INQUIRY FOR STUDENT VOICE, CHOICE, AND EQUITY: EXPLORING TEACHER PERSPECTIVES OF THE TEN CHARACTERISTICS OF INQUIRY-BASED LEARNING

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Dedication

for my Mom and Dad, my wife and my children

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Abstract

The purpose of this action research study was to analyze the teachers' perspective of 10 characteristics of inquiry-based learning. The review of literature framed inquiry-based learning aligned to the past professional development sessions in Parkland School District. The literature indicated that inquiry-based learning varied on level of inquiry and type of inquiry. Furthermore, it also showed that inquiry-based learning was influenced by teacher self-efficacy. The 10 characteristics of inquiry-based learning created a constant variable for all models of inquiry with a focus on student choice and student voice throughout. The perspectives of inquiry-based learning were measured through teacher surveys, classroom observations, and teacher interviews. The global Covid-19 pandemic impacted this study by providing a unique learning environment for educators. More specifically, this unique environment combines both face to face and online learning in a hybrid model. The new environment allowed for a comparison of inquiry-based learning in both face to face and online learning environments. Additionally, it opened many questions about equity for all students. This study used a mixed research design to pull demographic data of the learning environments and looked for trends based on equity for all students. The fiscal implications of Parkland's initiative to improve inquiry-based learning was outlined based on past and potential future professional development sessions. The findings of the research included evidence on the instructional impacts of the 10 characteristics of inquiry. Finally, future research in this area should continue to examine student voice, choice and equity with regards to inquiry-based learning.

CHAPTER 1

Introduction

Parkland School District, Allentown, Pennsylvania, has focused on building a culture of inquiry-based learning. As teachers focus on digitizing lessons, they lose some of the characteristics of inquiry in their instruction. In a world filled with high stakes testing pressures and school performance profiles, school leaders were always challenged with a task that teachers did not have enough time to teach through inquiry. With a dramatic shift in instructional practices due to a global pandemic (Covid-19), this challenge of needed instructional time is intensified by online virtual learners and hybrid model school systems. Focusing on the characteristics of inquiry for both face to face and online learners will build an understanding of the school culture around inquiry and teachers' overall perspective on the inquiry approach to instruction.

Background

I have served as an educator in the secondary world (grades 6-12) for 24 years. From the first moment I stepped into a classroom as a mathematics and computer science teacher, I have always had a passion for inquiry-based learning. I struggled to understand why teachers shied away from something students always seemed incredibly engaged in. During my career, I have been fortunate to have many experiences that helped me build an understanding around an inquiry-based culture. My perspective in my first 11 years of my career was specifically from the vantage point of a teacher in a mathematics and computer science classroom. During that time, I flipped my Cisco network engineering classes from teacher led instruction to completely inquiry-based. From the classroom, I left for an opportunity to engage in a statewide grant and push for technology use in the

classroom. I spent three years as an instructional technology coach at Parkland High School and another year as the Coordinator of Educational Technology K-12 for Parkland School District. During that time, I had the opportunity to truly dive into my passion and start building a STEM (Science, Technology, Engineering, and Mathematics) culture, reaching a variety of content areas throughout the K-12 levels. My work with technology instruction, inquiry, and STEM continues as I am currently in my 9th year as the Supervisor of Secondary Education for Curriculum and Instruction for Parkland School District.

Identification of the Capstone focus

Through my experiences, I have learned that school climate can change quicker than the culture. Fun teacher led programs can uplift a climate. However, the instructional practices and culture really takes time. We now sit ten years after my first STEM committee meeting, and I still have many of the same questions on the teachers' perspectives of inquiry-based learning. It feels like perfect timing to look deeper into the perspectives in our district. In the last three years, my district has moved toward 1:1 computers in K-12 and a focus on inquiry-based instruction. We have facilitated professional development with both Trevor MacKenzie and Ken Shelton for our faculty. Trevor MacKenzie brought a focus on 10 characteristics of inquiry learning, while Ken Shelton discussed equity within an inquiry-learning environment. As a district we value student voice and equity, within a theme to "educate the whole child." Teachers have digitized lessons well and have done a great job with formative assessment through our 1:1 professional development. We also have some teachers that moved forward well as they pulled together equity, student voice, and inquiry. The goal of this research is to

continually dig deeper into the perceptions of teachers using inquiry learning as we focus on equity, student voice, and student overall success. Within the research, teachers will give perspective and analyze their instruction as it moves to a digital online instructional environment.

There is a paradigm shift in education to move teachers from the sage on the stage to a facilitator in the classroom. This paradigm shift is no new hat for educators. It has been in discussion for the past 20 years during my transition from a classroom mathematics/computer science teacher, to an instructional technology specialist coach, to a coordinator of educational technology K-12 and to my current position as a secondary curriculum supervisor. Throughout this career, there have been very few instructional conversations that did not circle back to inquiry-based authentic instruction. Recently, many of our teachers digitized lessons well during professional development with technology; nonetheless, the question falls within how many teachers are pulling together inquiry, equity, and student voice. Being focused on digitizing lessons is not a bad thing for education; it has paid off in trying times like the Covid-19 school closures, which required teachers to deliver content through digital lessons. However, the emphasis on digitizing lessons also means possibly less focus on inquiry-based learning. This research is designed to dig deeper and evaluate how teachers have grown professionally with inquiry-based learning in order to prepare our students with the essential team skills they need for the future.

Research Questions

There is also a natural curiosity to see if inquiry continued during school shutdowns with online instruction and digital lessons. Teacher self-efficacy could play a

role in their perception and overall time put into inquiry-based lessons. The research is needed in this area because teachers struggle to make the connection between uses of technology, inquiry-based education, equity, and student choice. More specifically, many teachers look at these areas as individual initiatives, when in reality, they are needed to interact together under one framework. In order to work toward a solution, Parkland School District planned a professional development initiative that began with Trevor MacKenzie engaging with our teachers to explore his “10 Characteristics of the Inquiry Classroom" (MacKenzie & Bathurst-Hunt, 2018). Trevor MacKenzie’s vision of inquiry incorporates technology, equity, student choice, and inquiry-based education into one framework. This research is a continued follow-up to the professional development sessions on inquiry with a focus on both online and face to face environments.

The following research questions will be the focus of this study:

1. What characteristics of inquiry classrooms are most frequently addressed in both face to face and online instructional environments?
2. How do teachers perceive inquiry learning as we focus on best instructional practices that include student voice and equity?
3. Within inquiry learning environments, what sub-groups (economically disadvantaged, gender, race, ESL) are seen most frequently enrolled and to what level of inquiry-based learning is the most evident?

Expected Outcomes

There are three modes of data that I plan to analyze in this research, which are outlined in the following action steps. First, I will administer a research survey to teachers to collect information regarding their perceptions on inquiry-based learning as it

relates to student voice, equity, and diversity. Second, I will observe multiple classes in both the face to face and online classroom environments. My focus during these observations will be to collect data on student voice and equity during inquiry. The teachers observed will be on a volunteer basis, and the volunteers will be sought out during the initial research survey. I hope to see that there are many interesting connections between inquiry learning and student voice/equity that were stressed in past professional development sessions for our staff. Third, I will gather demographic data on a few classes with strong inquiry environments and compare that information with demographic data from classes that are found without strong inquiry environments. There are many studies that hypothesize that disadvantaged students do not have the same access to inquiry-based learning. In the same way, when given access they may not take advantage of that access for a multitude of reasons. A small part of this study is to cross reference the student data inside classrooms of volunteer teachers and high-profile inquiry-based programs like computer science, bio-medical, and engineering. Even though this research is focused on inquiry-based education in all contents and all grade levels from grades 6-12, I am hoping to see that the instructional pathways we have in place are encouraging all students to take the programs designed fully around inquiry-based learning.

Fiscal Implications

Through this research process, the financial implications are very minimal, as they are built into what we are already doing for professional development at the district level. We have had some free consultant presentations. However, we have paid for consultants, Trevor MacKenzie and Ken Shelton, to present and do working sessions with

our staff. We also bought one online tool, Defined Learning, specific to inquiry-based education. The majority of other costs would be fees to continue any collaborative work with outside professionals. In the end, predicting costs of instructional changes can often be tricky. In a world where things are changing so quickly, there is something new every year. If itemizing all instructional tools and software for online inquiry-based learning, then it could become costly. Since this research is not adding any instructional tools, then the cost will be focused primarily on professional development costs. The major focus for my research is to follow up the professional development sessions from Trevor MacKenzee and Ken Shelton with instructional shifts for inquiry and equity. The largest cost associated with this derives from building a professional development plan to support the findings from the study. Built into that professional development plan is a team of 12-14 lead teachers to facilitate learning for 380 professional staff. The second cost is a fee to allow Ken Shelton to return to Parkland and facilitate teacher professional development along with student forum conversations. The third cost planned in the professional development budget is to develop Parkland Academy courses to continue this learning in future years. Parkland hosts its own professional learning courses for our staff, which are run by our Parkland Staff. It is critical that professional development is not just a one-time wonder. I have been working on building a STEM and inquiry-based learning culture in Parkland for about 10 years. Change takes time in education; some people move faster than others. Persistence helps move those more resistant to change. If a professional development does not have follow-up, it will be coined, “this too shall pass.” The goal of this research, as well as this budget is to maintain and follow-up professional development on inquiry and equity to keep it moving forward.

Summary

To conclude, individual teaching styles are a result of many factors and experiences. If a teacher does not naturally grow into an inquiry-based teacher or if a teacher cannot quite see the characteristics of inquiry-based learning, then the outcomes of the professional development and shift in culture may take time. Through this study, I am looking for a better understanding of what inquiry-based instructional practices teachers gravitate towards, what their perspectives are of inquiry-based learning, and what have they taken from past experiences that revolve around the 10 characteristics of inquiry. Teacher self-efficacy combined with opening a platform for student voice ultimately varies and has levels that will need to be considered. The level of inquiry and the type of inquiry may also vary depending on teacher perspectives and self-efficacy. Undoubtedly, with the most motivated students, their voice can possibly uplift any inquiry-based lesson. Whereas, the least motivated students may not offer much voice and therefore may require guided inquiry. Within this research, the goal is to dig beyond the surface and understand these variables in order to move an inquiry-based culture forward.

CHAPTER 2

Literature Review

The review of literature begins by a definition of Inquiry-Based Learning. The definition of Inquiry-Based Learning is an instructional approach where students develop understanding through their own exploration and questioning. Many authors approached this definition with different wording and different models. Some maintained a completely open world to inquiry, in the event that students start and finish the learning with very little help from the teacher. In other cases, authors established a more restrictive approach to inquiry. More specifically, this model uses a fully guided lesson directed by the instructor, while the students follow the inquiry script. Early theories of inquiry are based on a constructivist approach and practices built around self-efficacy. This research is not building a case to side with one method over the other. This research is to explore characteristics of inquiry by examining various models within a public school secondary environment (grades 6-12). The research examined the theories, characteristics and teacher perspectives on inquiry-based learning as a closer look into what drives inquiry-based learning in the classroom. With that being said, the research was conducted in a unique time of education (global pandemic for Covid-19) with a high demand for online instruction during the 2020-2021 school year.

