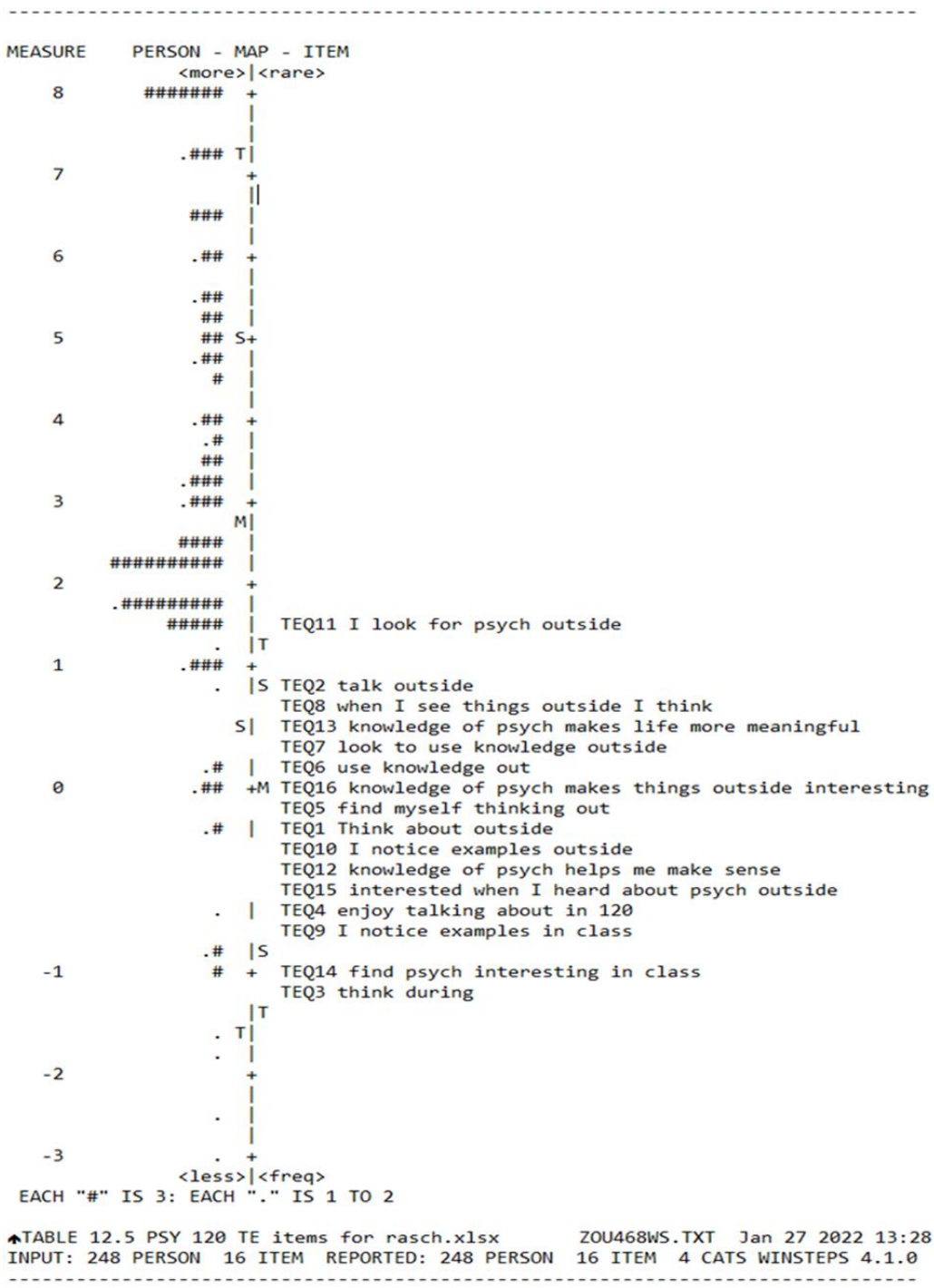
Transformative experience was measured using items adapted from the Transformative Experience Questionnaire (TEQ; Koskey et al., 2018). The version of the survey used in the current study consisted of 16 items that work to assess the three characteristics of TE (motivated use, expansion of perception, and experiential value) and are designed to measure engagement on a spectrum ranging from in-class engagement to out-of-class engagement. Sample items include, "I *think* about psychological principles when I see things (in real life or online) related to learning, social interactions, people exhibiting unique behaviors, or when I am browsing media (on YouTube, TikTok, Netflix, etc.)," and "I look for chances to *use* my knowledge of psychology in my life outside of school." Items were rated on a 4-point scale ranging from *strongly disagree* to *strongly agree*. The complete TEQ used in this study is provided in Appendix I.

To remain in accordance with previous literature regarding TE, Rasch analysis (Rasch, 1980) was used to create a composite score for the TEQ using WINSTEPS software (Linacre, 2006). Rasch analysis is valuable when measuring something like TE as it provides unique insight into the nature of TE and its existence on a spectrum. The TEQ presents items in a hierarchical fashion ranging from easiest to most difficult level of agreement; therefore, Rasch analysis allows us to understand which items are more or less likely to be endorsed by participants. Because of the nature of the TEQ, Rasch provides more accurate insight into participant responses than traditional subscale mean scores.

Item fit was assessed using infit MNSQ (Wright & Linacre, 1994), and items with a value greater than 1.4 were determined to be miss-fitting (i.e., items not in line with others in the Rasch model). No items were found to be misfitting. For the measure, both person and item reliabilities were strong (.90 and .94, respectively) indicating the replicability of the ordering of persons and items along the continuum for similar samples. Additionally, separation statistics indicated the measure sufficiently distinguished people and items (3.08 and 3.94, respectively) indicating that the measures distinguished among people and among different levels of engagement along the TE continuum. Figure 2 provides an illustration of the distribution of items and persons along the continuum for the TEQ. The distribution table presented in figure 2 contains the TEQ items along the right side and participant responses (represented by periods and hashtags) on the left side, with the middle line representing person/item means. In this table many of the participant scores sit above the item mean (some far above the item mean), meaning that many of the participants endorsed the most difficult items, indicating high levels of transformative experience.

Figure 2

Item and Person Distribution Map for Survey



Note. "." = 1 to 2 students. "#" = 3 students. M = person or item mean, the item mean is set at 0 logits.

Motivational Climate

Perceived classroom motivational climate was measured using items adapted from Appleton and colleagues (2016) Empowering Disempowering Motivational Climate Questionnaire--Coach (EDMCQ-C). Although the EDMCQ-C was originally developed to be used in sport and/or physical education settings, its constructs align well with the goals of this study, and the items were used as the basis for the final items used in this study. The original EDMCQ-C draws on concepts from achievement goal theory and self-determination theory to create four subscales: Task-Involving, Ego-Involving, Autonomy-Supportive, and Socially-Supportive. In the current study, only the task-involving, ego-involving, and autonomy-supportive subscales were retained as many of the socially-supportive items were redundant. The final questionnaire consisted of eight 6-point Likert-scale items (α = .92). Sample items include "Compared to other large introductory courses, how often are you encouraged to share ideas and work with other classmates?" or "Compared to other large introductory courses, how often are you given opportunities to study materials you found interesting?"

In addition to the original climate constructs identified by Appleton and colleagues (2016), the current study incorporated meaningful/authentic learning experiences as an additional climate construct. Seeing as one of the main purposes of PjBL is to provide authentic learning experiences, it was deemed appropriate to include a brief measure of this along with the other climate measures. Meaningful/authentic learning experiences was measured using four 6-point Likert-scale items (α = .87) that were created by the author of this paper and his advisors. Sample items include "How applicable to your everyday life are the things you are asked to do in this course?" and "How authentic (similar to the activities of professionals) are the things you are asked to do in this course?" Exploratory factor analysis revealed two distinct factors, with the

items adapted from the original measure forming one factor and the meaningful/authentic learning experiences forming another factor, which is in line with researcher expectations. The complete motivational climate questionnaire used in this study is provided in Appendix J.

Goal Orientation

Goal orientation was measured using 18 5-point Likert-scale items adapted from the Patterns of Adaptive Learning Survey (PALS) (Midgley et al., 2000) (current study $\alpha = .85$). Six items aimed to measure mastery approach goal orientation, six items aimed to measure performance approach goal orientation, and six items aimed to measure performance avoid goal orientation. Goal orientation was measured at Time Points 1 and 2 and was also used as a covariate when examining TE and motivational climate. Sample items include "I want to learn things so that I can come near the top of the class" and "I want to do well at school to show that I can learn difficult course work." Exploratory factor analysis revealed three distinct factors that correspond with the three subscales included in the survey (mastery approach orientation, performance approach orientation, and performance avoid orientation). The complete goal orientation scale used in this study is provided in Appendix K.

Psychology Interest

Psychology interest was measured using six 5-point Likert-scale items adapted from a measure of situational interest (Linnenbrink-Garcia et al., 2010) ($\alpha = .92$). The six items used to measure interest were administered only at Time Point 1 (pre) in the current study to measure psychology interest and were used as a covariate when examining TE at the end of the semester. Sample items include "I think the field of psychology is very interesting" and "I find psychology to be personally meaningful." The complete psychology interest scale used in this study is provided in Appendix L.

Self-Efficacy

Self-efficacy was measured using eight 7-point Likert-scale items adapted from the *self-efficacy for learning and performance* section of the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich, 1991) (α = .92). The eight items used to measure self-efficacy were only used at Time Point 1 (pre) in the current study and were used as a covariate when examining meaningful learning at the end of the semester. Sample items include "I'm confident I can do an excellent job on the assignments and tests in this course" and "I'm certain I can master the skills being taught in this class." The complete self-efficacy scale used in this study is provided in Appendix M.

Data Analysis Procedures

Preliminary Analysis

Prior to any data analysis or comparison, data were inspected for missing cases, univariate and multivariate outliers, skewness, and kurtosis. Cases were subject to removal if more than 10% of total survey data were missing or more than three data points per subscale were missing. There was attrition between Time Points 1 and 2, primarily as a result of low student attendance in some courses near the conclusion of the semester. Roughly 350 students completed surveys at Time Point 1, and only 243 completed them at Time Point 2. To check for univariate outliers, skewness, and kurtosis, z-scores were created for each case and if z-score exceeded 3.3, those cases were considered for removal. When looking for multivariate outliers, Mahalanobis distance was calculated and cases were examined using a p-value; if the p-value exceeded .05, cases were considered for removal. No cases were subject to removal based on z-scores or Mahalanobis distance statistics. Additionally, normality was assessed using the Wilk-Shapiro test and skewness and kurtosis scores. While there were higher skewness and kurtosis

scores for psychology efficacy and mastery goal orientation (efficacy presented statistics of -.850 and 1.263 and mastery orientation -1.343 and 3.608), Wilk-Shapiro tests showed the data were normal and further analyses could be conducted.

