The Effect of Project-based Learning on Student Motivation and 21st Century Skills

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THE EFFECT OF PROJECT-BASED LEARNING ON STUDENT MOTIVATION
AND 21ST CENTURY SKILLS

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AND 21ST CENTURY SKILLS

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Abstract

Keeping students engaged and motivated is a universal challenge faced by teachers of all grades and ability levels. This thesis focuses on the impact that Project-Based Learning (PBL) has on student motivation and preparedness for life after school (21st century skills). Project-Based Learning is a teaching technique, or strategy, where students get to create a project of their own. Research has shown that students' motivation, and most importantly intrinsic motivation, can be significantly increased through the implementation of project-based learning. Students of all ages thrive on the ability to design their own experience for learning. Project-Based Learning also provided a vehicle for students to gain valuable life skills such as critical thinking and collaboration. This thesis determines that Project-Based Learning increases student motivation and preparedness for life through authentic, hands-on learning experiences.
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CHAPTER I: INTRODUCTION

Keeping students engaged and motivated to learn is one of the everlasting struggles of teachers around the world. This universal struggle has led to the current educational philosophy of making learning (and teaching) student-centered. It is argued that this is the way in which students learn best.

Many theorists have worked on and contributed to what we now know as student-centered, or learner-centered, teaching. The educational psychologist recognized as the first proponent for this style of teaching was John Dewey. He thought that “schools and classrooms should be representative of real-life situations, allowing children to participate in learning activities interchangeably and flexibly in a variety of social settings” (Williams, 2017, p. ). While many of Dewey’s other thoughts on education did not catch on, his concern with focusing on what the student needed to be successful did.

In the 20th century work of two theorists, Jean Piaget and Lev Vygotsky, came to popularity. Their respective works that became so popular were grounded in what is now called constructivist learning theory. Constructivism is the belief that knowledge is “constructed” by the learner through actively engaging, being hands-on, in their learning. The major difference between Piaget’s theory and Vygotsky’s theory was that while Piaget believed that learning is an individualistic experience, Vygotsky argued that learning requires social interactions between the learner and people, such as teachers, parents, and peers (Kivunja, 2014). The constructivist approach aims to make the student the “leader” of their learning, helping them to discover their own “why?” for the topics presented in school.

The question, “When am I ever going to use this?” is a very common question asked of teachers. It is also a valid question for students to have and incited the following thoughts.
Wouldn't it be great if there was a way to allow students to experience these real-world scenarios in class? How can teachers make content more engaging so that students are active participants in what they are learning and they themselves are the teachers? How can teachers make adjustments to how they teach so that the content is more available to all students? Is there an instructional style that would increase students’ motivation and preparedness for life outside of school?

These questions led to the learning methodology of project-based learning. Project-based learning is a teaching technique, or strategy, where students get to create a project of their own. Through the process of creating their projects, they learn important problem-solving skills by identifying a problem, developing a plan, testing the plan, and reflecting on the process. Projects allow for trial and error to occur and for the students to be the leaders of their own learning. Teachers are there to guide and help students when they get stuck but are not directing the project.

Project-based learning puts students in the driver’s seats and gives them more control over what and how they learn. They also discover and apply important life skills of how to work with others, think critically about a topic, and how to be more self-sufficient. These are skills that are lacking in many middle school and high school students, but are soft skills that are necessary to be successful in the world we live in today. Project-based learning seems to be a possible solution to the growing problem of low student motivation and the required soft skills needed to be a productive member of society.
Thesis Purpose

The purpose of this thesis is to explore the effect project-based learning has on student motivation, and how it can be used to help prepare students to be successful, productive members of society. It will also provide some history as to the roots of how project-based learning came to be as well as specific life skills that are influenced by the methodology. The review will go on to delve into two types of motivation, intrinsic and extrinsic, the roles they play in student’s learning and how project-based learning can be used to impact both. The thesis will also provide some examples of implementations of project-based learning as well as challenges that this approach brings.

Guiding Thesis Question

The guiding question for this literature review is: What impact does project-based learning have on student motivation and students’ 21st century skills?
**Definition of Terms**

**21st Century Skills:** Refers to “the knowledge, skills, and expertise students should master to succeed in work and life in the 21st century” (Battelle for Kids, 2019). These skills are also commonly referred to as soft skills, interdisciplinary skills, and success skills.

**Extrinsic Motivation:** According to Ryan and Deci (2000), “extrinsic motivation refers to the performance of an activity in order to attain some separable outcome,” such as grade or to get some form of a reward (p.60). Extrinsic motivation requires some sort of external pressure, whether it be positive or negative.

**Intrinsic Motivation:** “The inherent tendency to seek out novelty and challenges, to extend and exercise one’s capacities, to explore, and to learn” (Ryan & Deci, 2000). Intrinsic motivation is doing something for the pleasure of it rather than doing it due to some external pressure or the pleasure of others.

**Motivation:** “Someone who is energized or activated toward an end” (Ryan & Deci, 2000). The amount of a person’s motivation varies between intrinsic and extrinsic based on the task.