Examining teacher perspectives and their inquiry approaches is important, but investigating if equity exists in those classroom opportunities is also necessary. Furthermore, research must not only determine if the classroom demographics are equitable, but also if the resources available to those students are equitable. A large

challenge for online inquiry-based projects, or even a project being required at home, is that not all resources at home are equitable.

Inquiry-Based Learning Theory

An inquiry-based classroom is one in which the teacher uses different strategies that allow the students to interact, imagine, and act as their own teacher. In this type of classroom, students are able to model what they learn and understand, track their learning by asking questions that clarify their misunderstandings, and explain why they interpreted their ideas the way they did. There were many different inquiry-based characteristics and inquiry-based learning strategies that can be used multiple ways to differentiate both formal and informal assessments. Likewise, inquiry-based instruction can reach a wide variety of learning styles. Individualized instruction built on inquiry-based learning characteristics proves to be a highly effective method inside a classroom. As research indicated, characteristics of inquiry-based learning helped better understand the needs for each individual student.

Furthermore, in an inquiry-based classroom, students model what they have learned as a way to show their understanding of different topics and track their learning. Students should also participate in the class discussions, asking questions and interpreting their ideas in their own ways. In order for this to happen, the teacher needs to show the students evidence, make the lessons engaging and interactive, form life connections that relate and interest the students, and create a safe place where students are encouraged to learn in the way that works best for them. The teacher should have the mindset that no one student is going to have the correct answer. Going off of the scenario given, there are many possibilities for inquiry-based approaches to be made. One way to incorporate an

inquiry-based approach is to have the students create their own model of the solar system, and then pair up with a partner to explain why they built the model the way they did. Another way to integrate an inquiry-based approach is to have the teacher walk around the classroom asking the students open-ended questions after they have explained their models. Not only will these questions give students a way to defend themselves and the work they have done, but it also provides the teacher with feedback on the student's understanding of the problem. Some possible open-ended questions to ask are, "Why did you put Jupitar here?" and "What would happen if Saturn were to switch positions with Mars?" In addition, another way this scenario can show an inquiry-based approach is for the teacher to teach the lesson while also incorporating a real-world phenomenon along with it. Relating standards to real-life phenomena proves to be a very effective way to grab students' attention and get them interested in the topic presented.

Many theories can be applied to both elementary and secondary instructional models. Inquiry is not a new term to education by any means. In fact, Rutherford (1964) and Anderson's (2002) researched (as cited in Abd-El-Khalick et al., 2004):

> Irrespective of how inquiry has been conceptualized during the past 50 years or so, and conceptions of inquiry have changed during this period, research has consistently indicated that what was enacted in classrooms was mostly incommensurate with visions of inquiry put forth in reform documents, past...and present. (p. 398)

Over a span of 50 years, the same basic discussion has reinvented itself around skills for inquiry. As the world evolves, new terms and focuses arise. Regardless of these new labels or focal points, there are two consistent points that measure inquiry instruction: the

model and the level. Taking into consideration the model explored and the level in which the inquiry was approached may have a factor on the characteristics used. This research will analyze the teacher perspective on these factors and their approach to inquiry.

There is also a new challenge to inquiry that did not exist 50 years ago: how does one successfully implement inquiry-based learning in the online learning environment? In 2020, a global pandemic forced instructors to maintain education online during stay at home orders directed by government officials. This was a new world of education that has not been seen before. Teachers are faced with the challenge of balancing a hybrid model of education, where students come to school face to face for two out of five days, and an online model of education, in which students learn remotely all days of the week. Moreover, the greatest struggle in this situation was that hybrid students and online students are grouped together in the same classroom roster. This requires daily lessons to accommodate both in person and remote learners. Some educators are teaching fully online sections of students, and at any given time a shift in the pandemic could force schools to move to 100% remote learning. The challenge of inquiry-based learning for an online environment existed prior to the pandemic for various reasons. Often, teachers define concepts with hands-on activities; undoubtedly, hands-on activities are a challenge to simulate online. As a result, this has historically been a focus of discussion as education transitions into the digital world. With this in mind, the pandemic's demanding times for online education has only heightened that need and discussion. It is very timely to analyze the perspective of teachers for characteristics of inquiry within face to face and online environments.

Some authors advocated specific inquiry-based models, while other authors expressed theories in inquiry-based themes. The world of inquiry-based learning is a pedagogical shift in education that everyone seems to put their little twist on. Many educators instantly think of STEM (Science, Technology, Engineering, and Mathematics) when they first hear the word inquiry. However, the problem-solving method for inquiry is an instructional practice for all content areas. It is the skills that matter, illustrated Freeman et al. (2014) findings (as cited in Tang et al., 2017) :

> While this paper reports on teaching through inquiry, we see this pedagogy as a subset of a collection of pedagogies termed active learning. Pedagogical techniques used to engage students in active learning vary between instructors, including group work, think-pair-share, student presentations, project-based learning, worksheets or tutorials completed during class...active learning techniques have a strong positive impact on student learning. (p. 4)

In addition, teachers incorporate these techniques using "personal response systems with or without peer interaction" (Tang et al., 2017, p. 4). This was a common voice of inquiry throughout many models.

A "Constructivist Approach" coupled with "Bloom's Domains of Learning" builds the foundation for the inquiry process. Within the theory of a constructivist approach, students build a case from questions to solutions. They gain knowledge through their own experiences in their lives. In a constructivist approach, there is no room for a complacent learner (von Glasersfeld, 1990). Dewey (1982) argued that learners need authentic learning experiences in order to gain knowledge. His belief on the constructivist approach had no room for memorization of facts without learning

experiences. There are three Domains of Learning within Bloom's Taxonomy, which was built on a constructivist approach. In order to critically analyze, students need to be equipped with all three domains of learning: Cognitive, Affective, and Psychomotor. The teacher becomes the facilitator, and the student becomes the driver of his or her own learning (Ștefan, 2017; Xu, 2019). The characteristics of inquiry-based learning stem from the foundation of the learning domains. The three learning domains are the most broadly used concept in education and directly apply to the research within inquiry-based learning (Anderson et al., 2001). In summary, within the models and characteristics of inquiry-based learning, the student learning domains, as outlined by Bloom, are a basis for the constructivist approach.

Rasmussen and Kwon provided a description of inquiry that looked at teacher planning and student activity within a math classroom. Regarding teacher planning, teachers build inquiry lessons that have three functions. The overarching description focused to ensure that there was an ardent space in the construction of various models. The models provided how the students interpret and generate various mathematical ideas. The approach described a distinct opportunity to ensure that teachers build problem solving approaches concerning tasks and teaching functions (Rasmussen & Kwon, 2007). inquiry-based learning provides a reliable approach in the innovation and learning techniques coupled with the exploration of distinct learning options for the students and the teachers. The most ardent definition of inquiry-based learning should be directed to the student learning domains. The inquiry-based learning approaches are structured with various needs to ensure that the learning approaches are initiated to capitalize on the student generosity and curiosity levels. The employed approaches are centered on the

student's world, and this creates a distinct need to utilize active questioning. The inquiry-based environment allows the student to work alone, which confirms that the student develops a deep understanding via the exploration and the need to discover. This in turn facilitates an innate understanding of the skills and content.

Research circled back to two main theories detailing the ideas of inquiry-based learning: a constructivist approach and the theory of self-efficacy. Kilpatrick (1987) claimed constructivism "seems to be having an especially strong impact on the thinking and activities of mathematics educators" (p. 5). Furthermore, Kilpatrick's claim can be applied to all content areas, as the learner learns from his or her experience in that content. In the theory of constructivism, knowledge was developed by the learner through experiences in the environment (Kilpatrick, 1987). Von Glaserfeld's theory on constructivist learning proved to be consistent with Kilpatrick's research:

> The task of education … becomes a task of first inferring models of the students' conceptual constructs and then generating hypotheses as to how the students could be given the opportunity to modify their structures so that they lead to mathematical actions that might be considered compatible with the instructor's expectations and goals. (von Glaserfeld, 1990, p. 34)

While these experiences are the main driver of learning within the constructivist theory, self-efficacy also plays an important role. The confidence of the learner directly impacts his or her ability to conduct a positive experiment in any learning environment.

Models and Levels of Inquiry-Based Learning

Several authors analyzed the overarching models in attaining the distinct skills in inquiry-based learning. The models outline the various steps in the pedagogy in the

inquiry learning process. The employed languages are aimed at offering a reliable balance between the various learning options. The scope of inquiry-based learning approaches provides three distinct levels that work to enhance the learner agency. These models are interlinked with distinct questioning, investigating, reflection, and acting methods. Models vary in the amount of levels, labels, and the description for those levels. For instance, Callison's model allows the students to learn through problem-solving via the investigation and analyzing approaches. The three inquiry levels aim to ensure that the employed approaches are guided, controlled, and free (Callison, 2014). Research has affirmed that there was a dire need to establish the reliability of distinct inquiry-based learning approaches in the teaching of sciences, especially in teaching specific science content areas. The inquiry-based learning approaches help meet the need to implement diverse strategies in teaching, including the delivery approaches in the teaching of sciences. The world is changing at a very fast pace. The rationale implies that educators need to focus on critical thinking approaches and the creation of distinct knowledge. The approach can be traced to the fact that, in education, traditional instructional methods are no longer effective. There is a a need to establish facts via inquiry-based approaches that give the students exact scenarios to enhance the students' thinking abilities and learning approaches (Abd-El-Khalick et al., 2004). The viability of the implemented teaching approaches lies in developing a reliable education system that intends to enhance the students' learning process. The rationale comes from the need to teach modern research values in the student learning processes. People have distinct perceptions of the rationale of digesting information if the learning process approaches are utterly decontextualized. The implications of repetitive tasks offered on the traditional learning domains mean that

the rationale of utilizing drills in repetitive tasks was meaningless. The distinguishing aspects of inquiry-based learning are framed on the need to make subjects meaningful (Allen & Penuel, 2015).

Furthermore, the implications of research in the current age have also ascertained that students who are taught via the inquiry-based learning approaches perform well on exams, unlike those taught via the traditional teaching methods. Jackson et al. (2015) performed a detailed screening approach to providing a procedure via the administration of distinct standardized approaches in mathematics learning and writing assignments in mathematics in various grades. The accruing student performance was heavily influenced by various instructional and environmental traits closely tied to the philosophy of inquiry-based learning (Jackson et al., 2015). The essence of integrating inquiry-based learning approaches was designed to maximize the overarching student performance levels. More specifically, the most reliable aspect of inquiry-based learning can be traced to the fact that the employed approaches are vital in developing students' critical thinking abilities. There is a need to examine the importance of inquiry-based learning in facilitating the knowledge based on critical thinking with a student centered approach. The traditional approaches concerning inquiry-based learning are also intertwined with the scope of memorizing, and this approach can be traced in the rote memorization approaches that are vital in counting and decoding of texts during the learning process.