Following data cleaning and normality tests, construct means were created using SPSS 27 so means could be appropriately examined and compared. Except for the TEQ (for which Rasch analysis was used and Rasch scores were used for analysis), means were created as new variables based on the number of items in the construct being measured. Once means were created for each construct, the means were used for all analyses moving forward. Following the development of means, descriptive statistics were examined and exploratory factor analysis was conducted where necessary. Exploratory factor analysis results are discussed above in the description of the measures; descriptive statistics and other scores will be further discussed in the results section.

Data Analysis

To measure meaningful learning (Research Question 1) and examine differences between conditions, multiple raters were used to score students' concept maps using the scoring technique proposed by Besterfield-Sacre and colleagues (2004). Three total raters were used to increase interrater reliability and to avoid any potential bias that may be exhibited by the primary researcher as they taught one of the sections involved in the study. Interrater reliability was calculated using Cronbach's Alpha coefficient (Markow & Lonning, 1998) through SPSS Statistics 27, an acceptable interrater reliability level is a coefficient above .70; for the current study, interrater reliability was .86 (Vermeylen, 1998). All raters were provided with targeted concept map training and a rubric designed to guide the rating of concept maps specifically for introductory psychology. After concept maps were scored individually, mean scores were

created for the two groups (project-based and traditional designs), then mean scores were compared using analysis of variance (ANOVA) to determine overall score differences.

For Research Question 2, MANCOVA was used to examine group differences as a whole in regard to the motivation and engagement variables: TE, motivational climate, and mastery goal orientation. These variables are not only related but predicted to be positively influenced by the PjBL intervention. Hence, investigating the potential impact of a PjBL design on these as a whole is valuable to understanding the effects of the intervention. In addition, a MANCOVA accounts for the possible increase in Type I error that results from conducting multiple independent ANCOVAs. The performance goal orientation variables were not included in the MANCOVA because these variables are conceptualized as being different from the other motivation and engagement outcomes and as having a different relationship with PjBL. Significant MANCOVA results would justify conducting follow-up independent ANCOVAs to address Research Questions 3-5.

For Research Question 3, analysis of covariance (ANCOVA) was used following the conducting of MANCOVA prior. Research Questions 2 focused on examining group differences in goal orientation by condition (project-based and traditional). Differences between conditions in goal orientation at post-test were examined using ANCOVA to increase the robustness of results. Seeing as goal orientation (mastery approach, performance approach, and performance avoid) were measured pre and post, results from the pre-measure were employed as covariates for the post measures. For example, a participant's mastery approach orientation scores at Time Point 1 were used as a covariate when examining differences in mastery approach orientation at Time Point 2.

For Research Questions 3 and 4 MANCOVA, ANCOVA, and multiple linear regression were used. MANCOVA was used initially to examine overall group differences with all variables included, then follow up ANCOVAs were conducted based on MANCOVA results. Perceived TE at post-test was compared by condition using year in school and baseline psychology interest scores as covariates. Additionally, I examined whether TE was dependent on goal orientation and psychology interest. The potential aptitude treatment interaction was examined using multiple linear regression. Similarly, differences in perceived motivational climate between conditions (Research Question 4) was studied through MANCOVA, ANCOVA, and multiple linear regression using the same covariates and dependent variables as Research Question 3.

In summary, the primary analyses employed in this study were ANOVA, MANCOVA, ANCOVA, and multiple linear regression. Where possible, covariates were used to account for factors potentially impacting change (i.e., school experience or interest in psychology), and to examine potential aptitude treatment interactions multiple regression was used. The following section will provide a breakdown of the results by research question. Each research question will be briefly summarized and then the analyses and subsequent results will be presented.

CHAPTER IV

RESULTS

Descriptive Statistics

The study aimed to examine the effects of PjBL on perceived meaningful learning, goal orientation, student engagement, and classroom motivational climate using a quasi-experimental design. Descriptive statistics and correlations are provided in Table 2. Correlations between the predictor and outcome variables varied. Meaningful learning, mastery goal orientation, and TE all showed moderate, significant correlations with psychology interest. Other small but significant correlations included meaningful learning with psychology efficacy and TE with mastery goal orientation (pre). The majority of the other correlations were small and not significant. Generally, mean scores for motivational climate were high (above 4.1 on a scale of 1-6) for both groups, with scores being slightly higher in the PjBL group. Figure 2 illustrates the distribution of transformative experience scores, and the mean is located above the items indicating that, on average, students reported very high levels of TE. Table 3 presents the mean scores by condition and, as with motivational climate, TE scores were slightly higher in the PjBL group. Mastery goal orientation scores were also high for both groups (mastery scores were above 4.1 on a 5-point scale) and performance avoid scores were low (below 3.15 on a 5-point scale). There were slight increases in both mastery and performance approach orientation across all conditions over the course of the semester as well as a general decrease in performance avoid orientation. All goal orientation subscale means favored the PjBL group, with the PjBL group

seeing a greater increase in performance approach orientation as well. Seeing as there were data collected at Time Point 1 to be used as covariates, analysis of variance was conducted to ensure there were no significant group differences at Time Point 1, no significant differences were found between conditions at Time Point 1.

Table 2

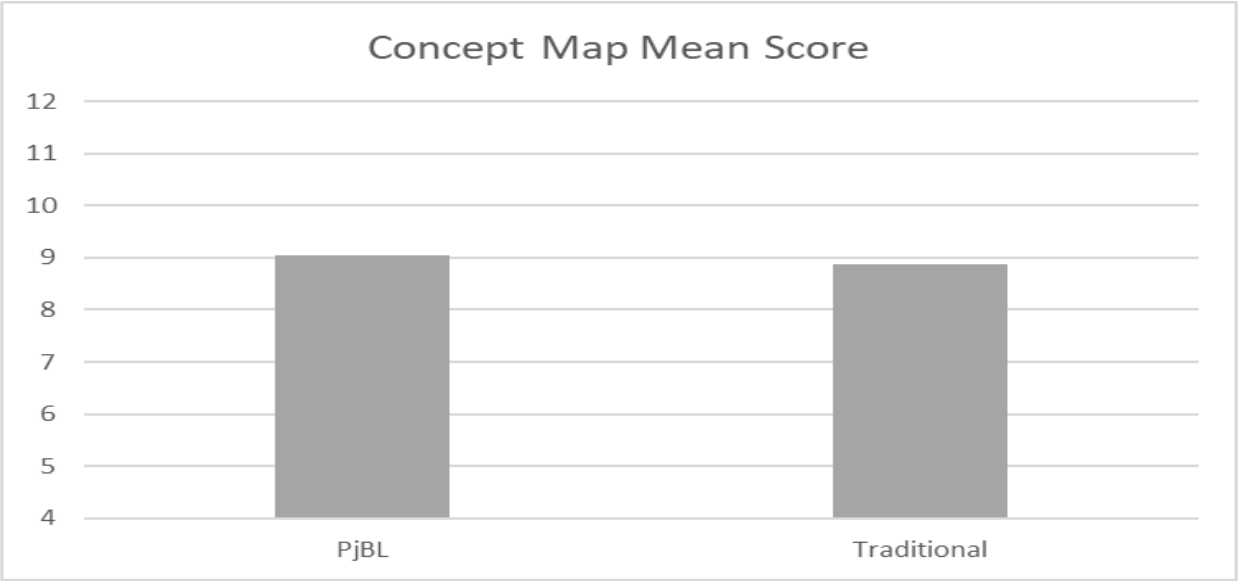
Descriptive Statistics and Correlations

Variable	*N*	*M*	*SD*	Correlations										
				1	2	3	4	5	6	7	8	9	10	11
Predictors														
1. Psychology Interest (pre)	341	4.19[1]	.65	--										
2. Psychology Efficacy (pre)	341	5.58[2]	.89	.22**	--									
3. Mastery Goal Orientation (pre)	341	4.17[1]	.57	.25**	.48**	--								
4. Performance Approach Orientation (pre)	341	3.00[1]	.76	-.01	.19**	.31**	--							
5. Performance Avoid Orientation (pre)	341	3.16	.87	.06	-.12*	.05	.57**	--						
Outcome Variable														
6. Meaningful Learning (post)	176	8.12[3]	1.39	.14**	.12*	.06	.02	-.04	--					
7. Mastery Goal Orientation (post)	182	4.17	.52	.24**	.08	.15	.08	-.06	.02	--				
8. Performance Approach Orientation (post)	182	3.21	.87	-.14	-.01	-.05	.17*	.02	-.02	.35**	--			
9. Performance Avoid Orientation (post)	182	3.17	.96	-.12	-.11	-.14	.09	.22**	.00	.18*	.67**	--		
10. Transformative Experience (post)	182	3.25[4]	2.61	.36**	.04	.16*	-.07	-.11	.08	.62**	.12	.01	--	
11. Classroom Motivational Climate (post)	182	4.29	.84	.06	.08	.12	-.01	-.11	.05	.45**	.24**	.10	.45**	--

Note: [1]Responses were on a 5-point Likert scale (1 = Strongly Disagree; 5 = Strongly Agree). [2]Responses were on a 7-point Likert Scale (1 = Strongly Disagree; 7 = Strongly Agree). [3]Measured using concept maps, scores ranged from 4 to 12. Measured in logits; $\leq$-2=Not at all transformative, $\geq$2=Highly transformative. [4]Measured in logits; $\leq$-2=Not at all transformative, $\geq$2=Highly transformative.
*p < .05. **p < .01.

Figure 3

Concept Map Mean Scores by Condition



Note: The lowest possible score for a concept map was 4, the maximum was 12.

Research Question 1

Q1 Compared to students in a traditional lecture-based course, do students experiencing an active, project-based course display more meaningful learning as assessed using a concept map?

Following completion of the concept maps, they were organized by instructor and distributed equally amongst three raters. There were 202 total concept maps completed (139 from the traditional group and 63 from the PjBL group); therefore, each rater was given about 67 (+/- 2) maps. Over the course of two weeks maps were rated and then returned to the researcher for score analysis. To ensure interrater reliability was acceptable, mean ratings were calculated and then analyzed using an SPSS reliability procedure to assess the internal consistency. The interrater reliability coefficient was .86, which is acceptable. Concept map scores were entered into SPSS by the instructor, and then mean scores were analyzed by group. One way analysis of variance (ANOVA) was performed to compare the PjBL design to the traditional design on

meaningful learning; ANOVA results revealed that there was no significant difference between groups regarding meaningful learning $F(1, 200) = .300$, $p = .584$, $\eta_p^2 = .001$). Figure 3 presents a histogram that illustrates mean differences.