**Project-Based Learning:** According to the Buck Institute for Education (2019), “project-based learning is a teaching method in which students gain knowledge and skills by working for an extended period of time to investigate and respond to an authentic, engaging, and complex question, problem, or challenge.” There is no single, universally accepted definition of project-based learning however most definitions have similar terminology or concepts.
**Student Engagement:** “Student engagement refers to the degree of attention, curiosity, interest, optimism, and passion that students show when they are learning or being taught, which extends to the level of motivation they have to learn and progress in their education” (Great Schools Partnership, 2016).

**Traditional (Conventional) Classroom:** A traditional classroom is teacher-centered rather than student-centered. This type of classroom is usually associated with direct instruction and rote memorization.
CHAPTER II: LITERATURE REVIEW

The following literature review was conducted based on research found in Education Journals, Scientific Journals, ERIC, EBSCOhost, CLICsearch, and Google Scholar. References throughout this paper range from 1929 to 2020. Numerous key words were used. The most common words/phrases used were “project-based learning,” “motivation,” “collaboration,” “21st century skills,” “project-based learning and student engagement,” “project-based learning and mathematics,” and “project-based learning implementation.” Most of the references for this paper come from empirical studies, journals, and case studies. Some books and chapters from books were also used. The literature review will focus on the history of project-based learning, the definition of project-based learning and key characteristics, project-based learning in practice. In order to understand the benefit of project-based learning, its connection to 21st century skills and student motivation is also reviewed. Finally, challenges to implementing project-based learning, ranging from teacher concerns to inconsistency within project-based learning information, will be discussed.

Project-Based Learning History

Project-based learning (PBL), in a simplistic form, can be traced at least as far back as 18th century Europe. The foundation on which project-based learning as it is known today, comes from William Heard Kilpatrick and his 1918 essay entitled “The Project Method” (Pecore, 2015). Kilpatrick, who was a teacher, principal, and professor, studied under theorists such as John Dewey and credited his early years of teaching for the reason behind his push for projects in the classroom (Pecore, 2015).

For Kilpatrick, the term “project” was used to describe an activity, “preferably [a] wholehearted vigorous activity” (Kilpatrick, 1929, p.3). The activity should be one such that
students are passionate about and would use in their current everyday life, to have purpose in the here and now, not just the future (Pecore, 2015). Kilpatrick’s methodology was influenced by the belief that students learn best by doing, that they are not just passive recipients of information and thus “advocated for student-initiated projects that utilize the laws of learning to intrinsically motivate the student” (Pecore, 2015, p.158). He realized that students were more motivated in school when they were in charge of their learning.

PBL is rooted in the constructivist learning approach which was popularized by theorists Jean Piaget and Lev Vygotsky. The constructivist approach is a learner centered methodology that stresses the importance of students working, actively, to build their own knowledge and understanding (Santrock, 2011, p. 6). In the constructivist approach, teachers are there to guide students' learning rather than to provide direct instruction. Jean Piaget was a major proponent of the constructivist approach to learning.

Lev Vygotsky also supported the constructivist standpoint, but as believed there was a social component to learning. Vygotsky developed the theory of the social constructivist approach which states that there are social contexts to learning and that knowledge can be built and constructed at the same time (Santrock, 2011, p. 53). The social constructivist approach argued that social interaction between a student and a more skilled individual is necessary to build and create knowledge. PBL lends itself to both the constructivist and social constructivist approach depending on how it is being implemented in the classroom.

Project-Based Learning

According to the Buck Institute for Education (BIE) (2019), “project-based learning is a teaching method in which students gain knowledge and skills by working for an extended period of time to investigate and respond to an authentic, engaging, and complex question, problem, or
challenge.” While there is no single definition of PBL, the BIE definition was selected because across research on PBL two characteristics hold: students must be actively engaged and their project must be something they are interested in that pertains to their everyday life. Real-world application provides students with “the opportunity to participate in authentic experiences, [and] they feel a sense of purpose and ownership over their learning” (Bowen & Peterson, 2019, p.2). As a result of participating in an authentic experience that the student chooses, students experience a higher level of motivation and engagement (Dole et al., 2017).

Aside from the key requirements that the project be personally meaningful and related to the real-world, PBL requires that teachers take a more hands-off approach. Teachers are meant to be guides for students, during the process of completing the students' projects, not to direct what or how the project should be completed. In his essay, Kilpatrick argued that in order to the project method to be successful the teacher needed to be “guiding the student through the process such that the student takes as much ownership as possible over each step so as to provide a healthy level of stress but prevent discouragement from too great a level of difficulty” (Pecore, 2015, p.159). The teacher guides students by presenting them with open-ended questions that drive students to discover what their project will be, as well as providing scaffolding during the process of creating their projects. Steven Wolk (1994, p.44) offered the following commentary on his role as a teacher in a classroom actively engaged in project-based learning, “My role in cultivating such an atmosphere is critical. I’m constantly moving from one student to the next - watching, listening, asking or answering questions, challenging, offering suggestions, or lending a hand. I am much less a teacher than a facilitator, guide, and resource.” According to Dole, Bloom, and Doss (2017), project-based learning allows teachers to devote more energy to interacting with students, making the students feel valued and respected. This in turn led to
students feeling like they were working with their teacher towards a common goal, rather than work for the teacher's predetermined goal.