Additionally, past research has always been centered on identifying the success of the actual implementation process in classroom teaching and the level of problem solving that developed during that process. The framing of the variables has always been entrenched with the need to compare students' performance both before and after the

implementation procedures of the inquiry-based learning domains. The results depict that the approaches employed in inquiry-based learning approaches are a central function between the students' performance and the implemented learning techniques and methods. The dependent variable has always been centered on student performance. In contrast, the independent variable has always been interlinked with the employed number of tutors, the employed training facilities, and the overarching costs in implementing the depicted teaching approaches. Therefore, the results have been interlinked with the need to determine whether the employed inquiry-based teaching approaches are reliable in diverse contexts, including the home education criteria. The traditional school teaching approaches were framed to provide a reliable workforce for the industrial age, yet this is no longer a primary focus. The outdated need for traditional school teaching approaches has been replaced by the contemporary need for instructional approaches better aligned to the informational age. The rationale implies that the current age requires creative thinkers and innovators (Buckner & Kim, 2014).

Not only should current educational methods work to develop creative thinkers, but in order for instructional approaches to be effective, they must also be engaging. Inquiry-based learning is fun; hence, students enjoy it and are more inspired. It was also interactive; hence, students tend to be engaged and are active participants in the learning process. Finally, inquiry-based learning makes it possible for discussion and critical thinking; hence, students learn more and remember what they have learned. In addition, this type of learning guarantees in-depth comprehension of content. However, the challenge of deploying cooperative learning within classrooms was problematic (Blessinger & Carfora, 2014). Teachers who have used smaller groups for learning can

attest that just putting students into groups plus directing them to collaborate hardly guarantees quality collaboration or learning. There was a need to set up positive social interdependence, structuring shared aims, and instructing 'how' to work together. (Baloche, & Brody, 2017). This research focused on secondary (grades 6-12); undoubtedly, the instructional components in elementary are similar and help with full understanding.

To fully understand levels and models of inquiry-based learning, the research showed that every author has an authentic name for his or her explanation. Kilpatrick's model was simplified into 3 levels. The pedagogy and ideas of other research was organized into an explanation of 4 levels relating to 4 models. To implement inquiry-based learning, researchers all closely followed the following four levels: Level 1-Confirmation Inquiry, Level 2-Structured Inquiry, Level 3-Guided Inquiry, and Level 4-Open Inquiry (Banchi & Bell, 2008). The levels are progressive in the amount of information given to the students. In teacher planning, the teacher gave more information to the student in Level 1 and absolutely no information to the student outside a probe in Level 4. The process of inquiry-based learning related greatly to the guidance given by the instructor. Instructor control was a large part of the level of the lesson planned.

Moreover, in a confirmation inquiry-based lesson, the students were completely guided by the teacher. Each process involved 3 sections of the lesson: questions, procedures, and solutions. As the research explained, this level 1 of inquiry-based learning handed the students information for all three of those sections. In this model/level of inquiry-based learning, the students followed an experiment already conducted. The end goal was for the students to "confirm" that the experiment results are

valid and reliable to the solution given. This was by far the easiest way to conduct inquiry-based learning. The upside to this model was that instruction took place consistently for all students and content was consistent for all students. The downside of this model was that it does not tap student curiosity or spark their interest as much as a topic they choose themselves.

As the solution was removed, the model moved to Level 2 of the inquiry-based learning model. The most common example of Level 2 - Structured Inquiry approach, followed the most typical science classroom with a scripted lab to follow. The typical lab experiment where students followed a structured procedure, answered given questions and developed their own conclusion exemplified this model. This model's structure closely resembled Level 1 with the solution being concluded by the students rather than given by the teacher. Huag (2014) highlighted the importance of guiding students toward conceptual knowledge rather than giving information. Huag (2014) illustrated the difference between teachable and learnable moments moving from Level 1 to Level 2:

> While teachable moments provide opportunities for learning, learnable moments in this study refer to episodes during which students actually are helped toward conceptual knowledge. Whether teachers capitalize upon teachable moments and turn them into learnable moments was manifested in the interaction between student and teacher and in teachers' action to student responses. (p. 80)

In the Level 2 model, structured lessons and teacher interactions were critical in the learning process. Again, in this model all students worked towards a common goal.

Also, Haug (2014) emphasized the fundamental element of inquiry-based learning as students seeking answers to questions. Cervetti et al. (2006) demonstrated (as cited in Haug, 2014):

> As mentioned, there was no specific definition of what inquiry was or agreement on how to explicitly engage students in inquiry-based learning in ways that enhance student conceptual understanding. What was collectively agreed upon was that inquiry-based instruction involves students pursuing answers to a researchable question and comparing their answer with what research was already known about the world. (p. 80)

Within Level 3 - Guided Inquiry, the teacher-created procedure to obtain a solution was removed from the sections of the lesson. The teacher still presented the questions; consequently, the students needed to focus on a procedure to answer the questions. In other words, Level 3 inquiry maintains that teachers provided only the questions. In contrast, Level 1 inquiry involved teachers providing information for all questions, procedures, and solutions. The problem solving skills needed to increase with this level of inquiry, as the students needed to build their own logical steps/procedure to solve. This level required the students to take more ownership in the experiments and the findings. The positive side of this level fell in the promotion of student learning, problem solving and student voice. On the other hand, it was only valuable if the teacher had the ability to manage multiple solutions. Feedback to the students during the process was critical to the success of the lesson and the ability of the teacher to facilitate.

To live at the highest level of inquiry-based learning, a teacher needed to release control to their students. Level 4 - Open Inquiry, required the students to create the entire

process from the idea stage to the solution stage. This level had broad parameters that often led teachers to difficulty in consistent content. However, this level had the highest level of student ownership, student voice and student investment/engagement. As students selected their own idea, research questions, and procedure to solve the problem, they build a direct interest into the learning of that inquiry problem. This level for teachers/students definitely reached the highest risk for planning/practice; however, it also had the highest potential for reward in authentic learning. Engaging with students in structuring and carrying out their very own logical examinations is a motivating method for learning. A specific example of this was establishing an examination question. Additionally, students find out how logical information was developed. Inquiry-based learning has been recommended to emphatically influence students' learning results by methods for empowering open inquiries (Minner et al., 2010). In open inquiry-based learning, teachers motivated pupils to carry out individually designed, interest-guided inquiries to respond to their study questions.

Nevertheless, other research questioned the effectiveness of inquiry-based learning when compared to more traditional teacher-centered models. The highest level, Level 4 - Open Inquiry, pushed the ceiling for students' problem solving and was a model of the constructivist approach. Furtak et al. (2012) and Kirschner et al. (2006) stated this level was unguided and showed negative impacts for that lack of guidance. Particularly, there was evidence-based research that focuses on the lack of effectiveness for Level 4 - Open Inquiry. Furtak et al. (2012) highlighted critiques of inquiry-based teaching: "Critics of inquiry-based teaching have argued that its minimally guided approach," which was level 4 open inquiry, "does not provide sufficient structure to help students

learn the important concepts and procedures of science" (p. 301). Similarly, Kirschner et al (2006) indicated that during inquiry-based learning, students lacked the support they needed. Students' lack of knowledge stressed bad procedures and created a lack of student engagement as a result of this unsupported classroom environment. This was a direct result of teachers relinquishing too much control in the process of the highest level of inquiry. Kirschner et al. (2006) concluded that there was a lack of research that supports advantages of minimally guided instruction:

> After a half-century of advocacy associated with instruction using minimal guidance, it appears that there was no body of research supporting the technique. In so far as there was any evidence from controlled studies, it almost uniformly supports direct, strong instructional guidance rather than constructivist-based minimal guidance during the instruction of novice to intermediate learners. Even for students with considerable prior knowledge, strong guidance while learning was most often found to be equally effective as unguided approaches. No only was unguided instruction normally less effective; there was also evidence that it may have negative results when students acquire misconceptions or incomplete or disorganized knowledge. (pp. 83-84)

Overall, critics of inquiry-based learning have promoted traditional, direct instruction in which teachers presented information to students through deliberately crafted lessons and lectures (Kirschner et al., 2006).

Characteristics of Inquiry

Regardless of the model, level, or style of teaching, the characteristics of inquiry funneled into 10 distinct characteristics. According to research from MacKenzie and

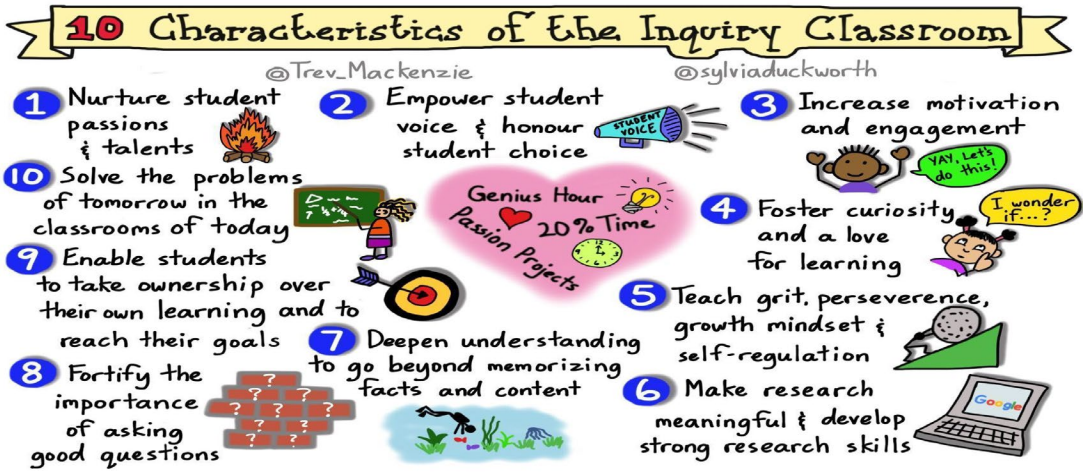
Bathurst-Hunt (2018), Figure 1 highlights characteristics that surface in an inquiry classroom across a span of time over several lessons, days, and weeks.

The characteristics are:

1. Nurture student passions and talents
2. Empower student voice and honour student choice
3. Increase motivation and engagement
4. Foster curiosity and a love for learning
5. Teach grit, perseverance, growth mindset and self-regulation
6. Make research meaningful and develop strong research skills
7. Deepen understanding to go beyond memorization of facts and content
8. Fortify the importance of asking good questions
9. Enable students to take ownership over their learning and to reach their goals
10. Solve the problems of tomorrow in the classrooms of today

Figure 1

The 10 Characteristics of the Inquiry Classroom



Note: Original from *Inquiry Mindset: Nurturing the Dreams, Wonders, & Curiosities of Our Youngest Learners* by T. MacKenzie & Bathurst-Hunt, (2018), p. 14. Copyright 2018

Today, in the 21st century, most students are visual and hands-on learners (MacKenzie, 2016). This being said, students need to be allowed to act as their teachers and use the information given to them by the classroom teachers to create their own understanding of the content. Teachers encourage their students to engage in dialogue and work with other students and peers to gain new ideas and look at other viewpoints of the topics. By creating an inquiry-based teaching environment where collaborations and model-based learning are encouraged, and phenomena are used to captivate students, students can show their understanding of different topics on a deeper level than they would if they were to sit, take notes, and be lectured at. Using inquiry-based approaches, students thought outside the box, learned with their own methods, and defended their understanding and knowledge of the given topics.