Research Question 2

Q2 Is there a difference between a traditional lecture-based course design and a project-based design in terms of mastery goal orientation, transformative experience, and perceived motivational climate as a whole?

Research Question 2 worked to examine group differences as a whole regarding motivation and engagement variables: TE, motivational climate, and mastery goal orientation. These differences were examined using multiple analysis of covariance (MANCOVA). Using Wilks' Lambda, significant group differences were found: $\lambda = .92$, $F(3,178) = 5.16$, $p = .002$, $\eta_p^2 = .081$. These results indicate a significant difference between groups on motivation and engagement related variables when controlling for year in school and psychology interest. A partial eta squared (η_p^2) statistic represents the proportion of variance explained by an effect and that effect plus its associated error variance. Cohen (1988) suggested .01 = small, .06 = medium, and .14 = large. The present statistic of .081 indicates medium effect size. Based on these significant results, the following analyses were conducted.

Research Question 3

Q3 Compared to a traditional course design, does a project-based learning course design have a greater impact on student goal orientation when controlling for initial levels of goal orientation?

Q3a Compared to students in a traditional lecture-based course, are students experiencing an active, project-based design more likely to report a mastery-approach goal orientation at the end of the semester when controlling for initial levels of mastery-approach goal orientation?

Q3b Compared to students in a traditional lecture-based course, are students experiencing an active, project-based design less likely to report a

performance-approach goal orientation at the end of the semester when controlling for initial levels of performance-approach goal orientation?

Q3c Compared to students in a traditional lecture-based course, are students experiencing an active, project-based design less likely to report a performance-avoid goal orientation at the end of the semester when controlling for initial levels of performance-avoid goal orientation?

Research Question 3 focused on investigating the impact of a PjBL course design on student goal orientation while controlling for initial levels of goal orientation. Goal orientation was examined in three ways: mastery approach, performance approach, and performance avoid. Research Question 3a targeted changes in mastery approach orientation over the semester. To measure these changes, analysis of covariance (ANCOVA) was used. Levene's test of equality of variance (Levene, 1960) was employed to ensure homogeneity of variances; Levene's test was not significant ($p = .224$) for mastery approach. When controlling for initial levels of mastery approach goal orientation, there was no significant main effect between groups on the post-measure of mastery approach orientation, $F(1,179) = 1.950$, $p = .164$, $\eta_p^2 = .011$. Estimated marginal means are presented in Table 3.

Table 3

Descriptive Statistics

Variable	PjBL *n*	PjBL *M(SD)*	Lecture *n*	Lecture *M(SD)*
Motivational climate[a]	53	4.66(.68)**	130	4.17(.84)**
Transformative experience[b]	53	3.34(2.59)	130	3.19(2.70)
Meaningful learning[c]	63	9.04(1.95)	139	8.87(2.14)
Mastery goal orientation				
Time 1	74	4.16(.56)	267	4.17(.57)
Time 2	53	4.28(.54)	130	4.16(.49)
Performance-approach goal orientation				
Time 1	74	3.00(.83)	267	3.00(.75)
Time 2	53	3.31(.94)	130	3.09(.84)
Performance-avoid goal orientation				
Time 1	74	3.03(.83)	267	3.19(.88)
Time 2	53	3.13(.99)	130	3.11(.95)

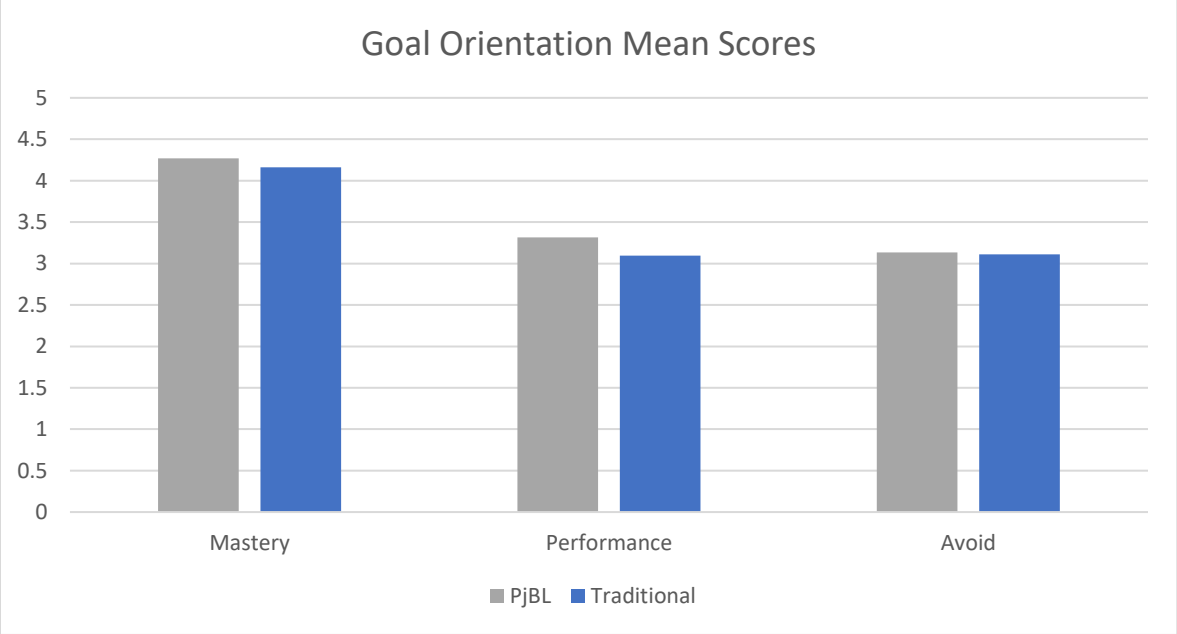
Note: [a]Responses were on a 6-point Likert scale (1 = Much Less, 6 = WAY More). [b]Responses were on a 4-point Likert scale (1 = Strongly Disagree, 4 = Strongly Agree). [c] Measured using concept maps with scores ranging from 4 – 12. ** p <.001.

Research Question 3b aimed to examine the impact of a PjBL course design on performance-approach goal orientation while controlling for initial levels of performance-approach goal orientation; ANCOVA was again performed to examine the differences between groups. Levene's test of equality of error variances was once again not significant (p = .413); therefore, analysis proceeded in a normal fashion. When controlling for initial levels of performance approach orientation, there was no significant main effect between groups on the post-measure of performance approach goal orientation, $F(1, 179) = 2.527$, p = .114, η_p^2 = .014. Estimated marginal means are presented in Table 3.

Research Question 3c aimed to examine the impact of a PjBL course design on performance-avoid goal orientation while controlling for initial levels of performance-avoid goal orientation; ANCOVA was again performed to examine group differences. Similar to mastery and performance approach, Levene's test was not significant (p = .391) and analysis was conducted normally. When controlling for initial levels of performance-avoid goal orientation, there was no significant main effect between groups on the post-measure of performance-avoid orientation, $F(1, 179) = .168$, $p = .683$, $\eta_p^2 = .001$. Estimated marginal means are presented in Table 3, goal orientation mean scores by condition are presented in Figure 4.

Figure 4

Goal Orientation Mean Scores by Condition



Research Question 4

Q4 Compared to students in a traditional lecture-based course, do students experiencing an active, project-based course report higher levels of transformative experience for course material?

Q4a Compared to students in a traditional lecture-based course, do students experiencing an active, project-based design perceive the course as being more transformative when controlling for year in school and initial levels of psychology interest?

Q4b Is there an aptitude treatment interaction in that transformative experience is dependent on goal orientation and psychology interest?

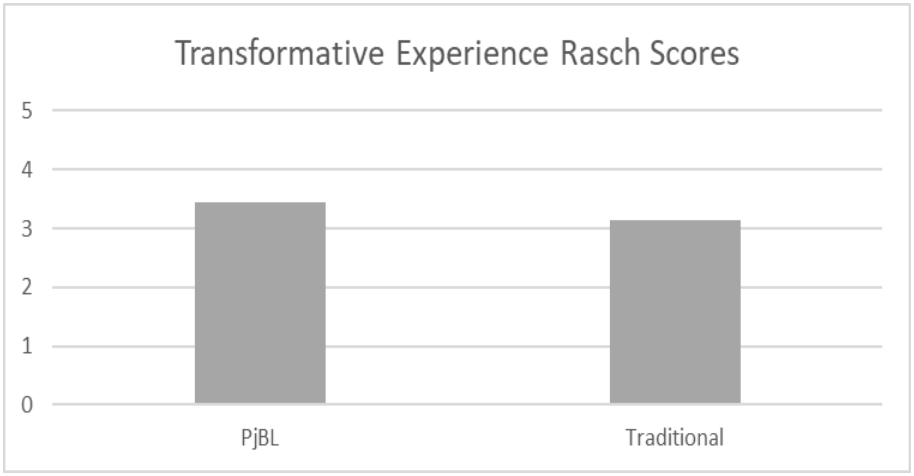
The fourth research question examined potential differences in perceived TE. As mentioned above, MANCOVA was conducted initially to examine overall group differences in motivation related variables, then follow-up analyses were conducted. Perceived TE was examined in two different forms--the first being the effect of a project-based design on perceived TE while controlling for year in school and initial levels of psychology interest, and the second being from an aptitude-treatment perspective in which I examined whether goal orientation and interest in psychology interacted with treatment condition to influence perceived TE. Research Question 4a focused on examining TE while controlling for year in school and psychology interest. Prior to performing ANCOVA, Levene's test was conducted to examine homogeneity of variances. Levene's test was not significant (p = .573). Therefore, analysis could continue normally; ANCOVA did not yield any significant main effect between groups in TE, $F(1,178)$ = .524, p = .470, η_p^2 = .003. Estimated marginal means are presented in Table 3.

Research Question 3b examined TE from an aptitude treatment interaction perspective, specifically whether perceived TE was dependent on goal orientation and psychology interest. Aptitude treatment interactions were examined using multiple regression models in which the outcome variable was the TE Rasch mean scores. This research question required multiple

interactions, one for each measure of goal orientation. Instead of employing hierarchical regression, multiple linear regression was used three separate times so the effect of each interaction could be examined independently. For the group by mastery approach orientation interactions, the factors present accounted for 2.6% of the variance (R^2 = .026, F(3,178) = 1.583, p = .195). The interaction was not significant in predicting TE scores (β = .074, p = .924). For the group by performance approach orientation interaction, the factors accounted for 2% of the variance (R^2 = .020, F(3,178) = 1.219, p = .304). The interaction was not significant in predicting TE scores (β = .938, p = .104). For the group by performance avoid orientation interaction, the factors present accounted for 2.1% of the variance (R^2 = .021, F(3,178) = 1.286, p = .281). The interaction was not significant in predicting TE scores (β = .826, p = .065). The final interaction between group and psychology interest showed the factors present accounted for 13.1% of the variance, and the regression indicated that the overall model was a significant predictor of TE scores (R^2 = .131, F(3,178) = 8.963, p = .001). However, the group by psychology interest interaction was not significant in predicting TE scores (β = .269, p = .657). Transformative experience Rasch logit scores by condition are presented in Figure 5.