**Project-Based Learning and 21st Century Skills**

The pedagogical framework of project-based learning not only provides students with authentic, hands-on experiences but also with numerous “soft” skills that students will need to be productive citizens outside of the classroom. These “soft” skills are commonly referred to as 21st century skills. The Partnership for 21st Century Learning (P21) described 21st century skills as “the skills, knowledge, and expertise students must master to succeed in work and life…” (Battelle for Kids, 2019). Skills that P21 deems essential to be successful in today's world are critical thinking (and problem solving), communication, and collaboration.

**Critical Thinking and Problem Solving**

According to the Delphi panel, a panel of 46 experts convened by the American Philosophical Association in 1990, critical thinking is defined as

>...purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based...The ideal critical thinker is habitually inquisitive, well-informed, trustful of reason, open-minded, flexible, fair-minded in evaluation, honest in facing personal biases, prudent in making judgments, willing to reconsider...and persistent in seeking results which are as precise as the subject and circumstances of inquiry permit (Facione, 1990, p. 3).

Problem solving, on the other hand, is more simply defined as “focusing on a problem and finding a solution - a narrow focus and scope” (Evans, 2020, p.6). Problem solving is seen as a
skill needed in order to be able to think critically. Many times, these two terms are used interchangeably, but are actually quite distinct. However, both skills are included as 21st century skills and are needed in order to be successful with PBL. Larmer et al. (2015) concluded that the purpose of PBL is to help students develop their knowledge and understanding of subjects, but to also develop their 21st century skills. They argued that as a result of being required to apply knowledge of various subjects, a greater depth of learning occurs and students build and develop skills such as critical thinking, problem solving, and collaboration.

Abrami et al. (2015), in their meta-analysis, found that there are two types of instructional intervention that are essential for the development of critical thinking skills: the use of collaborative learning methods and using real-life problems and examples. Both types of interventions are found in PBL implementation. Evans (2020, p.10) also argued that an effective way for teachers to help students improve their critical thinking skills is to “provide real-world opportunities for solving problems with multiple solutions, provide structure that allows students to respond to open-ended questions and formulate and articulate solutions to problems, and provide a variety of learning activities that allow students to choose and engage in solving authentic problems.”

Communication

Communication, as a 21st century skill, encompasses everything from being articulate while presenting material to the creation of the presentation and communicating via verbal or written response with another individual (Battelle for Kids, 2019). All of these pieces come into play with the PBL methodology. In relation to PBL, the physical presentation product will be the focus of the “communication” skill.
According to Krajcik and Blumenfeld (2006, p.327), “learning sciences research shows that students learn more effectively when they develop artifacts - external representations of their constructed knowledge.” The external artifacts can take many different shapes: book, poster, graph, computer program, experiment, artwork, demonstration, and many more options (Wolk, 1994). The creation of the external artifact, or product, strengthens the level of the students’ understanding by pushing the students to review and revise their learning. It also provides students with a sense of pride and community within the classroom (Wolk, 1994).

The Buck Institute of Education (2019) also argued that in order for PBL to be implemented properly a product must be created because the outcome should be “public.” Here public means tangible. The argument for a public product is twofold. First, having to present or display their project to people outside of their teacher and peers raises the bar for a higher quality product, “no one wants to look bad in public” (Buck Institute of Education, 2019). Second, the presence of a tangible product allows for discussion to be held, providing the opportunity for a learning community to exist, making it so teachers, peers, and community members can talk through the outcome (Buck Institute of Education, 2019).

Collaboration

Collaboration, as a 21st century skill, is grouped with communication as they are interconnected. Collaboration and communication are both vital components of project-based learning and thus have been separated here to show their distinctions. In PBL, communication is tied to the tangible product created while collaboration pertains to how students, teachers, and members of society work together to explore various problems and ideas (Krajcik & Blumenfeld, 2006).
Lee (2018) argued that collaboration allows students to share, challenge, and expand their own ideas, while also pushing them to find connections between their prior knowledge and the new information being presented to them. Students are able “to uncover information...using a variety of resources, to grapple with new information until it makes sense, and to create new ideas using the information they have learned...[creating] lifelong learners who are capable of discovering and applying new ideas on their own” (Edwards, 2015, p.28). Krajcik and Blumenfeld (2006, p.325) argued that collaboration provides opportunities for students to “build shared understandings...as they engage in discourse with their classmates and adults outside the classroom.”

Project-based learning is a pedagogy that emphasizes student-centered learning and turning “classrooms into active learning environments as students investigate significant questions and take responsibility for their learning while collaborating” (Krajcik et al., 1998, p. 496). Collaboration and taking responsibility for one's own learning is often the most challenging part of the project-based learning methodology, according to Krajcik and Blumenfeld (2006). Students are used to being told answers or given a step-by-step process for how to get them, not having to find, or create, the solution on their own. As such, “teachers need to help students develop skills in collaborating, including turn-taking, listening, and respect for others’ opinions” (Krajcik et al., 2002; Krajcik & Blumenfeld, 2006, p.325).

**Project-Based Learning and Student Motivation**

Bradford (2005) indicated that a lack of encouragement is a primary reason for high student dropout rates. This point is further supported by Bridgeland et al. (2006) who revealed that nearly 50 percent of surveyed students who dropped out of high school left school because they were “bored.” Project-based learning is a teaching strategy that has been implemented by
teachers as a way to combat boredom and increase student motivation. In a later section, studies will be presented that provide examples of how PBL has had a positive impact on student motivation. In order to understand why project-based learning had a positive impact on motivation, it must first be understood “how” people become motivated.