This inquiry approach allows students to learn in their own ways, model what they are learning as a way to track their process, and give students a more enjoyable approach to the standards taught to them. According to MacKenzie (2016), this approach was designed to "Foster curiosity and a love for learning" (# 4 in Figure 1). This approach benefited not only the students, but also the teacher. With this approach, the teacher differentiated lessons, encouraged collaboration and interaction of students in a productive way, and assessed students in a manner other than a multiple-choice test. An inquiry-based approach turned a lecture and test-based classroom into an explorative and conceptual applicative learning environment. In lessons like this, teachers focused on a growth mindset as referenced in MacKenzie and Bathurst-Hunt's (2018) research (#5 in Figure 1). To understand the growth mindset, research showed that the definition of self-efficacy best explained the central theme of growth mindset. More specifically, Bandura

(1977) and Maddux (2002) stated (as cited in Buenconsejo & Datu, 2020) to clarify the meaning of self-efficacy:

> Self-efficacy was the belief about one's capability of showing skills and performing actions needed to achieve a desired goal in a specific domain or situation. Personal accomplishments (e.g., successes and failure in specific tasks), vicarious experiences (e.g., observing others succeed or fail), verbal persuasions (e.g., words of encouragement from mentors), as well as physiological and emotional states (e.g., fatigue and anxiety level) influence self-efficacy beliefs. (p.2)

In conclusion, students that lacked the confidence to do inquiry, have shown less of the other characteristics.

Moreover, characteristics one, two, three and nine in Figure 1 all relate to intrinsic motivation for students. Rudd's (2008) argument (as cited in Song et al., 2012):

> Rudd (2008) proposes that personalization should "increase learner choice and voice" in which learners have the power and control over their learning. "Increase learner choice" means that learners have the opportunities to make decisions on the agenda of actions made by the teacher; and "increase learning voice" means that learners have the opportunities to initiate the agendas for action, and are co-designers for their education with the educators. (p. 681)

The term engagement came to mind with this statement, and it was a deep level of engagement to where that shifted to investment by the student. Nurturing the students' passions strengthened the investment/engagement the students had in their work.

Another key aspect in MacKenzie's research was problem solving skills. The research showed numbers 6, 7, 8, and 10 in the 10 characteristics (Figure 1) all revolved around an engineer design mindset. That mindset stressed solid problem solving skills with a desire to explore without a fear of failure. Research demonstrated inquiry-based practice included the development of problem solving through inquiry. Engineer design method skills such as "critical thinking, the ability to undertake independent inquiry, and gaining responsibility for their own learning" developed as a positive instruction result of inquiry (Vajoczki et al., 2011, p. 4). Research showed that inquiry-based learning performed with these characteristics in mind produced many more positive results than a memorization method of learning. Therefore, the growth mindset, student voice, and problem solving centralized as the main focus areas of inquiry.

Within the 10 characteristics, problem solving surfaced to the top of every discussion. Ruzaman and Rosli (2020) established this point in their research:

> Inquiry-based education (IBL) was a form of active learning approach that was strongly student-centered that was driven by inquiry or research. Students are given a sequence of questions or task and are asked to solve and make sense of them. In inquiry-based learning, students are challenged to engage in a deep understanding of the particular courses. Effective inquiry-based learning courses are making use of purposefully structured problems or scenarios that further can develop and enhance students' critical thinking skills, interpersonal skills and group collaboration skills. (p.5)

The pros of the students given the questions related back to the positive features of a guided model of inquiry. The teachers had the control of the direction of the unit within a

guided inquiry lesson. The negative result of the students being given the questions, lead to the lack of student choice in the learning. According to MacKenzie (2016), when teachers attempted to include the 10 characteristics, it became very difficult to hit all 10 within a guided lesson. The deep side of the pool was open inquiry and that was an area that teachers only visited and did not stay all the time. Instruction flows through the models as does the ability to embrace the 10 characteristics of inquiry (MacKenzie, 2016).

Inquiry Online and Inquiry Equity

The distinct characteristics of inquiry concerning face to face and online instruction are closely interlinked with the type of instructional method to be employed in the actual teaching and learning process. Research affirmed that the ingrained teacher's characteristics concerning the approaches in teaching identify a key relationship between the teachers' traits, the teaching content, the employed learning activities, and the individual differences between the students. (Bandura et al., 2001) The other key variable lies in the underlying objectives, which are to be attained at the end of the entire learning process. MacKenzie's (2016) research has also affirmed a direct relationship between the denoted teacher characteristics and the effectiveness of the employed project delivery methods. The most viable aspect of the project method was the proposition that teachers are controlling and better positioning their students to construct specific knowledge for the application of the denoted projects. According to Ruzaman and Rosli (2020),

> Simulations offer a chance for learners to perform experiments by changing variables and observing the effects. Mobile technologies are literally

> revolutionizing school education nowadays. Mobile technologies are converting the conventional classroom setting with interactive classroom applications. For example, Frog Virtual Learning Environment (Frog VLE), 1Note and Google Classroom. With this revolution, subjects in school will be taught on virtual learning platforms through interactive lessons. Students can complete their homework and also do some revising of their studies on the gamified teaching and learning platform. (p.5)

This was a direct correlation between the teacher traits and the content being taught. The research showed that the teachers' interest in technology use and their interest in content played a greater variable in the implementation of that technology. The question that remained in the background of the inquiry-based learning through technology assumed that all technology supplies are equitable for all students. Students may have all the interest in the world with full student choice, but the access to technology resources may have blocked the ability to follow through in some cases.

This research took place at a unique time in education - through a global pandemic (Covid-19 pandemic in 2020). School systems were forced to think about equity and technology as a means of redesigning the instructional delivery process. Some schools closed entirely operating on 100% remote instruction. Other schools took a chance to continue with a hybrid model and schedule some face to face time. Little research currently exists on the effectiveness of these models, along with the ability to continue learning through an inquiry-based approach. The research of Ruzaman and Rosli (2020) was not the common practice in the pandemic as many teachers were forced into using technology without the intrinsic values in that delivery model. The intrinsic value

may have existed in the content taught; however, the accelerated need for technology as a delivery model impacted the instructional inquiry-based models in a much different way.

Teachers' beliefs on how students learn impacted the classroom, whether that classroom was face to face or online. If the teacher missed the positive values of learning through online models, then the teacher believed that the students can not learn through that online model. According to a research study by Wong (2016), "The results show that the science and mathematics teacher participants significantly changed their beliefs over the one-year period. It appears that the iSMART courses had an impact on the teachers' beliefs, which moved toward more student-centered positions" (p. 9). As the teachers' beliefs were impacted, the students' progress became more evident. With this same study, the researchers also found that veteran teachers' beliefs shifted much less than the new teachers. Furthermore, the research also supported that teacher professional development and educational learning programs had an impact on the mind shift of instruction (Wong, 2016).

Teachers building relationships with students was a critical component to this conversation for both understanding and equity. Stone et al. (2019) illustrated the negative impact a poor student-teacher relationship could have on learning :

> As expressed by Angela, 'the whole point of being online is, I would have thought, for flexibility, and to then encompass a much broader range of learners in different circumstances' (PreSemester). It was disappointing, and potentially disengaging, when they experienced at times a lack of understanding or regard for their circumstances as online students. In the words of Julie, 'We all have different circumstances and that's why we're studying online'. Julie described

> how in one of her units the tutor had told all students, including those online, that any contributions to the discussion forum posted after Wednesday each week would not be looked at by the tutor, as this was considered to be too late in the week to merit attention. (p. 30)

Inquiry-based learning approaches, models and characteristics supported that teachers need to build relationships with students. Within Angela and Julie's experience, the lack of that relationship created a gap in learning. When students were turned off by the logistics and inequities, the learning experience was blocked. This showed the barrier was created when student voice is not heard.

In addition to the negative results that come from limiting student voice, another problem in this current educational system is teachers watering down content when they think a student is not capable of the skills needed to complete an inquiry-based project. Should educators incorporate more open ended projects for higher achieving students or should they attempt to keep it equitable? Although inquiry-based learning is not a complete solution to equity issues, it can function as an entry point into an equitable classroom. When done with the best interest of all students in mind and the perspective that all students learn equally, inquiry builds a level ground for all students to reach the future skills they need. Not only was it important to investigate teachers' perspectives and inquiry approaches, but it was also necessary to examine if equity existed in those classroom opportunities. This research will address if the classroom demographics are equitable and if the resources available to all students are equitable. A major challenge for online inquiry-based projects, or even a project being required at home, was the fact that not all resources at home are equitable.

Equity for all students and the ability to access the technology proved to be a greater challenge than many planned for during Covid -19, 2020. It could be projected that analysis of 2020 and beyond will show even more variables related to equity for all students. The overarching denotations were closely knit with the learning opportunities and the student outcome levels. Research in the same field has been aimed at ensuring that the students who are from poor backgrounds experienced stress during the entire learning process. There was a dire need to ascertain the achievement gap between the students from higher and lower income families. The income and the achievement gaps indicate that there was a need to examine attainment gaps between children form different income levels (Burchinal et al., 2011). This study was based on early childhood education and related to the question, "Why aren't more students from diverse backgrounds engaging in higher level classes like STEM and inquiry-based learning environments?" Further investigation of this question was necessary to fully grasp the concern that STEM courses our predominantly male and not students with diverse backgrounds.

Equally important, the classroom environment proved to be a critical contributor to inquiry-based learning. The 10 characteristics from Figure 1 had a direct correlation to building relationships and encouraging a positive learning environment. According to Hernandez et al. (2019),

> A caring, culturally responsive learning community was essential—one where all students are well-known and valued and are free from social identity or stereotype threats that exacerbate stress and undermine performance. These positive relationships with adults and peers encourage students to engage their curiosities

> and take learning risks while mitigating the effects of adversity that many students face requires equitable access to curriculum and the removal of strategies, such as tracking, that signal deficit views of some students' capacities. Building the relationships needed to ensure effective, personalized instruction requires structures that allow for continuity in relationships—such as looping with teachers for more than one year, advisory systems, small schools or learning communities, and teaching teams. These can enable individualized supports, outreach to families, and a sense of belonging crucial to student success. (p. 3)

Building relationships proved to be a great equalizer in helping students that faced equity and diversity issues. The better the teachers knew their students' stories, the more help accrued to create the highest quality of education for those students (Darling-Hammond & Cook-Harvey, 2018). Equity should not be a roadblock to inquiry-based learning; conversely, inquiry-based learning should be an opportunity to open student voice and choice helping to provide an equitable learning opportunity.

Teacher Effectiveness and Student Motivation Drives Positives/Negatives

The underlying issue of why student-led learning can be a weakness fell in the teacher's ability to deliver a high quality of instruction. The approaches in inquiry-based learning are centered on distinct goals. They are not framed on the need to let go of the learning process, but they need to retain ultimate control over the three learning domains (Callison, 2014). The lack of proper and well-controlled teacher intervention approaches in the learning process were a limitation to the envisioned scope of learning. This was because the students' thinking can be restricted to their innate experiences, and this led to lack of knowledge, which was vital in investigating a definite task or a proposed inquiry

line. The teacher should have an innate understanding of when it was most appropriate to introduce new concepts and ideas that are aimed at serving as a guide to the postulated student learning outcomes. The application of the interchange proposes a clear avenue for the students to self-direct their learning outcomes. The effectiveness of the inquiry-based learning outcomes should be tailored to ensure that it was appropriate for diverse learning groups and ages (MacKenzie, 2016). This rationale maintains that the complexity of the tasks is altered to match up the capabilities of the students in different ability levels. The approach demonstrates the need to offer diverse well-tailored questions that are directly intended to control and guide the presumed learning outcomes. Therefore, there is a need to guide the students to choose specific topics that spark their interest from which they should root their overarching research. The students should be guided in directing their research to diverse topics and well defined parameters to drive the scope of their research. The employed tasks should be adaptable to the specific abilities in line with the ability of the students to deliver the tasks. The ability of the students in completing diverse tasks should be examined in relation to the complexity of the task and the student's ability. According to Anderson (2002), the utilized inquiry process proved to be a significant advantage because it allowed the students to gain innate control over the chosen learning direction, and it was the most appropriate approach to student learning in diverse age groups. However, the effectiveness of the teaching process was highly influenced by the teacher’s ability to apply the theory properly.