Figure 5

Transformative Experience Rasch Scores by Condition



Research Question 5

Q5 Compared to students in a traditional lecture-based course, do students experiencing an active, project-based course report a more empowering motivational climate?

Q5a Compared to students in a traditional lecture-based course, do students experiencing an active, project-based course report a more empowering motivational climate when controlling for year in school and initial levels of psychology interest?

Q5b Is there an aptitude treatment interaction in that perception of an empowering motivational climate is dependent on goal orientation and psychology interest?

The final research question sought to investigate the possible connection between a project-based course design and a more empowering motivational climate. Motivational climate was examined as a wholistic concept consisting of three sub-components (task-involving, autonomy support, and meaningful/authentic experiences). As mentioned above, MANCOVA was conducted initially to examine overall group differences in motivation related variables, then follow-up analyses were conducted. Similar to TE, motivational climate was examined from two perspectives. First examined was the effect of a project-based course design on perceived classroom motivational climate while controlling for year in school and initial levels of psychology interest. The second was from an aptitude treatment perspective, examining whether the perception of an empowering motivational climate is dependent on goal orientation and psychology interest. Research Question 5a focused on perceptions of motivational climate when controlling for year in school and psychology interest; this was measured using ANCOVA. Levene's test was performed prior to ANCOVA to examine homogeneity of variances. Levene's test was not significant ($p = .072$), indicating that traditional ANCOVA could be performed. When controlling for year in school and psychology interest, there was a significant main effect

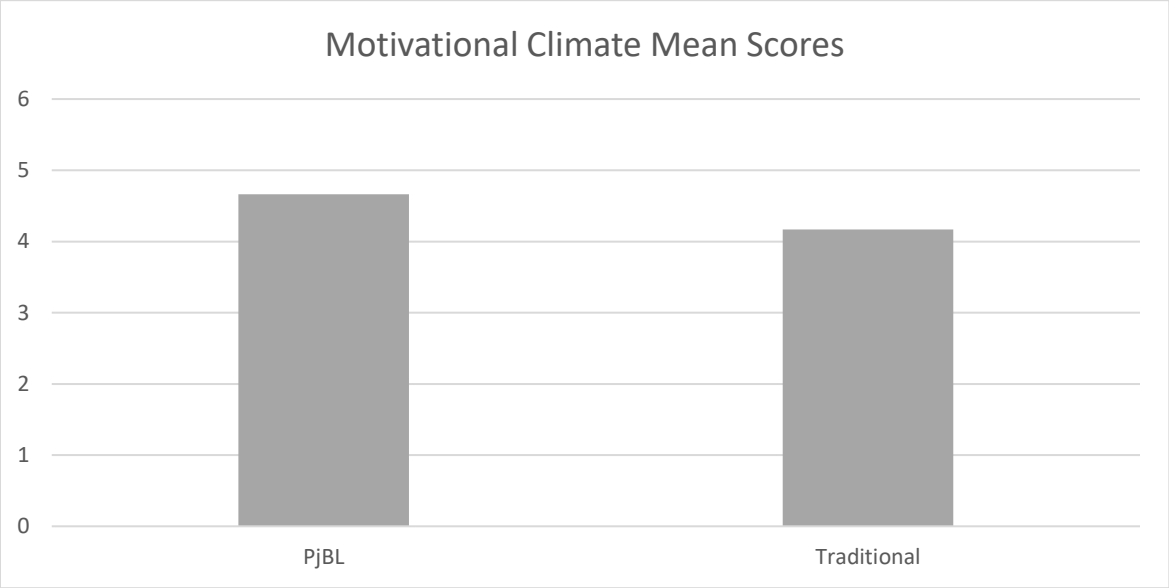
favoring the project-based condition, $F(1,179) = 14.936$, $p = <.001$, $\eta_p^2 = .077$. Estimated marginal means are presented in Table 3.

Research Question 5b examined perceptions of motivational climate from an aptitude treatment perspective, investigating whether the perception of an empowering motivational climate was dependent on goal orientation and psychology interest. This research question required multiple interactions, one for each measure of goal orientation. For the group by mastery approach orientation interactions, the factors present accounted for 9.3% of the variance, and the regression indicated that the overall model was a significant predictor of perceived motivational climate ($R^2 = .093$, $F(3,179) = 3.864$, $p = <.001$). However, the group by mastery approach orientation interaction itself was not significant in predicting perceptions of motivational climate ($\beta = -.151$, $p = .510$). For the group by performance approach orientation interaction, the factors accounted for 8.8% of the variance, and the regression indicated that the overall model was a significant predictor of perceived motivational climate ($R^2 = .088$, $F(3,179) = 5.728$, $p = .<.001$). However, the group by performance approach interaction orientation itself was not significant in predicting perceptions of motivational climate ($\beta = .279$, $p = .104$). In the group by performance avoid orientation interaction, the factors present accounted for 8.9% of the variance, and the regression indicated that the overall model was a significant predictor of perceived motivational climate ($R^2 = .089$, $F(3,178) = 5.764$, $p = <.001$). However, the group by performance avoid orientation interaction itself was not significant in predicting perceptions of motivational climate ($\beta = .063$, $p = .635$). The final interaction between group and psychology interest showed the factors present accounted for 8.7% of the variance, and the regression indicated that the overall model was a significant predictor of perceived motivational climate ($R^2 = .087$, $F(3,179) = 5.689$, $p = <.001$). The group by psychology interest interaction itself was not

significant in predicting perceptions of motivational climate (β = .222, p = .248). Motivational climate mean scores by condition are presented in Figure 6.

Figure 6

Perceived Motivational Climate Mean Scores by Condition



Summary

The current study examined the effect of PjBL on variables related to meaningful learning, engagement, and motivation. When examined as a whole, significant differences were found between groups regarding the motivation related variables (mastery goal orientation, TE, and classroom motivational climate), indicating that a PjBL design has value in promoting positive motivation related outcomes. Further analyses indicated additional significant group differences regarding perceived classroom motivational climate, but no significance regarding meaningful learning, student goal orientation, or TE.

CHAPTER V

DISCUSSION AND CONCLUSIONS

While research on alternative course designs such as PjBL have become more prevalent in recent years, legitimate studies investigating the impacts of these course designs on outcomes such as learning, engagement, and motivational climate remain minimal. Large introductory classes such as introductory psychology have been a staple in higher education for nearly the last century and are poised to remain in the same position for years to come. These courses serve a large, diverse group of students each academic year and have been shown to have benefits beyond simply introducing a large group of students to a particular field such as the development of study skills, communication skills, and enhanced approaches to course work later in college (Hard et al., 2018). Employing alternative course designs such as PjBL has the potential to enhance the benefits that already exist in these large introductory courses as well as introducing new ones. The primary purpose of this study was to add to the body of research regarding the improvement of introductory psychology through the use of PjBL as well as examining the potential relationships between PjBL and certain adaptive motivational outcomes.

Meaningful Learning

No significant differences were found between conditions in terms of meaningful learning. While there is limited research comparing meaningful learning outcomes, this finding is in contrast with the literature that does examine this (Muehlenkamp et al., 2015). The aforementioned study involved a comparison of two sections (one traditional lecture section with

exams and one active, problem/project-based section) of introductory psychology at a small liberal arts college in which class enrollments were less than 35 students, and meaningful learning was assessed using unit quizzes and essay questions (on which the problem/project-based section generally performed better). Although the current study and the one done by Meuhlenkamp and colleagues may not be entirely comparable, research involving designs employing constructivist principles is common and has demonstrated increased meaningful learning (i.e., Marx et al., 2004). While the results of this study were not statistically significant, the project-based condition did show a higher mean concept map score when compared to the traditional instruction condition. It was hypothesized that incorporating a design that was more deeply rooted in constructivism would lead students to have more meaningful and effective interactions with course material which would, in turn, lead to greater meaningful learning. Seeing as there is limited literature examining the potential relationship between PjBL and meaningful learning, further research is necessary to determine if PjBL has a significant effect on meaningful learning.

Motivation Related Variables

There were significant differences found between groups regarding motivation related variables (TE, mastery-approach goal orientation, and classroom motivational climate). When these variables were examined together by group, the PjBL group was favored over the traditional group statistically. These differences are in line with current research regarding adaptive motivational outcomes and PjBL and other autonomy-supportive environments (Appleton et al., 2016; Dweck & Leggett, 1988; Stolk & Harari, 2014). Seeing as the PjBL classroom is designed to support student autonomy, content mastery, and application of course materials, increased adaptive motivation patterns are expected. These findings showing that

PjBL supports the development of valuable motivational outcomes indicate there is value in using this type of design in large introductory classes and that the style of instruction and assessment promote important motivational patterns. Furthermore, these variables should be of interest for research conducting similar studies in the future as they might well as primary outcome variables.

Goal Orientation

The findings from this study revealed no significant differences between conditions in student goal orientation when controlling for goal orientation as measure at Time Point 1. Similar to meaningful learning, there is limited research examining the relationship between PjBL in introductory psychology and goal orientation; therefore, it is difficult to pinpoint direct comparisons in existing literature. However, motivational research (Dweck & Leggett, 1988) has shown that learning oriented tasks (tasks designed to show students they are learning new information and they might make mistakes during the process) are more effective in promoting a mastery orientation than performance-oriented tasks (tasks designed to demonstrate competence), showing the impact that a student's learning environment (instruction, student-teacher interactions, and assessments) can have. Additionally, studies using PjBL in introductory courses (not introductory psychology) have been shown to promote the development of a mastery orientation (Corkin et al., 2017; Kalyuga, 2009; Stolk & Harari, 2014). Using projects as the primary form of assessment affords students greater opportunities to employ feedback and learn from mistakes than traditional assessments will, which in turn should be more likely to promote the development of a mastery goal orientation. However, the results of the current study are in contrast to this existing literature. The lack of significant differences in goal orientation at

the conclusion of the semester might be due to a ceiling effect, as reported mastery goal orientation levels were surprisingly high across all conditions at both time points.