Motivation is split into two main categories: intrinsic and extrinsic. “Motivation is the theoretical construct to explain the reason or reasons we engage in a particular behavior” (Barkley, 2010; Cooper et al., 2011, p.2). Cooper et al. (2011) went on to state that when students participate in activities they are interested in, they are in turn motivated to complete them. Project-based learning provides a curriculum that helps motivate students, both intrinsically and extrinsically. Students are provided autonomous and authentic projects that evoke motivation. The evoked motivation is both intrinsic and extrinsic in nature. Therefore, both types need to be examined to understand how PBL impacts student motivation. Ryan and Deci are some of the top researchers on motivation, and their research from 2000 provides important connections between motivation and education.

Intrinsic Motivation

Intrinsic motivation is defined as “the inherent tendency to seek out novelty and challenges, to extend and exercise one’s capacities, to explore, and to learn” (Ryan & Deci, 2000, p.70). In more simplistic terms, intrinsic motivation is doing something because it appeals to you rather than doing it due to some external factor. Intrinsic motivation requires personal satisfaction or interest in order to exist.

Numerous studies and research has shown that when students work on something that they have interest in and find important to themselves, their intrinsic motivation increases (Bowen & Peterson, 2019; Dole et al., 2017; Wart & West, 2020). Ball (2016) found that her
students’ “Passion Projects,” students must identify a problem that affects them directly, one they care deeply about, increased their motivation and engagement. “By trusting children and allowing them to choose what to explore, they become intrinsically motivated - more than happy to work hard for the highest quality” (Wolk, 1994, p.44). Virtue and Hinnant-Carwford (2019) received a similar response from a surveyed student when asked why they enjoyed the PBL model, “It doesn’t feel like work because you’re doing things that are meaningful to you.”

Intrinsic motivation is also closely tied to students' engagement in their learning. According to Barkley (2010) engagement means students “really care about what they are learning; they want to learn and exceed expectations and go beyond what is required.” Barkley’s definition of engagement connects back to Ball and her findings with her students' Passion Projects. Student engagement makes students want to raise the bar, leading to a “public product” that is of the highest quality. Barkley (2010) also made an argument for engagement being related to critical thinking, an important 21st century skill when the author said, “engaged students are involved in the academic task at hand and are using higher-order thinking skills such as analyzing information and solving problems.”

In a study by Holmes and Hwang (2016), where they conducted interviews and surveys of students participating in a PBL mathematics classroom, and a control non-PBL mathematics classroom, they found that students’ intrinsic motivation was positively impacted. When looking at responses to intrinsic motivation-based questions, the project-based learning students’ intrinsic motivation went from 25% to 67%, over the course of a school year. PBL students were also shown to be more intrinsically motivated as compared to their control group counterparts. Holmes and Hwang’s findings support conclusions made by Deci and Ryan (1985) indicating that when personal choice and opportunities for self-direction occur, intrinsic motivation
increases due to a greater feeling of autonomy. Holmes and Hwang’s research showed that PBL allowed for student choice, self-direction, and autonomy, leading to increased intrinsic motivation.

**Extrinsic Motivation**

According to Ryan and Deci (2000, p.71), “extrinsic motivation refers to the performance of an activity in order to attain some separable outcome,” such as grade or to get some form of a reward. Since extrinsic motivation is not derived from personal interest or enjoyment, many argue that it is a non-autonomous behavior. However, self-determination theory argues that extrinsic motivation can vary based on how a person’s behaviors have been internalized and integrated (Ryan et al., 1997).

“Internalization refers to people ‘taking in’ a value or regulation of a requested behavior, and integration refers to the further transformation of that regulation into their own so that it will emanate from their sense of self” (Ryan & Deci, 2000, p.71). Ryan and Deci (2000) researched ways in which internalized and integrated behaviors lead to extrinsic motivation that have relative autonomy.

Consider two students who complete their homework each night. Student 1 completes the work because they know that it will have value further down the road in their desired career. Student 2 completes the work because their parents tell them too (Ryan & Deci, 2000). Both students’ responses are based on an external factor rather than enjoyment; however, the first student shows autonomy in their choosing to do the work for their own reasons rather than someone else's.

While the goal of education is to get students to be intrinsically motivated and engaged in their learning, that is not always the case, as evidenced by a high high school dropout rate due to
“boredom” (Bridgeland et al., 2006). Even with implementing PBL to combat this issue, sometimes students will have a topic they are not personally excited about researching. In these instances, Ryan and Deci (2000) argued that as long as the “projects” have some component of autonomy and authenticity, students will be extrinsically motivated. Virtue and Hinnant-Crawford (2019) had a student state that although completing their project was somewhat satisfying, the more valuable part to them was knowing their work would be important to others.

**Project-Based Learning Implementation**

**Project-Based Learning in Elementary Grades**

Steven Wolk implemented project-based learning in his 5th grade classroom. His class has two one-hour project times a day, one in the morning and one in the afternoon. The morning session is for students to explore anything they choose. “Students have used this time to study everything from hydrofoils to elephants to Claude Monet, as well as to repaint bookshelves” (Wolk, 1994, p.42). The afternoon session is for class led discovery, either a topic chosen by class majority or a topic based on the curriculum.