The review has affirmed that inquiry-based learning represents a student-centered learning approach characterized by minimal directions from the tutor; therefore, it can be effectively utilized in diverse learning criteria. The approaches were vital in distinct

subjects concerning the needs of the students of diverse ages. The inquiry-based learning approaches employed in theory are diverse. They entail detailed inquiry through research and a deep focus on student collaboration rationales, problem-solving approaches, and the innovative application of the accruing knowledge. The practice's effectiveness introduced new ideas and concepts by the student because the teacher acts as a facilitator to the learning process. The learning approach's success was ingrained in the careful application of the underlying approaches to diverse learning environments.

Moreover, the success of the implemented inquiry-based learning approaches also relied on teacher effectiveness. The approach implied that teachers' self-efficacy had an innate and long interest in teaching the subject. If a teacher believes in his or her own ability, then creating an avenue of exploring the concepts in other outside of the classroom activities becomes routine. The underlying interest lies in ensuring that the teachers overcome the overarching difficulties in teaching the subject. Teacher burnout can drastically impact teacher self-efficacy. The scope of the extent in the inquiry-based learning approaches led to the realization of innate interest traits among teachers with higher self-teaching and self-efficacy levels. Research was based on the need to ascertain the various effects of personal learning goals and the overarching efficacy in teaching via the central inquiry-based approaches (Bandura et al., 2001). The results of numerous studies have been compared with the need to employ diverse approaches concerning teacher efficacy. The various inquiry-based learning models are interlinked with the confirmation inquiry approaches, the structured inquiry, and the open inquiry rationales.

The various learning models' scope confirmed that teachers with high personal values have a higher need to increase their personal goals. The teacher's role in the

teaching process was to ensure that all the student experiences are documented (Bandura et al., 2001). The other method lies in providing the students with a viable learning curve that was embedded in creating a team spirit. It was necessary that the student learning experience was well-coordinated by incorporating well-prepared teaching and learning materials. In conclusion, there was a positive relationship between teacher preparation levels and student achievement levels.

The teachers who capitalized on articulating the syllabus and the teaching content were most likely the ones to deliver superb teaching approaches that result in student achievement. The results of several studies (Bandura et al., 2001; Makenzie, 2018; Allen & Penuel, 2015) reflected that there was a direct relationship between the subject matter, the teacher's knowledge, and the student attainments. This affirmed that the student's confidence level has a direct impact on the utilized teaching approaches. The 10 characteristics in Figure 1 imply that students build confidence with investment in student voice and choice (MacKenzie, 2016). Conversely, missing voice and choice broke down confidence. Within the characteristics, the lack of a teacher's background knowledge has a direct effect on the students' learning abilities. In an open inquiry-based learning project, students may have confidence in a topic that a teacher lacks the knowledge to support. The teachers' learning abilities suggest a need for the teacher to exercise mastery of the instructional materials. The most rigorous approach for teacher planning lies in employing various instructional methods interlinked with the subject matter's key details. The instructional materials should be aimed at adjusting information concerning the students' learning needs. The reliability of the employed teaching approaches was embedded in the rationale of active communication approaches between the teachers and

the parents to ensure that distinct instructional materials (i.e. iPads) facilitate the actual learning process (Hong et al., 2017). The instructional materials are vital in ensuring that the activities provide a clear rationale for the students to interact with the project requirements.

In addition, the implemented teaching approaches' scope aimed to ensure that the subject matter was appropriate and successful. The teacher should have vast knowledge of the subject matter with a good mastery of the subject content. The teacher's role was solely based on the need to impact a clear rationale characterized by ongoing knowledge exchange. More specifically, the approach postulated that the teacher's qualifications have a direct impact on the student's achievement levels. The school management ensured that there are highly qualified teachers to spearhead classroom instruction. The school management also established a reliable framework in defining and preparing the staff members. The rationale of quality teachers was to confirm that the provided instruction provoked the students' innate thoughts and demonstrates a clear avenue in facilitating the classroom teaching approaches. The teachers exhibited high professionalism levels by displaying desirable traits while upholding high standards and norms in the teaching process. The scope of a teacher's ability lies in that they have a vivid experience of the students' learning abilities (Hong et al., 2017). The teachers were better positioned to establish that they bring out the actual learning by capitalizing on their experiences. They should be assessed by utilizing various normative attributes by verifying that the learning process was logical and closely knit in distinct ethical attributes. Research has affirmed a direct relationship between the teacher's effectiveness and years of teacher experience. However, the teacher's years of experience are not

entirely linear with the actual classroom content delivery (Allen & Penuel, 2015). The available information suggested that inexperienced teachers are always less effective when compared to senior teachers. The accruing benefits of the teacher experience form an ardent avenue in the actual classroom teaching approaches. The direct implications of teacher experience and the postulated student attainment levels is solely based on the teacher's motivation levels during the content delivery approaches.

Most importantly, effective teacher instruction required elements of differentiation to meet the needs of a diverse group of learners. Differentiation was seen in many different ways when it comes to an inquiry-based approach. To start, one method had students work with partners. By students working with partners, they asked questions, built off of each other, and saw the topic from a different perspective. Another way differentiation was seen in an inquiry-based classroom was to use various hands-on activities. An inquiry-based classroom proved to be model-based, which allowed students to create their own models based on their understanding level. From the model, the students explained what they did and why they did it. Assessments in inquiry-based classrooms exhibited differentiation in many ways. One way was to have the students defend their models. This can be done by asking open-ended and higher-order thinking questions for the students to answer. From this, the teacher demonstrated a gauge of the understanding level of the students. However, a teacher who was not able to manage multiple styles of learning for inquiry did not get the same depth of knowledge from students.

The scope of inquiry-based learning approaches was closely knit in the scope of the overarching inquiry-based characteristics. First, there was a need to nurture student

passions and talents. In addition to nurturing student passions, inquiry-based learning approaches must empower student voice by honoring the student choices. Moreover, inquiry-based learning approaches address the need to increase the student's motivation and engagement. The other approach lies in fostering curiosity and an innate love for the learning approaches. Also, the teacher's grit works to preserve a reliable growth mindset and the self-regulation approaches (Rutherford, 1964). The teacher's role was to develop meaningful projects that produce reliable research from students with viable problem-solving skills. As stated in the constructivist approach fostering curiosity needs to deepen an innate understanding, which goes beyond the actual memorization of the distinct facts and the available content. In this research by Rutherford (1964) and MacKenzie (2016), teachers often focused on content and lost sight of these inquiry-based rationales. Inquiry-based learning aimed to teach students the essence of asking the right questions instead of the teacher asking the right questions. The most experienced teachers created a clear rationale, which was aimed at developing an innate ownership of the learning process to attain the overarching goals. The right approach lies in creating an innovative culture in the contemporary classroom to spearhead the actual learning domains. The right rationale called for a dynamic teacher to understand a balance with characteristics, levels, and depth of knowledge.

Conclusion

There are distinct approaches concerning inquiry-based learning methods. The overarching synergy regarding the employed approaches ensures that all the inquiry-based models are enacted under the key advantages of the inquiry-based learning characteristics. The elements of inquiry-based learning approaches can also be confirmed

in relation to the basic problem-solving methods or processes. The critical consideration was entrenched in underlying issues of inquiry-based learning methods. The key focus on the overarching inquiry was interlinked with the need to employ the denoted approaches in distinct contexts. Embedded within that context, 10 characteristics and 4 main levels assembled that main theme of inquiry-based learning. However, challenges in pedagogy and terminology often varied slightly due to the author at hand.

The long-term hybrid approaches can be examined via the scope of the traditional lectures and the curricula. There is a dire need to examine the distinct disciplinary contexts, and it can be employed to a range of scales in the contemporary learning environments. The learning approaches can be altered to accommodate different learning environments, which should also include the nature of the discipline at hand. The framing of the inquiry-based approaches should be tailored to ensure that the students are equipped with the necessary resources in spearheading the entire learning approach. The key approaches demonstrate a need to solicit the vital time in gathering the necessary resources to lead the entire learning process. The teacher's preliminary work can also be interlinked with the need to ascertain the availability of the essential resources necessary to guide instruction. The most veteran teachers capitalize on distinct information searching skills to support the subject matter and support the entire learning timeline of content delivery. Collecting the best materials requires a need to engage various skills in searching for extra content aimed at enhancing the teaching process.

More specifically, inquiry-based learning represents a core teaching approach, which revolves around the student's perceptions, ideas, and innate observations to guide the learning process. The teacher acts as a facilitator, and his/her role is characterized by

the need to create an ongoing knowledge exchange platform by ensuring that the ability of the students to understand and refine the key details lies at the core of the entire learning process. Inquiry-based learning approaches are not centered on the need to answer the right questions or get the right answers. Rather, they are concentrated on the need to question, research, investigate and engage in a dedicated pursuit of the actual learning process. Furthermore, the method was enhanced by the active involvement of different learners in the same educational setting to enrich the scope of the ongoing interactions in relation to the learning process (Tang et al., 2017). The actual learning process's responsibility lies with both the teacher and the student because the general focus was framed on the ongoing exploration and analysis of the available knowledge rather than the need to unearth the correct answers in diverse situations. The entire learning process in an inquiry-based approach was characterized by various open-ended questions, which included the need to conduct knowledge transfers through the scope of interpretation, hypothesis questioning, and reflective learning. In summary, inquiry-based learning was not centered on self-directed research elements, but it revolves around the rationale of student-based learning.

To further emphasize the student was at the core of inquiry-based learning, the classroom instruction rationale was based on the need to nurture the student's discipline stemming from the students' thinking and acting abilities rather than the need to work on an individual project (Maab, 2018). The overarching goal lies in ensuring that the students are better positioned to tackle real world questions to determine the truth surrounding different controversies. The scope of the learning process relies on the development of diverse communication and questioning skills. The accurate articulation

of the approaches mentioned facilitates the student's ability to develop a deep-rooted understanding of the content knowledge.