The effects of a PjBL design on performance approach and performance avoid orientation were also examined in the study. As mentioned above, much of the motivational research regarding goal orientation links task-orientated tasks to the development of a mastery-approach orientation and are typically not conducive to increased performance-approach or performance-avoid orientation (Dweck & Leggett, 1988). The results of the current study were in line with the literature regarding performance-avoid orientation in which the PjBL condition reported lower performance-avoid orientation scores. However, the results regarding performance-approach orientation were contradictory to existing motivational literature. The PjBL section reported higher (but not significantly different) performance-approach goal orientation scores than the traditional lecture condition. An environment designed to be more task-oriented and provides opportunity for feedback and correction should yield lower performance-avoid orientation scores as mastery orientation would be expected to increase. Seeing as a performance-approach orientation is characterized by a desire to demonstrate ability relative to others or to demonstrate self-worth publicly (Wolters, 2004), it is possible that the project-based interactions among students and between students and instructors led to an increased desire to prove their competence to each other or to the instructor.

Transformative Experience

Despite the finding of a significant difference between the PjBL and traditional instruction conditions on the motivation and engagement variables as a whole, a follow-up ANCOVA revealed no significant differences between traditional course designs and a project-based design in perceived TE. Although much of the research on TE has been conducted in K-12

science settings (i.e., Koskey et al., 2018; Pugh, 2004, 2011), the findings of this study are contrary to much of the existing TE research. The goals of PjBL involve working collaboratively with other students and exploring driving questions, which were hypothesized to increase the likelihood students would seek out and use new, relevant information in their daily lives (Filippatou & Kaldi, 2010). The TE Rasch logit scores were marginally higher in the project-based condition, but generally TE scores were very high across all conditions. Consistently high TE scores in both conditions indicate a possible ceiling effect, potentially as a result of the TE items being too easy to endorse for university students or for a social sciences course. Seeing as TE is often examined in science courses, it is possible that the social nature of psychology and the material presented in the course are more naturally transformative than expected. Much of the material discussed in introductory psychology is framed within relevant real-world examples. Even when topics such as research methods and the scientific method are discussed, class examples often revolve around experiments and thinking processes related to students' lives. Transformative experience is a holistic concept comprised of three factors (motivated use, expansion of perception, and experiential value) (Pugh, 2011), and the concepts discussed in introductory psychology are often examined in ways that allow students to see the material or their life in a new way, consider methods of using the material in their lives, and understand the value of the information they recently learned. Typically, TE needs to be carefully scaffolded and modeled by the instructor for students to understand how to engage with material out of class (Pugh, 2020), but it is possible that many of the examples presented in introductory psychology naturally incorporate this process.

Classroom Motivational Climate

The current study revealed a significant difference between conditions regarding perceived classroom motivational climate when controlling for year in school and psychology interest. Classroom motivational climate was examined as one wholistic concept comprised of three factors (autonomy support, task-involving, and meaningful/authentic activities), with a high motivational climate score indicating an empowering motivational climate. At the conclusion of the semester, students in the PjBL section reported significantly more empowering motivational climate than students in the traditional PSY 120 condition. This finding algins well with existing research on motivational climate (Appleton et al., 2016), which posits that increased autonomy support and task-involving activities lead to a more empowering motivational climate. Seeing as students in the PjBL section were provided more options for assessments (different projects), more opportunities to receive feedback and incorporate feedback into projects, and engage in activities that might be more meaningful, this result is expected. Additionally, when working on projects, students are provided increased opportunities to work collaboratively with other students in the class and the instructor. These repeated interactions may serve to support some of the basic needs of self-determination theory (Deci & Ryan, 2000) such as competence and relatedness. Self-determination theory significantly influenced much of the motivational climate research used in this study (i.e., Appleton et al., 2016); therefore, the promotion of these needs are likely to have strongly influenced the perceptions of classroom climate. This result speaks to the potential of PjBL to enhance perceived motivational climate in classrooms of all kinds, which in turn may improve additional adaptive motivational outcomes.

Limitations

The primary limitation of the study is related to experimental design. First, there was a lack of balance in the number of classes per condition with the control condition containing four classes and the PjBL condition containing only one section. This lack of symmetry may have contributed to abnormalities in results and provides a less clear picture of the effect of PjBL compared to traditional course formats. Along with this, instructor differences were not accounted for when conducting analyses. Differences in instructor lecture style, assessment format, methods of interaction with students, and years of experience all potentially impact perceived classroom motivational climate, learning, and even goal orientation. Future research may want to address this limitation by having one instructor implement a PjBL intervention across multiple sections or have instructors of other sections use a project-based design for one unit and compare results following that unit.

Another limitation of this study comes in the form of researcher error. Data collection was conducted at two time points during the semester to provide opportunities for pre-post comparisons as well as the use of baseline data as covariates. Analyses of these types requires the use of a participant identifier so data collected and both time points can be paired by participant and accurate changes over time can be tracked. In this case, I failed to collect a participant identifier such as the last four digits of student ID number or university-issued email address, resulting in difficulties matching data by participants. While no formal identifier was collected, I was able to match data using demographic data that were collected at both time points that included instructor, year in school, major, ethnicity, gender, and participant IP address. While this two-tiered system of matching by hand served as an adequate solution, it is possible that not all matches are correct. Because of this, the results of this study may not be

generalizable across other populations and may present some abnormalities. The use of a formal participant identifier would undoubtedly lead to cleaner data and more accurate, generalizable results.

Attrition was also a limitation of this study. It was decided that data would be collected only twice during this study in hopes attrition would be reduced, but even with only two time points, only about 60% of students completed both surveys (348 at Time Point 1 and 248 at Time Point 2). One of the main factors leading to this significant attrition was a lack of consistency in attendance policies across classes in which data collection was conducted. The university does not require consistent attendance policies in large introductory classes; therefore, policies are developed at instructor discretion. In two of the five sections, attendance was only required for students with poor grades during the last two weeks of the semester, and in those classes there was between 18-40% participation, which alone accounted for the loss of almost 75 participants.

Implications

While many of the results from this study were not in line with prior research, there were some significant results that speak to the potentially beneficial nature of PjBL introductory psychology. As mentioned previously, there is limited research examining the use of alternative instructional methods like PjBL in large introductory classes, particularly in the social sciences. The reasons for this are not entirely clear; however, it is likely due to difficulties such as large class sizes, intense quantities of material, and the necessity to alter the structure of a course that has remained consistent for many years. Even without the use of targeted alternative methods, courses such as introductory psychology can be quite impactful (Gurung & Hackathorn, 2018; Hard et al., 2018). The high levels of perceived TE, mastery goal orientation, and substantial meaningful learning in the traditional sections involved in this study speak to the power of the

course. Additionally, the reporting of a more empowering motivational climate seen in the PjBL section indicates there is room for improvement, and the implementation of alternative methods may have the potential to significantly enhance the effect introductory psychology has on students of all types. Alternative methods such as PjBL deserve more attention from instructors teaching introductory psychology, and further use of non-traditional designs and assessment formats is merited.

Directions for Future Research

The primary direction for future research would be to examine the effectiveness of PjBL compared to traditional designs when each condition is taught by the same instructor. Conducting experiments with this design would provide a more accurate understanding of how the alternative design impacts students with all instructor difference accounted for. It is possible that instructor difference play a more significant role than currently believed, and if that is that case, a better understanding of the role of instructor differences would be invaluable in determining further research. If it is not possible for one instructor to teach multiple sections with difference designs, conducting research where students are exposed to a project-based design for one half of the semester and a traditional design for the other half would be a useful alternative. Instructor difference might still impact results, but students would be able to report differences in conditions immediately after experiencing each one. Also, learning would be more easily tracked as similar assessments could be used throughout the semester in all sections.

Another interesting direction for future research in this area would be examining the effects of PjBL on long-term outcomes such as the adoption of psychology majors and minors, subsequent semester project efficacy, performance on course projects in subsequent semesters, and performance in later psychology courses. Previous studies (i.e., Hard et al., 2018) have

shown that introductory psychology in a traditional form can positively impact future study skills, communication skills, and approaches to coursework later in college. Therefore, it is reasonable to believe that the use of a project early in an academic career might lead to the development of valuable skills and enhanced performance later one. Additionally, it is possible that when students are provided opportunities to work with psychological principles in a personally meaningful way and attempt to use them in their own lives, they will be more likely to identify with the discipline and adopt a major or minor. Tracking long-term outcomes could yield valuable results for instructors and departments alike.

Investigating PjBL with a greater focus on instructor-related variables also presents an interesting opportunity for future research. Establishing a project-based design (particularly in a large introductory course) requires unique engagement from the class instructor. Compared to a traditional design, a project-based design will often demand increased interactions with students, the development of more concise and applicable course material, regular and in-depth feedback, and regular course adaptations to aid student understanding. To this moment, I am not aware of any research examining the role of instructor factors and their relationship to the effectiveness of PjBL. Useful instructor variables that might be examined are teacher passion, perceptions of students' connection to their instructor, instructor experience, quality of instructor feedback, and the ability of the instructor to incorporate feedback from students. It is possible that the factors mentioned above and others could significantly impact the effectiveness of a project-based course design.

Conclusion

In summary, a project-based course design can be beneficial in introductory psychology courses. A project-based design led to the development of a significantly more empowering

motivational climate than a traditional course design and showed promising results in other areas related to engagement and meaningful learning. While this project did not yield as many significant findings as desired, it did provide many valuable insights for researchers and instructors alike. My hope is that it serves as a building block for future research and helps others improve their introductory psychology courses by capitalizing on its affordances. This study shows that it is possible to improve this course, but significant additional research is needed that examines methods of improving introductory psychology. Introductory psychology serves millions of students from a multitude of backgrounds each year and has the potential to significantly impact each of their lives. However, the significance of this impact may remain limited if more motivated educators and researchers do not continue to test alternative methods of presenting the course.

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APPENDIX A

ADDITIONAL INFORMATION REGARDING STUDENT PROJECTS

The project process was designed to progressively provide students more autonomy in terms of the products they turned in as well as the information they could focus on in the project. Early in the semester students were provided with only one project option that was laid out clearly in the instructions. The reason for this is to familiarize the process and to avoid students focusing on irrelevant information, turning in projects that are disorganized or lacking in depth, and to prevent students from developing a distaste for the project process because it is too ambiguous. As the semester continued, students were provided more autonomy as they learned the process and general requirements. The following bullet points provide examples of the project's students turned in, so that if a similar design is implemented instructors can have an idea of what to expect from students.