Wolk (1994, p.44) stated that he uses PBL because “projects enable students to use processes, skills, and ideas as the need arises.” He references a student who struggled in math and as a result decided to survey her classmates on their favorite basketball players as a way to improve her graphing skills. After completing her work on paper, she then used a computer program to replicate her pie graph and presented all of her work to her classmates. Wolk (1994, p.44) noted that her classmates were so interested in the program that they asked her to teach them how to use it, which resulted in “three other students using the computer program to create graphs for their projects.”
Wolk (1994) also commented about another student who struggled in math and wanted to work on his graphing skills. After completing his project, his classmates recognized him as the “class expert” and he went on to volunteer his time to help fellow classmates and teach them how to graph properly. Students in his class unanimously stated that their favorite parts of the day were the project hours, to which Wolk build on to argue that the reason project-based learning is successful is because students have a voice in their curriculum which gives them a personal stake in the classroom because it is of their own creation (Wolk, 1994).

**Project-Based Learning in High School**

Holmes and Hwang (2016) performed a study to look into the impact project-based learning has on secondary mathematics students, motivationally. The study used student survey results, classroom observations, and student interviews for data. Data for both PBL students and conventional high school students were analyzed.

As previously noted in the section on “Intrinsic Motivation” Holmes and Hwang (2016) found that PBL students’ intrinsic motivation increased from 25 percent to 67 percent over the 2-year study. It was also found that the belief that they [the students] were in control of their learning increased from 75 percent to 98 percent (Holmes & Hwang, 2016). Another key finding was that students’ collaborative skills improved and in fact, students actively sought out ways to collaborate with their peers.

Holmes and Hwang (2016) noted that at the very start of the study PBL student struggles with autonomy and collaboration, getting off task easily, but in the end (p.458) “they became more focused, skilled in working with others, and appreciative of their peers' different strengths.” These qualities are demonstrated in this student’s interview response,
The projects not [about] getting the project done all by yourself; it's about working together. I realize that it's choosing to take the time to work with people instead of just completing the project. If somebody is lagging and if you try and keep that person who’s lagging with you, you can benefit from it. I try to be patient and not fire people immediately. (Holmes & Hwang, 2016, p.458)

This response, along with many others, show that the students gained deeper cooperative-learning skills and a richer understanding of the positive impact of work with others.

Another finding from the study was that students began to see value in their mathematical learning. During an interview, one student noted that when she was shopping, she noticed she was doing price comparisons, between products, in her head (Holmes & Hwang, 2016). A second student stated that in the midst of working on his pancake box design project, he realized how helpful mathematics and economics were to his final goal. Using both concepts would allow him to have an aesthetically pleasing box while containing the least amount of pancake mix inside (Holmes & Hwang, 2016). The student realized that his mathematics learnings would help him find a way to make the most money possible, making mathematics applicable and practical.

Virtue and Hinnant-Crawford (2019) led a study to look at what PBL looks like in various disciplines and how students viewed the impact of PBL in said discipline. The study found that students felt that project-based learning is better suited for some subjects over others. Four academic disciplines were examined: mathematics, science, English, and social sciences.

The majority of students struggled to see the relevance of using PBL in a math class. One student commented, “It’s just normal math. Because there is not a lot you can do with it [PBL]” (Virtue & Hinnant-Crawford, 2019). Another student, who found project-based learning
to be relevant in math, used math to create a golf course, mapping trajectories and angles to get from the tee-off to the hole. He found “the most memorable part of the math PBL experience to be the hard work and the end product” (Virtue & Hinnant-Crawford, 2019).

Project-based learning in science classrooms was not received much better. Students could see how the projects applied to science and were usually interdisciplinary in nature, but lacked enthusiasm and “[science assignments] were the least talked about among our participants” (Virtue & Hinnant-Crawford, 2019). Virtue and Hinnant-Crawford (2019) did find that students were more enthusiastic and engaged when the PBL curriculum related to the medical field.

Both English and social sciences saw success with the project-based learning used in the curriculum. Virtue and Hinnant-Crawford (2019) argued that it appeared easier for these disciplines to split their curriculum into themes such as “end of life” or “social justice” that provided more open-ended options for topics and research. It was also found that these two disciplines lent themselves well to each other. In a class entitled “American Studies,” which was a combination of English and History, students were able to use debates to research and present on topics. The students noted that sometimes the debates would get heated, but that just made them feel more real (Virtue & Hinnant-Crawford, 2019). Students became invested and dedicated in their research and subsequent debate because they knew the debates in their class were real.

**Project-Based Learning in College**

Warr and West (2020) researched the experiences of students who participated in their colleges’ Creativity, Innovation, and Design (CID) studio courses. The CID studio was run by
an interdisciplinary group of faculty members who taught cross-curricular classes utilizing the PBL model. Three projects, that spanned multiple semesters, were described in the study.

The first project described was called Fundacion Paraguaya. In this project students were asked to work in a group to “design a product that would generate a social change” (Warr & West, 2020). The project was designed in collaboration with the founder of Fundacion Paraguaya. The students worked collectively to design a commercial and documentary, even travelling to Paraguay to take interviews and film footage (Warr & West, 2020).