Inquiry-based learning employs a number of teaching and learning approaches, including problem-based and design-based learning criteria. The student learning domains of design learning involve posing actual challenges to the students via offering projects that require a hands on approach. The scope of design learning abilities extends to the creation of project presentations to ensure that the students have an innate understanding of what they have learned in the classroom. The distinct approaches in inquiry-based learning can be integrated into a single task or diverse task in an approach best suited to offering diverse learning styles (Dana et al., 2011). The pedagogical approach emphasizes the need for the students to self-direct their learning in the scope of the curriculum with minimal instruction from the tutors. The advantages can be traced to the fact that the learning approach fosters student-based learning. An underlying disadvantage was that not all students have the tools or background knowledge to successfully learn in this environment. The fact that the learning approach was directed by the student and not the teachers creates a distinct avenue in ensuring that the students are in full control of what they learn. If education was equal for all students, then ultimate control in the student learning domains serves as an innate stimulation to the student’s learning and creativity levels. Not all students have the same motivation, even if the education background is equal. The fact that the students are more self-driven in understanding the diverse elements of their research, assumed that all students are self-motivated. This was primarily due to the fear of students losing focus as well as a fear of students lacking the ability to digest what they are learning.

The world is changing very quickly, and the field of education must evolve in order to support these dynamic times. The need to implement the most dynamic teaching approaches is more important now than ever before. Moreover, the scope of contemporary research regarding inquiry-based learning proves that there is a dire need to ensure that students are well-positioned to engage with the subject matter via distinct approaches in order to effectively stimulate the learning process. Student voice and choice proved to be at the front of research evolving from the characteristics and levels of inquiry. Not only is it necessary to evaluate the needs of the student, but it is also essential to confirm the skills of the teacher to guarantee that there is ongoing quality delivery of the content. In an inquiry-based classroom, the teacher is perceived as a knowledge simulator and not a knowledge dispenser. As a result, the employed approaches' validity serves as a key in uplifting the student's creativity levels to various knowledge heights.

CHAPTER 3

Methodology

Inquiry-based education is no new term to educational professionals. The world surrounding our current instructional models have changed exponentially over the past 10 years. This research study is significant because it will dig deeper into what teachers value about inquiry-based learning. There are many characteristics of inquiry-based lessons that this study will analyze. Additionally, through the examination of teacher perspectives, this study will identify the most valued or accepted characteristics in our lessons. The year 2020 has even accelerated the change in education with a global pandemic. Technology has become essential, and online education has become a normal part of all educators' lives. This study will also take a look at any similarities and differences in the teachers' perspectives on their inquiry-based lessons in a face to face and an online environment. This chapter will explain the purpose of this study as well as build a greater understanding of the research questions by identifying the participants and setting including fiscal needs, the research method, the plan for incorporating teacher perspective, and an overview of data collection.

Additionally, this chapter will focus on the reasons to study inquiry-based learning within the Parkland School District. This study is based off of three research questions that will be listed within and highlighted by the goals throughout this study. In order for readers to completely understand the need for this study in the Parkland School District, they will need to recognize the background and district goals. Knowledge of the dynamics within the school district will be explained and threaded through each section of this chapter. This research is not a shallow look at the Parkland School District; the

reader will need to acquire an understanding of Parkland's history over the past 10 years. Even though this research concentrates on the characteristics of inquiry, the pedagogy is critical and embedded throughout professional growth and goals internalized in the school district as a whole. This will become more clear to the reader as this chapter further discusses the make-up of the district and the resources available to the teachers.

To start, the data collection of this research will be a mixed research design. In this design, the researcher is expecting to ascertain an understanding of the teachers' perspectives on inquiry through a survey, classroom observations, and a few interviews. This data will be used as a cross section to some demographic data pulled from our district databases. More specifically, the demographic data will be analyzed to view the make-up of high profile inquiry pathways, along with the student populations of the classrooms observed. In the end, a section of this chapter will describe the validity of the data. In other words, it will detail the measures that have been taken to assure confidentiality and the steps taken to collect data in order to maintain credibility, reliability, and dependability of the results.

Purpose

The purpose of this study is to take a closer look at the characteristics identified in past professional developments as essential characteristics for inquiry-based learning. As we dig into these characteristics from a teacher perspective, we will analyze both the face to face classroom and the online classroom. The research identifies the correlation between the most frequent characteristics in both environments. It is also important to note that this is not specific to any one content area. The research data will be collected from grades 6th through 12th and open to all content areas for analysis.

Within the past few years, the Parkland School District has made a mark with STEM (Science, Technology, Engineering, and Mathematics) education. Parkland School District has built partnerships in these fields and developed pathways of learning to support STEM education. The school district has also rolled out a one to one computer initiative over 3 years for all K-12 students. With each student having their own computer and a strong STEM pathway in place, one would think that the research on inquiry-based learning would become relatively easy and straightforward. However, even with those initiatives in place, the district has seen hurdles for inquiry education and challenges with building cultures around inquiry-based learning. This investigation will look at the characteristics of inquiry-based learning and establish an understanding of the characteristics as they relate to other district initiatives.

Furthermore, for a district to move forward collaboratively and cohesively, initiatives need to be seen as interlocking gears with consistent goals. If teachers and administrators feel they are getting hit with multiple new unrelated initiatives, there is often a feeling of overwhelming workloads. It is incredibly important for readers to not only know the characteristics of inquiry-based learning, but they must also understand the other initiatives. This study would become too broad to analyze the characteristics in all other district instructional goals. The core of this research is to investigate what characteristics of inquiry-based learning are most often evident in instruction.

Within this study, a large part of the characteristics will bring attention to student voice and student choice. This is an area that will naturally cross-over again with STEM instruction and with any computer one to one initiative. The professional development with inquiry-based learning does not stand alone. Also, it is important to note that within

this research study it will be critical to analyze the equity within the demographics of a classroom. As we evaluate student voice and choice within the characteristics of inquiry-based instruction, learning if equitable opportunities exist will be an essential part of analyzing the most commonly implemented characteristics.

It may seem complex to navigate STEM education, one to one computer initiatives, equity concerns, and best instructional practices all in one research study. However, the reason for this is a result of the complexity that a school district faces in order to institute change. If the gears are not working together, it will be perceived as an overwhelming task of accomplishing multiple initiatives. On the other hand, if the gears all work together, it will be seen as one larger objective. This study will target one aspect of that larger goal, while at the same time never forgetting that there are multiple components working together to initiate instructional change. Within this study, data regarding student voice and choice along with equity will hopefully shed light on current teacher perspectives of inquiry-based learning. More specifically, the study will dig deeper into 10 characteristics as outlined in professional development with Trevor MacKenzie.

As discussed in the research, there are many levels of inquiry and multiple models of inquiry-based learning that will all factor into the comfort level and self-efficacy of a teacher. Each teacher has something different that motivates them. Some teachers are incredibly motivated with STEM education. Other teachers are incredibly motivated with technology and digitizing lessons. Some are just motivated by the pure love of their content and passing that content to their students. The one common thread that fits into any level, any model, or any reason for that motivation are the characteristics that

surround inquiry-based learning. According to research from MacKenzie and Bathurst-Hunt (2018), the characteristics are:

1. Nurture student passions and talents
2. Empower student voice and honour student choice
3. Increase motivation and engagement
4. Foster curiosity and a love for learning
5. Teach grit, perseverance, growth mindset and self-regulation
6. Make research meaningful and develop strong research skills
7. Deepen understanding to go beyond memorization of facts and content
8. Fortify the importance of asking good questions
9. Enable students to take ownership over their learning and to reach their goals
10. Solve the problems of tomorrow in the classrooms of today

These characteristics can be identified in a wide range of instructional practices from teachers with diverse backgrounds in inquiry-based education.

By narrowing this study to these 10 characteristics, this research will indirectly analyze any level of inquiry. It also fits into multiple instructional models to see if the characteristics of inquiry-based learning exist. During early STEM initiatives in Parkland, some teachers never realized they were doing STEM activities or inquiry-based learning. They were incorporating effective instructional methods, but they did not yet recognize that these practices were rooted in STEM. Moreover, concentrating on the list of characteristics will help analyze inquiry-based learning in all instructional environments. The research questions are designed to open the data collection to all instructional environments without limiting the study to any one content area. In Parkland School

District, we have been working toward building a culture of inquiry in all content areas. The following research questions will guide this study:

1. What characteristics of inquiry classrooms are most frequently addressed in both face to face and online instructional environments?
2. How do teachers perceive inquiry learning as we focus on best instructional practices that include student voice and equity?
3. Within inquiry learning environments, what sub-groups (economically disadvantaged, gender, race, ESL) are seen most frequently enrolled and to what level of inquiry-based learning is the most evident?

These research questions are the focal point of this study and will facilitate data analysis for all content areas by examining the characteristics of inquiry-based learning.

Equally important, recognizing the history of the Parkland School District is essential for the purpose of this study. This study was specifically designed to embrace multiple district goals that interlock into one larger instructional shift. This current year has added new dimensions into that larger instructional shift with a fast demand for online learning driven by the Covid-19 pandemic. Some of these necessary changes that have taken place in just one year are changes that have been discussed for over 10 years. The current crisis of a worldwide pandemic has moved that discussion along much faster. Regardless of how we ended up in our current learning environment, this research has a focus on characteristics that support inquiry-based learning for both face to face and online learning. It will also take a look at student voice and choice as it aligns to both inquiry-based learning and equity.

Setting and Participants

The setting for this research study is Parkland School District. According to the district profile located on the district website, Parkland School District is a suburban, public school located in Lehigh County in eastern Pennsylvania. This region is a semi-metropolitan area known as the Lehigh Valley. This Lehigh Valley area is made up of Lehigh and Northampton Counties. There are three cities: Allentown, Bethlehem, and Easton, which are the foundations for this Lehigh Valley as well as numerous townships and boroughs. With approximately 675,000 residents and a $40.1 billion economy, the Lehigh Valley is the third largest metropolitan area in the state. This region is made up of many large employers that have been strong supporters of STEM education and building a STEM ecosystem. A few of the top advocates and partners in education have been Air Products, Amazon, B. Braun Medical, Crayola, and hospital systems including Lehigh Valley Health Network and St. Luke's University Health Network. Within Lehigh Valley, Parkland School District encompasses three townships with a total population of approximately 60,000. It covers 72 square miles with a wide socio-economic range as it borders the city of Allentown on one corner and stretches to farmland on the other corner.

Parkland School District prides itself on a vision statement of, "Educating the Whole Child: Arts, Academics, and Athletics." Parkland maintains a reputation of excellence as it has SAT results that are historically above both the State and National means, a graduation rate of 96%, and offers 31 Advanced Placement College Board courses. The total student population for grades K-12 is 9,572. The district personnel consist of 670 teachers, 68 administrators, and 660 support staff. This study prioritizes the secondary level and is reflective of 5,429 students and 299 teachers for grades six to

twelve. The total school district budget is currently $192 million for the current school year. Having a solid financial foundation and many business partnerships invested in the STEM field, Parkland has implemented pathways in Engineering, Bio-Medical and Computer Science. We have embraced the engineering design method as a basis for learning with the creation of a Parkland Problem Solving (Appendix A) method used in all content areas to support inquiry. It is also a large part of the learning design method that is supported in our makerspaces. The creative engineering learning of a makerspace is supported in every Parkland school.

The student demographics have been changing in Parkland over the last 10 years. Within the last five years, the student population eligible for free or reduced lunch has increased significantly. More specifically, the percentage of eligible students for free or reduced lunch in 2016 was 11% of the entire population. In 2020, that number has more than doubled to 28% of our student population. The special education population is currently at 15%. This number has been pretty consistent over the past ten years. In 2011, our special education population was at 16%. Within the last 8 years, we have built interventions and supports that have helped our struggling student population. However, one statistic that has increased quite a bit is our English Language Learners (ELL). We currently have 301 ELLs within grades K-12, with 38 native languages spoken. In 2011, the ELL population was 130, with 20 native languages spoken. Lastly, the diversity of the student population of Parkland School District is White (62%), Hispanic (16%), African American (5%), Asian (13%) and Muli-Racial (4%).