Early Semester

Earlier in the semester students often opted to do PowerPoint or Prezi presentations with voice over recordings. Students were often comfortable with this method of presenting information, so it was a good place for them to start and typically resulted in coherent presentations. These presentations often consisted of 10-18 slides and students often talked for around a minute per slide. In addition to slide show presentations, students also wanted to write papers. After some creative encouragement they could typically be convinced to go beyond writing a normal discussion style paper and were willing to present their information in the form of a blog post (or series of blogs), a newspaper article, or something similar to those. These papers typically ranged

from 3-5 pages of writing. Depth of information in projects varied by student (as expected), but early in the semester they needed more clear guidelines as to how much information is expected. Many students were very concerned about providing enough information, so clarity in this front was important. Topics covered early in the semester included research methods, consciousness, brain structures, neural and hormonal systems, theories of emotions, and stress and illness. If possible, it is best to create project options that include more than one topic to increase breadth of knowledge.

Mid/Late Semester

As mentioned previously the students were granted more autonomy as the semester continued and were also expected to provide more depth and creativity if possible. While creativity was not a main driver of the current study or design, it seemed that students enjoyed the process more and often developed more sophisticated products when they were encouraged to work outside their comfort zone regarding creativity. Later semester projects often involved children's books written about psychology topics, podcast recordings, screenplays or movie scripts, board games (along with written instructions/discussion about how the game relates to psychology), works of art such as paintings or sculptures (again, with written instructions/discussion about how the work relates to psychology and so they can display their knowledge), videos designed to show human behavior (videos are very common following units on conditioning, as a great project option is to challenge student to record themselves conditioning their roommate or family member), or sample psychological experiments. Formal length requirements were sometimes tough to impose for these projects, but later in the semester more depth was required as students should be familiar with the process and have a solid knowledge base. Podcasts ranged from 6-18

minutes in length (I often ask students to provide a script or list of main topics with the times they are discussed during the podcast so I Podcasts will range from 6-18 minutes in length (I often ask students to provide a script or list of main topics with the times they are discussed during the podcast so I can navigate appropriately), screenplays or movie scripts ranged from 4-8 pages, videos ranged from 3-6 minutes, and for works of art I would often require 2 pages or more of discussion about the product and how it represented class-related knowledge. Topics covered later in the semester included human development, social psychology, psychological disorders, motivation, sport psychology, and sleep.

APPENDIX B

SAMPLE COURSE PROJECT DESCRIPTION

We have spent the last 3 weeks of the semester learning how to think like a scientist. We have explored the history of psychology and some great early thinkers in the field, how to adopt a scientific attitude, how to think critically (and avoid potential roadblocks to critical thinking), how to conduct an experiment using the scientific method, and how our consciousness/brain allow us to think like scientists. Now it's time to put it all to work and show me just how good you are at thinking like a scientist. There will be two options for this project, choose whichever one you think will best allow you to show what you've learned and why this material is important to you.

Option 1 – The Greatest Experiments of All Time, Put Yourself in Their Shoes.

History is filled with influential science experiments. Some experiments were conducted centuries ago and paved the way for other great discoveries, others were conducted just a few years go and proved science is capable of more than we ever thought. For this option you will examine one of the greatest experiments ever conducted (choose from the article provided in Canvas) and put yourself in the shoes of the scientist that conducted it. You will do your best to understand their thinking by doing the following:

1. Discuss who conducted the experiment you are examining, what year was this experiment conducted and what might the current thinking have been about the topic your person researched?
    a. How did the experimenter think critically to challenge current thinking and decide to conduct this experiment (there might not be much about this, but think like a scientist and try to understand their thinking)?
2. The components of a **scientific attitude** are **curiosity**, **skepticism**, and **humility**. How might your experimenter have displayed (or not displayed) this attitude when conducting their experiment?
3. Consider how your scientist used the **scientific method** when conducting their experiment. What do you believe their **theory, hypotheses, operational definitions,** process for **testing hypotheses,** and **conclusions** were? (Again, put yourself in their shoes and think like them when doing this).
4. The major **barriers to critical thinking** we discussed were **hindsight bias**, **overzealous pattern recognition**, and **overconfidence**. How do you believe your scientist avoided falling victim to these? Provide some examples.
5. Provide a brief (3-4 sentence) reflection of this process. Was it easy or difficult to put yourself in the shoes of a scientist and try to understand their thinking? Did you enjoy looking at someone else's experiment and breaking it down like this? Was it an enjoyable process or not?

Option 2 – Become a Scientist, Create Your Own Experiment.

A couple weeks ago we spent time in class thinking of topics we might want to research and providing a basic description of how we might conduct the study. Thinking about something in our own lives we'd like to research can be very beneficial. It might help us improve our lives drastically, help someone close to us make an important change, or inspire us to pursue a career in a specific field. For this option you will develop a topic that you would like to research (preferably something you are very interested in or could help you improve your life right now) and describe exactly how you'd conduct this study; essentially, you will become a scientist. The process is very similar to the option above, only it is for your own study and not someone else's. This option is challenging but can be very valuable! You will describe your experiment by doing the following:

1. Discuss the experiment you are going to conduct. Provide a general overview the topic/problem, why it is interesting or valuable to you, and how thinking critically has helped to develop this idea/experiment (discuss how you might be challenging current thinking or your own previous beliefs).
2. The components of a **scientific attitude** are **curiosity**, **skepticism**, and **humility**. How are you going to display these components when conducting your experiment?
    a. Discuss how curiosity led you to want to do this experiment, how you might have been skeptical of current thinking, ideas, or behavior, and how you will be humble throughout the process.
3. How will you use the **scientific method** when conducting this experiment? Describe your **theory, hypotheses, operational definitions,** process for **testing hypotheses,** and **conclusions.** (Be descriptive here! Explain it all in depth and remember the difference between a theory and hypothesis).
4. The major **barriers to critical thinking** we discussed were **hindsight bias**, **overzealous pattern recognition**, and **overconfidence**. How will you avoid falling victim to these? Provide some examples.
5. Provide a brief (3-4 sentence) reflection of this process. Was it easy or difficult to come up with an idea and conduct a "mock experiment"? What do you feel like you learned about yourself or thinking like a scientist as a result of the process? Was it an enjoyable process or not?

APPENDIX C

GENERAL PROJECT RUBRIC

Table C 1

General Project Rubric

	25	20	15	10
Expression of Conceptual Knowledge	Exceptional expression/display of conceptual knowledge in clear, understandable real-life terms. In depth display and discussion of concept.	Adequately expresses/displays conceptual knowledge in understandable, real-life terms. Displays knowledge but does not go in depth.	Minimally expresses/displays conceptual knowledge in real-life terms.	Does not or minimally expresses conceptual knowledge.
Time/Length	Meets or barely exceeds time/length requirement.	Barely below time/length requirement.	Below the time/length requirement (>1 minute, ¼ page, etc. below).	Significantly below the time/length requirement (2 minutes, ½ page, etc. below).
Understanding/ Display of effect of concept on thinking and behavior	Exceptionally displays understanding of how concept impacts thinking/behavior using in depth examples, discussion, visual aids, etc.	Adequately displays understanding of how concept impacts thinking/behavior using discussion or example.	Minimally displays understanding of how concept impacts thinking/behavior using brief discussion or limited example.	Does not/minimally displays understanding of how concept impacts thinking/behavior.
Examination/ Exploration of different viewpoints	Exceptionally examines multiple viewpoints/impact of different viewpoints on thinking/behavior/life using examples, discussion, problem solving, visual aids, etc.	Adequately examines multiple viewpoints/impact of different viewpoints on thinking/behavior/life using discussion and/or example.	Minimally examines multiple viewpoints/impact of different viewpoints on thinking/behavior/life using brief discussion.	Does not/minimally examines multiple viewpoints/impact of different viewpoints on thinking/behavior/life.

APPENDIX D

PROCEDURE TIMELINE

Table D 1

Project Procedure Timeline

Date (Timepoint in Semester)	Element of Procedure
August 23, 2021 (Week 1)	Class begins. Students told projects will be used in the course.
September 7, 2021(Week 3)	Baseline data collected (data collection 1 of 2).
November 30, 2021 (Week 15) December 2, 2021 (Week 15)	Concept maps introduced completed in class. End of semester data collected (data collection 2 of 2).

APPENDIX E

INSTITUTIONAL REVIEW BOARD APPROVAL

UNIVERSITY OF
NORTHERN COLORADO

Institutional Review Board

Date:	08/23/2021
Principal Investigator:	Kevin Pugh
Committee Action:	**IRB EXEMPT DETERMINATION – New Protocol**
Action Date:	08/23/2021
Protocol Number:	2108028521
Protocol Title:	Project-Based Learning in Introductory Psychology: Modern Adaptations to an Academic Classic.
Expiration Date:	

The University of Northern Colorado Institutional Review Board has reviewed your protocol and determined your project to be exempt under 45 CFR 46.104(d)(701) (702) for research involving

Category 1 (2018): RESEARCH CONDUCTED IN EDUCATIONAL SETTINGS. Research, conducted in established or commonly accepted educational settings, that specifically involves normal educational practices that are not likely to adversely impact students' opportunity to learn required educational content or the assessment of educators who provide instruction. This includes most research on regular and special education instructional strategies, and research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

Category 2 (2018): EDUCATIONAL TESTS, SURVEYS, INTERVIEWS, OR OBSERVATIONS OF PUBLIC BEHAVIOR. Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (including visual or auditory recording) if at least one of the following criteria is met: (i) The information obtained is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained, directly or through identifiers linked to the subjects; (ii) Any disclosure of the human subjects' responses outside the research would not reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, educational advancement, or reputation; or (iii) The information obtained is recorded by the investigator in such a manner that the identity of the human subjects can readily be ascertained, directly or through identifiers linked to the subjects, and an IRB conducts a limited IRB review to make the determination required by 45 CFR 46.111(a)(7).

UNIVERSITY OF
NORTHERN COLORADO

Institutional Review Board

You may begin conducting your research as outlined in your protocol. Your study does not require further review from the IRB, unless changes need to be made to your approved protocol.

As the Principal Investigator (PI), you are still responsible for contacting the UNC IRB office if and when:

- You wish to deviate from the described protocol and would like to formally submit a modification request. Prior IRB approval must be obtained before any changes can be implemented (except to eliminate an immediate hazard to research participants).
- You make changes to the research personnel working on this study (add or drop research staff on this protocol).
- At the end of the study or before you leave The University of Northern Colorado and are no longer a student or employee, to request your protocol be closed. *You cannot continue to reference UNC on any documents (including the informed consent form) or conduct the study under the auspices of UNC if you are no longer a student/employee of this university.
- You have received or have been made aware of any complaints, problems, or adverse events that are related or possibly related to participation in the research.