The second project was a collaborative effort between faculty and staff from numerous departments such as education, arts and communication, information technology, and more to create an augmented reality game for a third party. The game was designed to teach science principles to teenagers (Warr & West, 2020). Lastly, the third project noted the research was on social innovation. Students had a year and a half to develop their own social innovation projects. Final products ranged anywhere from internships for at-risk high school students to a service organization run by professional athletes (Warr & West, 2020).

Through this study Warr and West (2020) found that “students were motivated by the nature of the problem to be solved, not by the course grade.” Students felt that they learned more in the project-based learning setting than in a traditional classroom because “you’re having an experience,” as noted by one participant (Warr & West, 2020). Students also commented that the CID courses provided a more real-world, flexible style of learning as compared to conventional practices. Teachers were more of guides and resources rather than dictating the direction of the projects (Warr & West, 2020). Warr and West (2020) recorded a student's response that sums up all of the prior feelings into one thought, “The freedom that you are given as a student in the class to make it your own and decide what you want to work on makes the
class particularly valuable.” Overall, Warr and West (2020) study found that students received numerous benefits from the CID studio courses “because of the thick authenticity of the interdisciplinary project-based learning.”

**Project-Based Learning Challenges**

While the prior research has shown that the PBL methodology has positive impacts, there are some drawbacks to this approach. The biggest challenge that was noted throughout the studies was the toll project-based learning takes on teachers. From the time it takes to create and teach this methodology to the internal and external support teachers require, teachers face many challenges when using project-based learning. Another challenge with PBL is the lack of a universally accepted definition and structure for the methodology.

As it has been argued throughout the literature review, PBL seems to be beneficial to students, however benefits towards teachers may not be as high. Rotherham and Willingham (2009, p.20) stated that “what teachers need is much more robust training and support than they receive today, including specific lesson plans that deal with the high cognitive demands and potential classroom management problems of using student-centered methods.” Rotherham and Willingham (2009) went on to note that while the student-centered approach is a big movement in education currently, very little is done to equip teachers with the tools and support they need in order to make approaches like project-based learning work. The support teachers require is further noted by Warr and West (2020) conclusion that teachers who use project-based learning curriculum, or want to, need training in order to support students in developing critical thinking and collaboration skills, so they can be successful with the PBL approach. Students need to be taught how to think critically and collaborate, they can’t just “turn it on” out of nowhere. These
two skills are essential to success in project-based learning but it means that teachers must then incorporate those concepts into their lesson plans.

Being training to teach the students, and then in turn teaching the students, these skills take time. Ladewski, Krajcik, and Harvey (1991) found that one of the dilemmas teachers faced when implementing PBL was whether their time was better spent teaching the students to explore their own interests or to meet the state required standards. Not only is time an aspect for learning about and teaching students the necessary soft skills for project-based learning, there is also the fact that projects usually take longer than a few days of homework and then a test (Marx et al., 1997). Both of these time consuming characteristics lead teachers to question the best avenue forward, for the students and themselves.

Another challenge teachers face is their lessened feel of control over their classrooms. As they are not “front and center” in the PBL model, some are uncomfortable and don’t know how to help students when they struggle or fail (Wurdinger et al., 2007). Some teachers are hesitant to switch from a traditional classroom to a project-based learning setting due to deeply ingrained beliefs (Lam et al., 2009). This hesitancy often leads to an improper implementation of PBL, which in turn does not provide the benefits sought after when using project-based learning. Thomas (2000) summarized that these concerns and issues can be mitigated through a supportive school environment and an administration who aids in the teachers’ development in project-based learning methodology.

A last point of concern is the lack of a universally accepted and known definition for PBL. Different researchers use different variations of project-based learning definitions. Furthermore, project-based learning terminology is used interchangeably for other methodologies such as problem-based learning, inquiry-based learning, active learning, project
method, and many more (Hovey & Ferguson, 2014). These approaches share similar characteristics and goals with that of project-based learning. However, a single agreed upon definition should be used to improve consistency of the methodology and its research. Each research study in this literature review had its own terminology, and even acronyms, making it hard to analyze and relate the data from one study to another.
CHAPTER III: DISCUSSION AND CONCLUSION

Summary of Literature

Engaging and motivating students is an on-going challenge for teachers. A common educational philosophy used to combat this challenge is making education and learning student-centered. There are numerous methodologies that have been developed that are focused on student-centered learning. One of the more popular methodologies is Project-Based Learning (PBL).

While there are many theorists who have contributed to the student-centered teaching approach, John Dewey is one of the first proponents of this philosophy. Dewey thought that “schools and classrooms should be representative of real-life situations, allowing children to participate in learning activities interchangeably and flexibly in a variety of social settings” (Williams, 2017, p.92). After Dewey, there were two additional educational psychologists who furthered the student-centered approach, Jean Piaget and Lev Vygotsky. Both men argued for the constructivist approach to learning. Constructivism is the belief that knowledge is “constructed” by the learner through actively engaging, being hands-on, in their learning. The constructivist approach aims to make the student the “leader” of their learning, helping them to discover their own “why?” for the topics presented in school.