Moreover, Parkland is a school district that has a wide variety of offerings and pathways available for students. It has been financially successful in providing resources

needed to move forward in the fields of STEM education. The instructional models have been supported by technology and the use of digital content in an inquiry-based learning environment. The environment encompasses both face to face and online instruction in which every student, regardless of instructional model, has a computer. The culture has evolved to understand that STEM education exists within all content areas. Within that culture has been a revolutionary shift in pedagogy to see that the inquiry-based learning process is critical to student success. We understand that we are preparing students for many jobs that have not even been designed or invented at this point. The problem solving method is designed to help students be prepared for that ever changing world. This research study is designed to help us better understand the perceptions of the inquiry-based characteristics within this culture of Parkland School District.

Parkland has developed many initiatives to support inquiry-based learning and build the knowledge around the problem solving process for our educators to better their instruction. The participants in this study are teachers from grades 6th to 12th in all content areas within the Parkland School District. There are 74 teachers that responded to the initial survey (Appendix B). The volunteers for the classroom observations and interview process have all been teachers within the district for at least 5 years. The sample group has been open to all content areas and all experience levels. There are 6 volunteers for an extended study that cover: two high school math, one high school science, two middle school English teachers and a middle school social studies teacher. That was not something planned; however, those were the volunteers that came forward. The anonymous survey (Appendix B) may have some teachers new to the district, as the current data shows that three teachers have less than five years experience. The remainder

of the teachers that have answered the survey have 6 or more years of teaching experience.

When the first survey was administered, the high school staff had just been informed they would be switching from hybrid to fully online instruction starting December 21st, 2020 as a result of increased cases of Covid in the building. The timing of this survey was designed to catch teachers over the winter break after allowing for some time of relaxation and reflection. The first semester was a whirlwind of balancing a hybrid model in which class rosters have both face to face and fully online students. When a Parkland school has hit a limit of Covid positive cases, it will switch to full virtual. As a result, the participants in this study experienced instructional situations in both face to face and virtual classrooms.

In order to get informed participant consent, the researcher created the inquiry-based survey (Appendix B) which included an explanation of the study and a disclaimer built inside the Google Form questionnaire. The survey part of this study was to remain anonymous, so the informed consent was designed as an original disclaimer and extended for the volunteers offering an interview and classroom observation. The participants are completely voluntary and are a sampling of both middle and high school teachers (Appendix C).

There were 289 teachers that received the original survey, and there are 74 responses. The 74 responses represent 25.6% of the secondary contracted teachers. The researcher was hoping for a larger sample size. In the original planning the goal was to get one third of the contracted teachers in the original survey. Given the fact that most teachers feel overextended this year due to the circumstance surrounding the pandemic

and its impact on education, the sample size of one fourth can be considered a success. The level of teacher stress is higher than I have ever witnessed in my 24 years in education. Any task above the normal job is easily pushed off and considered too much. Again, the timing of the initial survey was planned to reach teachers over winter break in order to allow time off to de-stress. Then school buildings needed to shut down for outbreaks of Covid-19 cases. At that point the researcher had received 54 responses. The researcher decided to allow teachers time to complete their first semester grades and get through the mid-term, ending in January. The researcher sent out a second effort to collect data in February. In order to validate that there were no duplicate responses, the Google Survey was designed to allow only one response per account. After the second effort, 20 new responses surfaced to accumulate the 25% sample.

The survey to staff is just the beginning of the data collection. This data will be cross referenced with observations and interviews. The process for the selection of teachers involved with the class observations and interviews will be completely voluntary. This year has been challenging enough, and the researcher was cautious to not create additional stress for the staff. By using volunteers for the second phase, it will allow the authenticity of the effort put in by the teachers. During the original survey process, a separate questionnaire was issued to ask for additional volunteers needed for extensive data collection within class observations and individual interviews. The researcher's goal was to gather six volunteer teachers to allow for a look deeper into the perspectives of the staff. In the end, there were six total volunteers. There are three participants from the high school and three participants from the middle school.

Likewise, this group offers a nice span over all four core content areas (English, mathematics, science and social studies).

Intervention and Research Plan

After a thorough review of literature, the research illustrated many natural progressions in inquiry-based learning. There are many factors that influence this instructional process. Teacher self-efficacy is a large factor in any instructional model. After examining inquiry-based learning in the literature review, it became clear that influence plays a great role and could be a factor that the researcher definitely wants to keep in the foreground of this research plan. However, this research study is not designed around that factor. This research study is designed to look deeper into the characteristics that influence inquiry-based learning. Regardless of the model or level of inquiry, the literature review identified a common thread of characteristics that were important to a successful inquiry-based lesson. The study will also analyze the implementation of inquiry-based instruction in a face-to-face environment versus an online environment.

To further understand these characteristics with any instructional practice involving inquiry-based learning with equity in mind, this study was designed as a mixed-methods study. Within the qualitative research, the researcher will analyze the teachers' perspectives through surveys, classroom observations, and interviews. The data collection will consist of survey questions offered to all secondary teachers (grades 6 to 12) in Parkland School District. The survey, classroom observations, and interviews are offered to all with a voluntary response incited. To understand any possible hurdles through equity, there is an added quantitative part that will analyze student demographic data in targeted classes and pathways.

There are three major pathways in the high school that relate to STEM education and a fully inquiry-based curriculum. The three pathways align to the Project Lead the Way curriculum. Project Lead the Way (PLTW) is a non-profit organization offering inquiry-based STEM education curricula for K-12 students. The PLTW curriculum aligns to the design process that is very similar to the Parkland Problem Solving (Appendix A). We also have 31 advanced placement courses aligned to the College Board curriculum and have a strong inquiry-based learning foundation. Data from these areas will be a critical component to understanding any equity concerns in inquiry-based learning pathways.

Although the survey can only reveal the perceptions and opinions of the teachers, it was designed to stay anonymous to pull a more reliable sample of positives and negatives. The survey responses will be a starting gauge for the study followed by an in depth look provided by a few additional teacher volunteers. In analyzing the research, we hope to better understand the culture of Parkland School District, and in the future we plan to design extensions for professional development sessions strengthening the characteristics of inquiry-based learning. Historically, teachers have been seen as the sage on the stage and the deliverer of content knowledge. Based on the literature review and the models of inquiry-based learning, the contemporary teacher needs to act as a facilitator in the classroom in order to successfully reach today's learners. Also, the literature review emphasizes the importance of student voice and student choice in the learning process. Through teacher classroom observations and teacher interviews, the researcher will be able to analyze the original survey perceptions up against these other authentic experiences.

The research may prove to be timely, as there has never been a shift in education as quickly as this shift to online learning during the Covid-19 pandemic. This shift may help understand inquiry-based learning in both face to face and online environments, or it may completely hinder the process. The concerns that may impede the process is the current work environment of the teachers, which has been taxing on their energy and time planning. For the most part, teacher planning and preparation time has been greatly consumed by supporting students in the classroom and students at home at the same time. Prior to this year, there are few environments out there that model this current environment in the Parkland School District. The literature review has detailed a breakdown of models in face to face environments and the level of inquiry necessary to build invested students in those environments. Similarly, the literature review also has studies and documentation of instruction for remote learning along with the models used in those online formats. The new hybrid educational world (combination of face to face and online within one classroom) that Covid-19 has required to meet the needs of all of our students has never been so widespread as it is currently. School districts across the nation, not only Parkland School District, were shut down in March of 2020. This forced a rapid shift to online education. A year later, in March of 2021, districts continue to navigate the most effective and safe way to educate students. Within this last year, schools have been utilizing 100% online learning, hybrid learning, or full time face to face learning. Parkland School District has flipped models multiple times; however, during this current year they have been mostly hybrid. This research plan is designed to analyze the full spectrum of these experiences and gauge the characteristics of inquiry-based learning in both environments.

Furthermore, the fiscal implications of this research do not extend from what was currently already budgeted by the district for improving inquiry-based learning. In other words, this study will not require the district to accrue any additional costs beyond what was already planned for professional development. However, the findings of this study may discover areas to increase future professional development sessions. Prior to the start of this study, the district had invested in two outside consultants, Trevor MacKenzie and Ken Shelton, to work with our teachers. This collaboration is an ongoing process. The work has been organized through our curriculum and instruction office and is already aligned to district goals. Other costs for the district, including the one to one computer initiative and software upgrades to improve online learning, were already in place prior to the research study plan. To continue, one future cost that we are projecting and planning for is a professional development cost to have teachers collaborate together and also to work with student groups. The best time to accomplish this collaborative work with both teachers and students is during normal school hours. This would require substitute staffing costs. We have budgeted to allow 280 hours of substitute costs, which equates to 40 full days for teacher release time. This study itself has no overhead costs. The survey used is through our Parkland Google Domain using Google Forms. The class observations and interviews required no additional release time or compensation. The tool used to transcribe the interviews is a free online tool.

Research Design, Methods, and Data Collection

The design of this research is an investigation into the perspective of our teachers on the characteristics of inquiry-based learning. This study is an extension of work done by Trevor MacKenzie with our staff. Within MacKenzie's (2016) work, he states 10

characteristics critical for inquiry. In order to obtain an accurate reflection of the teachers' perspective on inquiry-based learning in the Parkland School District, the research is designed to analyze the characteristics of inquiry-based learning and equity within inquiry from multiple measures. The qualitative pieces of this research are the classroom observation (Appendix F) and teacher interviews (Appendix G). The questions on the teacher survey (Appendix B) are designed on a five-point Likert scale and seek information regarding logistical purposes, online environments and face to face and online environments that begin a quantitative look at data. This would imply that hybrid classes will have students in both of those environments. Examining both the qualitative and quantitative data collected will consistently check in on the teacher perspectives of the 10 characteristics on inquiry-based learning. By examining the 10 characteristics through a survey, classroom observations, and teacher interviews, the researcher's goal is to pattern consistent measures in the perspectives of inquiry-based learning.

In the shadows of the 10 characteristics of inquiry-based learning is a question on equity. In order to triangulate data on equity, this research will move beyond just qualitative data from the survey, classroom observation, and interviews to collect quantitative data analyzing a few of the high-profile classes. The researcher will analyze the quantitative data from all of the classrooms that were observed and cross reference the data to the results of the interviews. The researcher will also analyze data on a larger, more global perspective of the district in regards to the pathways aligned to the Project Lead the Way (PLTW) curriculum. By analyzing these PLTW groups, we hope to see if all students, regardless of demographic characteristics, have equal opportunity to excel in these pathways. More specifically, the analysis of the demographic data will reveal a

snapshot of how the inquiry-based Parkland Problem Solving process, which is used in all content areas of Parkland School District's curriculum, influences the demographics of the three pathways in PLTW. Project Lead the Way has proven to be a key factor to success in inquiry-based learning within engineering, bio-medical, and computer science fields (Utley et al., 2019). Overall, the mixed-methods approach will provide the researcher with critical data to develop school improvement plans in any areas that produce less than adequate for the Parkland School District.