If you have any questions, please contact the Research Compliance Manager, Nicole Morse, at 970-351-1910 or via e-mail at nicole.morse@unco.edu. Additional information concerning the requirements for the protection of human subjects may be found at the Office of Human Research Protection website - http://hhs.gov/ohrp/ and https://www.unco.edu/research/research-integrity-and-compliance/institutional-review-board/.

Sincerely,

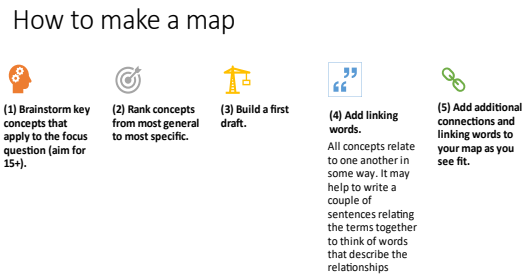
Nicole Morse
Research Compliance Manager

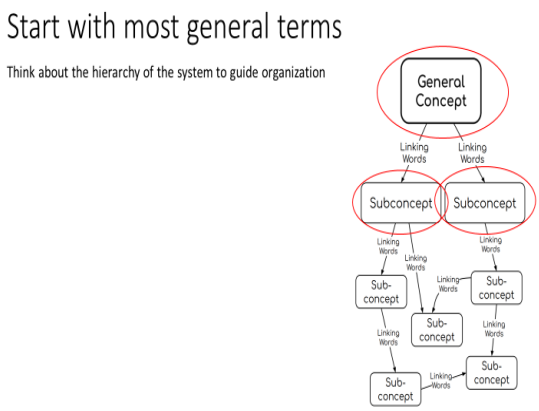
University of Northern Colorado: FWA00000784

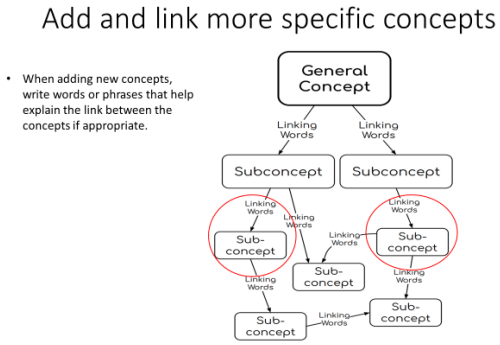
APPENDIX F

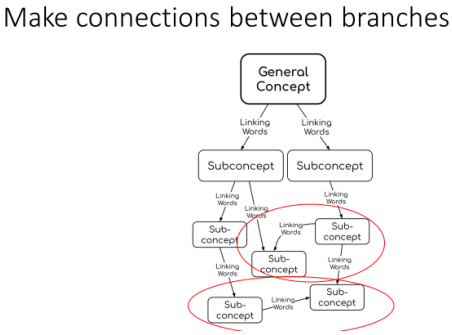
CONCEPT MAP INSTRUCTIONS

Instructions for constructing a concept map were presented via PowerPoint in each PSY 120 section, the slides are presented below.









Note: These slides were created by the author of this paper and are publicly available.

APPENDIX G

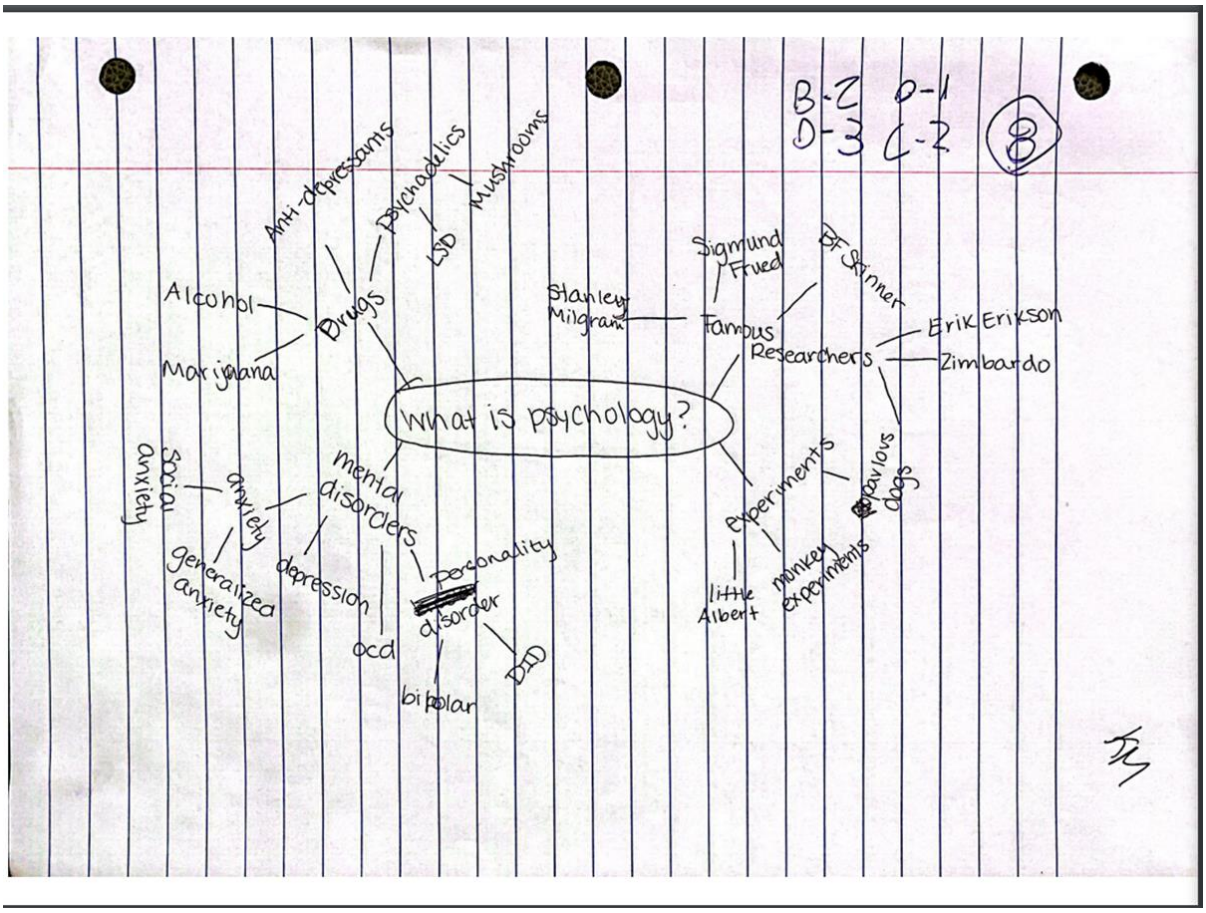
STUDENT CONCEPT MAP INSTRUCTIONS

1. **What is a concept map? -** A concept map is method of representing and organizing knowledge.
2. **Key Terminology**:
    1. **Concepts/nodes** – Terms enclosed in boxes or circles, or other types of illustrations that relate to the topic.
    2. **Linking lines** – Lines, sometimes with arrows, that connect two nodes.
    3. **Linking words** – Words, phrases, or symbols on the lines between nodes that describe the relationship between those concepts.
    4. **Propositions** – Two or more concepts connected using linking words or phrases to form a meaningful statement.
    5. **Cross-links -** Linking lines and words between branches in the map.
3. **Why use Concept Maps in Psychology?**
    1. Psychology = multiple levels of hierarchical organization and complex, interwoven processes.
    2. Creating a concept map will help you remember/understand the concepts discussed throughout the semester and their interconnected nature.
4. **How to Make a Map**
    1. Brainstorm key concepts that apply to the focus topic (introductory psychology), aim for 10+ concepts.
    2. Rank concepts from most general to most specific, the organize them in a hierarchical (top to bottom) fashion using arrows and connections.
    3. Build a first draft.
    4. Add linking words (All concepts relate to one another in some way. It may help to write a couple of sentences relating the terms together to think of words that describe the relationships).
    5. Add additional linking words to your map as you see fit.