In 1918, William Kilpatrick wrote an essay “The Project Method,” that utilized his learnings from Dewey and a constructivist approach to put forth the idea of providing students with a “project,” or a vigorous activity that students could be passionate about and most importantly would use in their everyday life (Kilpatrick, 1929; Pecore, 2015). Kilpatrick argued that the activity needed to be something that had purpose for the students in their “here and now” otherwise it wouldn’t be impactful (Pecore, 2015). Through his own teaching and applying his
methodologies in his own classes, he noticed that students were more motivated in school when they had control of their learning. Kilpatrick’s project learning, and the constructivist learning theory, have made a lasting impact on teaching methodologies, and have led educators to different ways of engaging, motivating, and preparing students for life outside of school. One of those methods is through Project-Based Learning.

The Buck Institute for Education (BIE) (2019) defined project-based learning as “a teaching method in which students gain knowledge and skills by working for an extended period of time to investigate and respond to an authentic, engaging, and complex question, problem, or challenge.” The methodology of project-based learning provides students with authentic, hands-on experiences but also with numerous “soft” skills that students will need to be productive citizens outside of the classroom. These “soft” skills are commonly referred to as 21st century skills. 21st century skills are described as “the skills, knowledge, and expertise students must master to succeed in work and life…” (Battelle for Kids, 2019). Skills included in this category included critical thinking, communication, and collaboration. Project-based learning is a pedagogy that emphasizes student-centered learning and turning “classrooms into active learning environments as students investigate significant questions and take responsibility for their learning while collaborating” (Krajcik et al., 1998, p. 496). PBL requires students to think critically about what they are researching, being able to explain what they found and created, and collaborate with others to find those solutions.

Another benefit to the PBL method is the effect on students’ motivation. Numerous studies have found that using PBL has increased student engagement and motivation. Holmes and Hwang (2016) found that project-based learning students’ intrinsic motivation went from 25% to 67%, over the course of a school year and were shown to be more intrinsically motivated
as compared to their control group counterparts. Their findings support conclusions made by Deci and Ryan (1985) indicating that when personal choice and opportunities for self-direction occur, intrinsic motivation increases due to a greater feeling of autonomy. PBL can also be helpful even when students do not have intrinsic motivation to do the work.

In these circumstances, Ryan and Deci (2000) also indicated that as long as the “projects” have aspects of autonomy and authenticity, students will be extrinsically motivated and thus engaged in the work.

Throughout the literature, educational research on project-based learning ranged from elementary to collegiate education. The studies revealed the effects of PBL on students' motivation, engagement, and how they learned important life skills. Wolk’s (1994) students favorite time of the day was project hour, because they got to choose what they spent their time working on. They used this freedom to not only learn or create new things, but also to improve on skills they felt were lacking. His students then went on to teach their peers their new and improved skills. Holmes and Hwang (2016) noted that the PBL high school students (p.458) “became more focused, skilled in working with others, and appreciative of their peers' different strengths.” Students in multiple studies also indicated how PBL helped them to find the relevance in the mathematics that they were learning; it provided them with authentic applications of their lessons (Holmes & Hwang, 2016; Virtue & Hinnant-Crawford, 2019). Warr and West (2020) found that their students felt that they learned more in the project-based learning setting than in a traditional classroom because “you’re having an experience” and “the freedom that you are given as a student in the class to make it your own and decide what you want to work on makes the class particularly valuable.”
While there are numerous benefits to project-based learning, it does present some challenges as well. Utilizing the PBL method can be fairly difficult on teachers. PBL requires training and support from one’s school and administration. It requires a lot of planning and time to provide students with the skills they need in order to be successful in project-based learning. Not only is time an aspect for learning about and teaching students the necessary soft skills for project-based learning, there is also the fact that projects usually take longer than a few days of homework and then a test (Marx et al., 1997). Teachers can also have a hard time letting go of some control in their classroom. As per the design of PBL, teachers are more guides and resources rather than the holder of all the information. It can be challenging, and takes time to learn, to let students struggle and find things out on their own. In addition to teacher concerns, there is a lack of a universally agreed upon definition for project-based learning. This disparity makes it difficult to compare data and results from various studies and the implementation and outcomes are affected by the way the researchers have chosen to define PBL. Even with this inconsistency, these challenges can, and have been found to, be mitigated through a supportive school environment and an administration which aids in the teachers’ development in project-based learning methodology (Thomas, 2000).

Professional Application

Studies for this literature review have come from researchers across the globe. Each one has found benefits to project-based learning. It provides an avenue for teachers to get their students engaged and motivated to learn, while also providing them with important life skills. PBL has been found to be successful in classrooms from elementary school to the university level, with students of all ages commenting on how much they enjoyed the experience of project-based learning (Ball, 2016; Holmes & Hwang, 2016; Virtue & Hinnant-Crawford, 2019; Warr &
Project-based learning is a hands-on approach, putting students in more control over their learning. They get to choose topics and problems that are of interest to them, then discover possible solutions on their own. The hands-on authentic experience nature of PBL has been found to raise students’ intrinsic motivation significantly (Holmes & Hwang, 2016). Numerous studies have shown that PBL is a methodology that, when implemented properly, leads students to want to learn, regardless of the subject (Virtue & Hinnant-Crawford, 2019). Project-based learning is an approach that is suitable for all ages, and while many studies have noted implementation difficulties faced by teachers, with training, time, and support from administration, PBL can be utilized, successfully, in the classroom for all parties involved (Thomas, 2000).