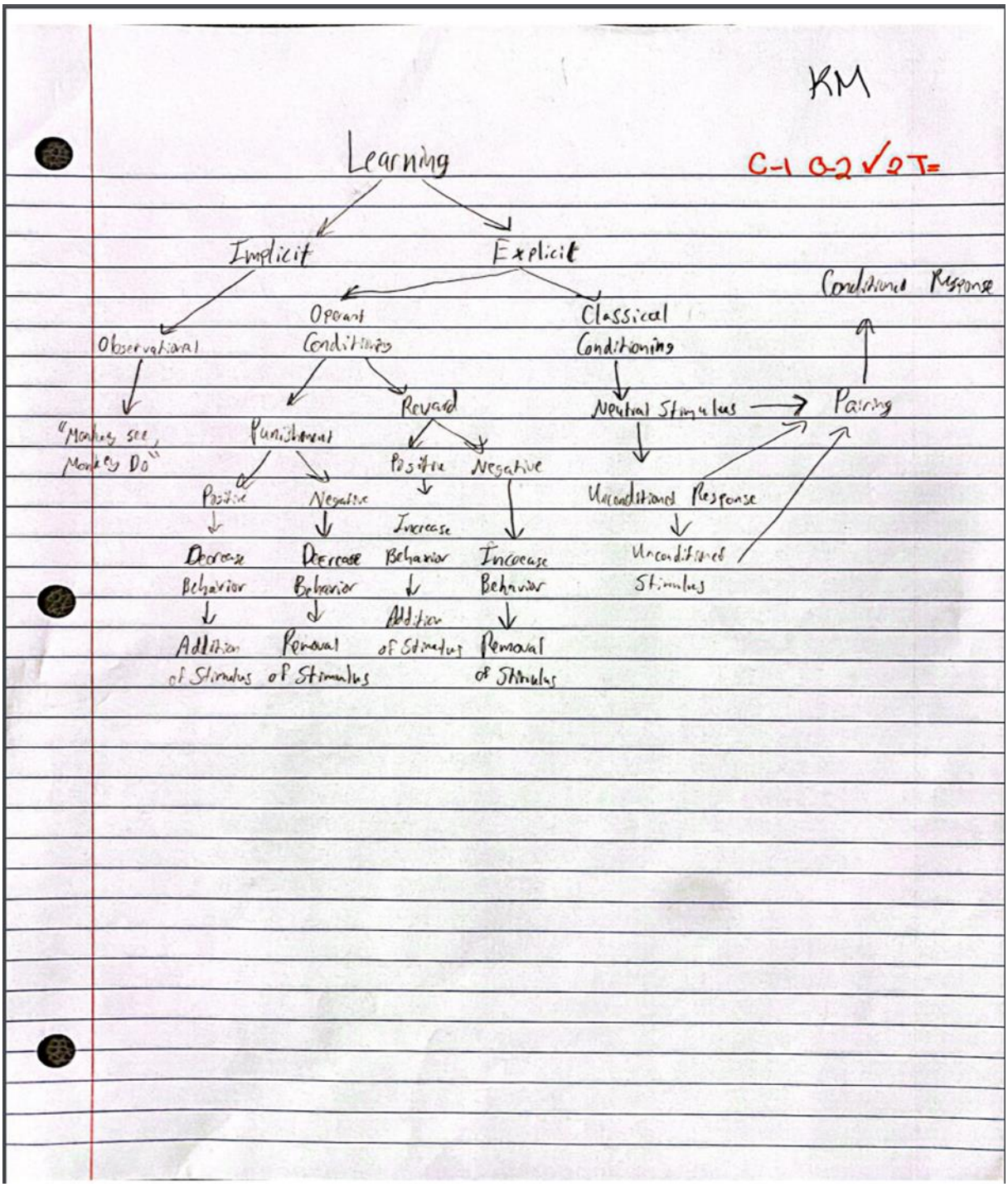
APPENDIX H

EXAMPLE OF STUDENT CONCEPT MAPS

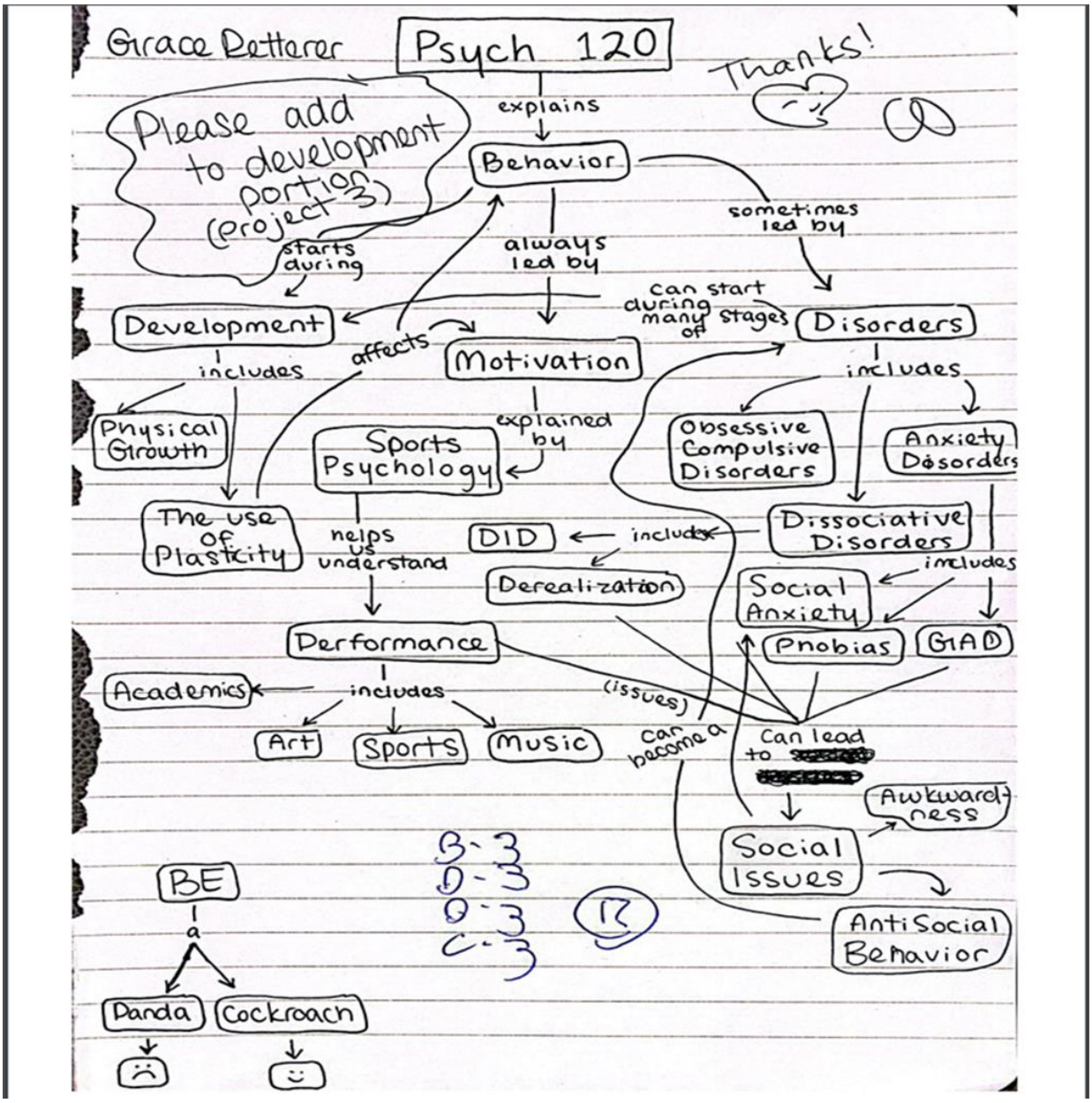
"Average" concept map.



“Below Average” concept map.



"Above Average" concept map



APPENDIX I

TRANSFORMATIVE EXPERIENCE QUESTIONNAIRE

Measure using a 4-point Likert Scale (1 = Strongly Disagree, 4 = Strongly Agree)
The following questions ask about your in and out of class experiences.

I ***think*** about psychological principles when I see things (in real life or online) related to learning, social interactions, people exhibiting unique behaviors, or when I am browsing media (on YouTube, TikTok, Netflix, etc.).

Can you provide an example of how you thought about or applied psychological principles when you saw something in your daily life or on some form of media?

I ***talk*** outside of class about psychology.

During this class, I ***think*** about psychology.

I enjoy ***talking*** about the psychology topics learned in PSY 120.

I find myself ***thinking*** about psychology in my life outside of school.

Outside of school, I ***use*** the knowledge I've learned about psychology.

I look for chances to ***use*** my knowledge of psychology in my life outside of school.

When I ***see*** things related to learning or social interactions, people exhibiting unique behaviors, or when I am browsing media (on YouTube, TikTok, Netflix, etc.) I think about psychology.

During this class, I ***notice*** examples of psychology.

I ***notice*** examples of psychology outside of class.

I ***look*** for examples of psychology outside of class.

Knowledge of psychological principles helps to ***make sense*** of the world around me.

I find that knowledge of psychological principles makes my current, out-of-school experience more meaningful.

Knowledge of psychological principles makes things related to learning or social interactions, people exhibiting unique behaviors, or browsing media (on YouTube, TikTok, Netflix, etc.) much more interesting.

Can you provide an example of how your knowledge of psychological principles made your daily life or browsing media more interesting?

In this class, I find it interesting to learn about psychology.

I'm interested when I hear things about psychology outside of school.

APPENDIX J

MOTIVATIONAL CLIMATE MEASURE

Measured using a 6-point Likert Scale (1 = Much Less, 6 = WAY More)

Think about other introductory courses you have taken in college. Compared to these courses, how much are you..

Task Involving

1. Encouraged to try new things?
2. Acknowledged for trying hard?
3. Given time to really explore and understand new ideas?
4. Encouraged to share ideas and work with other classmates?

Autonomy Supportive

5. Given choices and options?
6. Given opportunities to study materials you found interesting?
7. Given choices about how to do projects or assignments?
8. Given a say in what you do in class?

[Much less, A little bit less, About the same, A little bit more, Much more, WAY more]

Think about what you are required to do in other introductory courses you have taken in college, such as take tests or complete assignments. Compared to these courses,

Meaningful/Authentic Learning

9. How authentic are the things you are asked to do in this course?
10. How meaningful are the things you are asked to do in this course?
11. How applicable to your everyday life are the things you are asked to do in this course?
12. How enjoyable are the things you are asked to do in this course?

[Much less, A little bit less, About the same, A little bit more, Much more, WAY more]

APPENDIX K

GOAL ORIENTATION MEASURE

Measured on a 5-point Likert Scale (1 = Strongly Disagree, 5 = Strongly Agree)

The following items ask about your educational experience.
Please tell us how much you agree or disagree with each of the following by marking the correct response. If you make a mistake, simply go back and choose the correct response.

Mastery Goal Orientation

1. I want to do well in this class to show that I can learn new things.
2. I want to do well in this class to show that I can learn difficult course work.
3. I try hard to understand my course work.
4. I work hard to understand new things in this class.
5. I work hard in this class because I am interested in what I am learning.
6. I try hard in this class because I am interested in my work.

Performance-Approach Goal Orientation

7. I want to do well in this class because being better than others is important to me.
8. I try to do well in this class because I am only happy when I am one of the best in the class.
9. I want to learn things so that I can come near the top of the class.
10. I want to learn things so that I can get a good grade in this class.
11. When I do good course work it's because I am trying to be better than others.
12. I want to do well in this class so that I am one of the best in my class.

Performance-Avoid Orientation

13. It's very important to me that I don't look stupid in this class.
14. An important reason I do my course work is so that I don't embarrass myself.
15. The reason I do my course work is so my teacher doesn't think I know less than others.
16. The reason I do my course work is so others won't think I'm dumb.
17. One of my main goals is to avoid looking like I can't do my course work.
18. One reason I would not participate in class is to avoid looking stupid.

APPENDIX L

PSYCHOLOGY INTEREST MEASURE

Measured using a 5-point Likert Scale (1 = Strongly Disagree, 5 = Strongly Agree)
These next items ask you about your attitudes toward **psychology in general**.
Please tell us how much you agree or disagree with each of the following by marking the correct response. If you make a mistake, simply go back and choose the correct response.

1. I think the field of psychology is very interesting.
2. Psychology fascinates me.
3. I'm excited about psychology.
4. I find psychology to be personally meaningful.
5. Psychology concepts are practical for me to know.

APPENDIX M

SELF-EFFICACY FOR LEARNING AND PERFORMANCE QUESTIONNAIRE

Measured using a 7-point Likert Scale (1 = Strongly Disagree, 7 = Strongly Agree)

The following items ask about your educational experience.

Please tell us how much you agree or disagree with each of the following by marking the correct response. If you make a mistake, simply go back and choose the correct response.

1. I believe I will receive an excellent grade in this class.
2. I'm certain I can understand the most difficult material presented in this course.
3. I'm confident I can understand the basic concepts taught in this course.
4. I'm confident I can understand the most complex material presented by the instructor in this course.
5. I'm confident I can do an excellent job on the assignments and tests in this course.
6. I expect to do well in this class.
7. I'm certain I can master the skills being taught in this class.
8. Considering the difficult of this course, the teacher, and my skills, I think I will do well in the class.