**Project-Based Learning in Mathematics**

As a math teacher, it is not uncommon for me to hear the question “when am I ever going to need this?” While a fair question for students to ask, it is one that plagues math teachers year after year. Mathematics has a long history of being seen as a rote memorization subject, with seemingly endless amounts of practice problems to complete to “learn” the various skills. Due to the historical direct instruction approach, many students find it difficult to see the value of the skills they are learning. Students also tend to struggle to retain information they learn from class to class, or year to year. Project-based learning is a possible solution to this issue and a way for students to answer for themselves the question of when they will use various math skills.

Virtue and Hinnant-Crawford (2016) found that students were able to see the value in their math classes through the use of project-based learning. The real-world application and experience that is inherent to PBL connected students' school life to life outside of school making them more motivated to learn. One group of students designed a golf course, and
learned how to use angles, arcs, and sectors to layout the holes for the course. They even figured out how to use sand traps to make holes slightly more challenging (Virtue & Hinnant-Crawford, 2019). Even though a couple of the students in the group weren’t very interested in golf, they enjoyed the project because they were able to appreciate the complexity of golf courses and experience how geometry is incorporated in a very popular hobby and sport (Virtue & Hinnant-Crawford, 2019).

Other students learned how to combine mathematics with other disciplines to create useful tools for their community. Bradford (2005) described various interdisciplinary projects that California high schools created and presented to their community. All the projects were thought up, designed, and presented by students. One group took data from their cities fire and police departments to try to find a way to track and find arsonists. They created a program that plots the fires on a map by various categories, to allow the fire and police departments recognize areas within the community to focus on (Bradford, 2005). They used and expanded their math skills in learning the purpose of various types of graphs and plots, while also learning how math is inter-related to computer programming and coding.

As a math teacher, I also hear fellow math teachers comment on their dislike of projects in math classes. They feel like students don’t show what they actually know, and some students just do the bare minimum and take advantage of other students' work and effort. These are valid concerns, and I have experienced some of the same feelings when implementing projects. The difference between projects and project-based learning is that PBL is an entire methodology. It is more than just assigning a project after lessons have been taught in class. Project-based learning is the lesson and the assessment, all rolled into one. As it is a teaching methodology, it requires training, time, and practice just like any other method or skill. Teachers that have been
trained and implemented PBL a little bit at a time, have found success using the approach
(Ladewski et al., 1994). Project-based learning is a powerful tool that all teachers, but especially
math teachers can implement to increase student motivation and engagement and provide them
with authentic experiences that will provide them with understanding of the value of the skills
they are learning.

**Limitations of Research**

Research for this literature was limited to studies that focused on student motivation and
engagement, “soft” skills or 21st century skills, impacts of implementing project-based learning.
For the most part each of those pieces were parts of separate studies. They provided insight into
key benefits and applications of project-based learning. The research was also limited by
looking for some studies that focused on PBL implementation in math classrooms. All of the
studies varied in terms of class size, grade level, subject implementation, and student
demographics.

Additionally, there were some limitations found within the research itself. Many of the
studies found were focused on high school and college level applications of PBL. There were
some elementary level studies but very few studies focusing on motivation and engagement of
middle school students in correlation with project-based learning. The majority of the studies
also centered around the sciences or didn’t specify a specific subject as the focus of the study.
The studies researched all contained different definitions for project-based learning, as well as
differing views on using technology as a component of PBL. These irregularities found in the
research can cause inconsistencies between data sets and make it more challenging to draw
common conclusions.
Implications for Future Research

Further research is needed on the impact and utilization of PBL in middle school classrooms, as well as a continued focus on implementing PBL in core specific classes such as math, social studies, science, and language arts. Research studies should also include the teacher's perspective, time for preparation, teacher concerns, issues that arose during the study to provide a well-rounded view of project-based learning. As the majority of the studies and articles were based on STEM classes or in general education elementary classrooms, it would be beneficial to have an understanding of how project-based learning impacts students in classrooms that already lend themselves to projects, such as art, technology education, physical education etc. It would also be helpful to see research on utilizing PBL to expand upon interdisciplinary learning.

It would be interesting to gain insight into how increased student motivation and engagement impacts students' academic achievement, and discover if there is a correlation. Additionally, as a teacher it would be beneficial to see long-term studies that follow students through multiple years of PBL and to get qualitative and quantitative data on how the methodology prepared them for life after high school and college. Did they have an easier time determining a major or knowing what career they wanted to pursue after school? Did they feel better prepared to enter the workforce? Overall, more longitudinal studies should be conducted to see the full-scale effects of implementing project-based learning in the classroom.

Conclusion

What impact does project-based learning have on student motivation and students’ 21st century skills? Research has shown that students' motivation, and most importantly intrinsic motivation, can be significantly increased through the use of project-based learning. Students of
all ages thrived on the ability to design their own experience for learning. It allowed them to find value in what they were learning. Project-based learning also provided a vehicle for students to gain valuable life skills such as critical thinking and collaboration. PBL requires students to be inquisitive, well-informed, flexible, and willing to work with others in order to be successful, all skills that help one be a successful, productive member of society. All in all, this thesis found that project-based learning increases student motivation and preparedness for life through authentic, hands-on experiences.
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