Entering into this research, the researcher knew that participation of human subjects was going to be required to secure a complete understanding of teachers' perspectives pertaining to inquiry-based learning. This research project incurs very minimal risk to participants. Volunteer participants completed an entry survey (Appendix B) on their perceptions of inquiry-based learning and equity as they explored 10 characteristics learned in previous professional development sessions. Following the initial survey to all staff, a sample of six teachers were selected from the participants that responded to the volunteer survey (Appendix D). This selection will serve a purpose to narrow the group for interviews and class observations. Furthermore, all information will be confidential. The participants may opt out of the question(s) of their choice and may opt out of the complete study at any time. The teacher consent form will be distributed through email along with the survey by the researcher (Appendix C). This form clearly states that participation is voluntary and participants may withdraw consent without explanation at any time. The anonymous survey will have a question to approve consent to start the survey. A written consent form will be signed and collected from all participants volunteering for the classroom observations and interviews. The projected

time requirement for the completion of the survey, interviews, and class observation is a maximum of two hours. As stated, all information is voluntary and confidential. In the final stages of this study, I will collect and examine demographic student data on the classrooms observed to see if there are any equity concerns. No student names or confidential information will be used. For instance, all identifying information will be hidden and only the overall percentages of students in each sub-group will be used in this study. Additionally, this research plan was reviewed and approved by the Internal Review Board (IRB) during the month of August 2020. The official approval was obtained from IRB on September 10th, 2020 (Appendix E).

When the researcher started this study, there was a concern that his research had little to no costs. However, the overview of this research stresses many actions that revolve around the growth of teachers and observational practices to help those teachers continue to grow. Therefore, this study is not based on an implementation of new costly items. This forced the researcher to think in a different way, pondering the question: "What does Parkland School District currently pay for and use, that if taken away, it would have a hard time stressing inquiry and equity?" The budget began to grow quickly. One of the largest areas of inquiry used by many teachers is makerspace items. In particular, the 3D printing materials and printer inks are a starting point of needed consumable materials. Next, the researcher reflected on the one to one initiative in which every Parkland student has a district issued device. Not only is the cost of maintaining those computers a huge expense, but addressing equity concerns by providing Kajeets to students for leveling internet access at home also adds to the cost. If you add the equity concerns the researcher has built into this research, then the researcher needed to also add

the cost of Kajeets for leveling internet access at home. These expenses are more appropriately labeled as indirect costs rather than direct costs; however, the researcher felt it was noteworthy to start that explanation here. It is essential for a reader to understand and connect other potential initiatives that helped with inquiry-based learning even if those other initiatives were not a direct result for an inquiry-based learning goal.

Another indirect cost to consider is the instructional software. Without software tools, teachers may be limited on the level of inquiry they can provide students when teaching face to face in a classroom. Certainly, teachers would be restricted to an even greater extent in the level of inquiry they can deliver to remote learners. The top software needed is our learning management system, Schoology. We have become very dependent on this tool as online education is in the forefront of our current world. This tool is critical for this study to exist. Schoology also has administrative tools that will help me observe classes in an online setting. Additionally, this is a district-wide learning management system, and consequently, it allows for a consistent online platform as students move from teacher to teacher. Some other necessary online resources are Newsela, Defined STEM, Breakout Edu, AutoCAD, WeVideo, Discovery Streaming, EdPuzzle, and Nearpod, many teachers use these tools for some inquiry-based projects. Parkland School district also has events that support inquiry-based learning like the Science Fair. There is a minimal cost for the Science Fair; nevertheless, it must be noted as this is one area the researcher may see inequities within students' projects.

Moreover, the most direct fiscal implication is the plan for professional development. Parkland School District currently has an annual budget for Professional Development sessions of around $80,000. Prior to this research, we have invested around

$20,000 annually for the last three years towards inquiry-based learning professional development sessions. Predicting costs of instructional changes can often be tricky. In a world where things are changing so quickly, there is something new every year.

The primary objective of this research is to follow up on the professional development sessions from Trevor MacKenzee and Ken Shelton with instructional shifts for inquiry and equity. The costs for the supplies and outside speakers were accounted for within the $20,000. We also built in a substitute cost for teacher leader collaboration and professional learning community planning time. The largest cost associated with this derives from creating a professional development plan to support the findings from the study. Built into that professional development plan is a team of 12-14 lead teachers to facilitate learning for 299 professional staff. In addition, the second cost planned in the professional development budget is to develop Parkland Academy courses to continue this learning in future years. Parkland hosts its own professional learning courses for our staff, which are developed and administered by our Parkland staff. It is critical that professional development is not just a one-time wonder. The researcher has been working on building a STEM and inquiry-based learning culture in Parkland for about 10 years. Change takes time in education; some educators move faster than others. Persistence helps move those more resistant to change. If a professional development plan does not have follow-up, it will be coined, “this too shall pass.” The research, as well as this budget for the planned professional development, should support the need for follow-up professional development sessions on inquiry and equity to keep it moving forward.

Validity

In order to triangulate data to ensure the results are consistent from multiple measures, the researcher will analyze inquiry-based learning through a teacher survey (Appendix B), classroom observations (Appendix F), and teacher interviews (Appendix G). Hendricks (2017) states that it is necessary to triangulate data in action research. This is a critical step to the validity of the findings and something this researcher is very mindful of. Within those three components, both characteristics of inquiry and also equity of students in those classes will be studied. To fully analyze the equity in the classrooms, the researcher will pull student demographic data from the classes observed and the major inquiry-based learning pathways of the PLTW curriculum. This pragmatic view of concrete data will help to better interpret and understand the data collected through classroom observation and survey results. The research is purposely designed as a mixed-methods study to bring the actual numbers for student groups into the analysis of the research.

Hendricks (2017) further explains four criteria for increasing credibility and validity: Credibility, Transferability, Dependability, and Confirmability. According to Hendricks (2017), triangulating data is at the core of his view on the four criteria. Some other factors within the four criteria are prolonged observations, accurate data recording, peer debriefing, and biases made clear. All of these factors have been taken into account while designing the plan for this research. To explain in more detail, it is important to recall the timeline discussed earlier in this chapter. The work on inquiry-based learning has been ongoing for a couple years in the Parkland School District. The first survey was planned in December after ample time for the outcome of previous training to take effect.

The last inquiry-based training occurred 14 months prior to the survey, and the last equity training occurred right before the Covid-19 shutdown of school, 9 months before the initial survey. The timeline for classroom observations and interviews were planned to follow the survey; however, these will be spread out over the months in the second half of the year. As a result of allowing this time, it was critical to use tools to not only record the data but also access the data to review multiple times. The researcher created a process of collecting interview transcripts and Google Meets recordings, all with complete confidentiality, to allow for future review and reflection on the data. Another factor in this plan and process to build credibility and validity was having an external committee member available for continued discussion. This member is an employee of Parkland School District; however, this individual has no connection to the inquiry-based training or equity committees. He has been a valuable asset to keeping the researcher reflective and non-bias throughout this process.

In the beginning of planning, the researcher reflected on the timeline of the classroom observation and the teacher interviews. It became clear that the teacher interviews should occur following a classroom observation. It was a concern if the teachers knew the interview questions prior to the observations. Knowledge of the questions could influence their instructional delivery of the lesson. The concern would be if teachers accentuate on the key areas acquired from the interview questions. Therefore, the researcher made sure that all classroom observations were complete prior to the teacher interviews. The interview questions were designed to be a reflective measure for both the teacher and the researcher during this data collection process.

Conclusion

In the end, the intention of this research is to determine the scope of our teachers' perspective of inquiry-based learning characteristics and equal opportunity for all students in inquiry-based education. The results of this study will help design a plan to improve upon the characteristics that were the least evident and also enhance the characteristics that were most frequently observed. In addition to the characteristics of inquiry-based learning, student voice and student choice flow as an underlying theme in all areas of this study. The mixed-methods approach will allow the researcher to analyze equity and student voice/choice through multiple angles. The Covid-19 global pandemic brought a shift in education that will help this study evaluate and build a deeper understanding of face to face and online learning. The researcher will observe the characteristics in the two environments and draw conclusions in an unbiased manner. There is no need for bias because the goal of this study is to identify what is working and what is not working within the system as a follow-up to inquiry-based learning professional development sessions.

Finally, the themes of the research questions driving this study are built to better understand student voice and student choice through the background knowledge of the inquiry-based learning characteristics. As the research takes a deep dive into the world of inquiry, the education environments of both face to face and online learning will become an essential factor in the data collection and analysis. This is one area that the research had to migrate towards given the current learning environment for the next school year. This natural migration has strengthened the research study and action plan. Additionally, it brought into focus a new factor of equity as students learn remotely and not all students

have the same resources at home. The true reflection of the data and results from this study will help better support our teachers and students in the future years of inquiry-based learning.

CHAPTER 4

Data Analysis and Results

The objective of this study was to examine teachers' perspective of inquiry-based learning as it related to10characteristics that all content teachers in grades 6 to 12 were taught during a previous professional development session. In order to dig deeper into the learned characteristics, three major goals were identified and aligned to the research questions. While analyzing this data, the first goal was to look at a broad scope of perceptions from the staff members who responded to the inquiry-based survey. Data was collected on the perspectives for both an online learning environment and face to face learning environment. Moving beyond that survey, the second goal was taking a more in-depth look into the classroom instructional model. Teachers' lessons were analyzed through classroom observations and teacher interviews with volunteer teachers. The final goal was to analyze equity within the high-profile inquiry-based learning pathways at Parkland High School. Demographic data was pulled from our database in the Project Lead the Way (PLTW) pathways and measured against the demographic data of the district as a whole.

The classroom instructional model prior to 2020 functioned much differently than the structure of the classrooms during this global pandemic and this study. Traditionally, inquiry-based learning was an instructional model where students were face to face in one classroom and usually worked in groups. It is important to understand that during the professional development session in the fall of 2019 on inquiry-based learning, this was the instructional environment most commonly seen in teachers' classrooms. During the collection of data, that traditional classroom environment was uprooted, and something as

simple as students working in groups could no longer happen. For this entire school year, students had to work six feet apart to meet social distancing regulations. It is also important to note that during the data collection, students were mostly on a hybrid schedule where some students were online and some were face to face at same time. This allowed for data collection in both environments (face to face and online) within the same teacher's classroom on a given lesson.

Furthermore, this chapter will present the data analysis and the process the researcher used to analyze the data. The survey was developed based on a Likert scale and designed as a broad-brush survey yielding results that can be cross referenced to the observations made in the classrooms and the teacher responses in the interviews. The following sections of this chapter include data triangulated from the original survey overview and data collected over a few months following that survey. The data collected on the classroom observation tool (Appendix F) created a profile of a lesson from the researcher's observation. The data collected on the interview was a transcribed discussion following each classroom observation analyzing the teacher perspective on their classroom and lesson. The classrooms observed were intentionally not from the high profile PLTW courses. This will allow areas of inquiry to be analyzed up against the equity of the PLTW pathways. The data shared in the next section of this chapter paints a picture of inquiry-based learning through multiple lenses for Parkland School District. The chapter concludes with a clear and comprehensive summary that illustrates inquiry-based learning for student voice, choice and equity.

Data Analysis

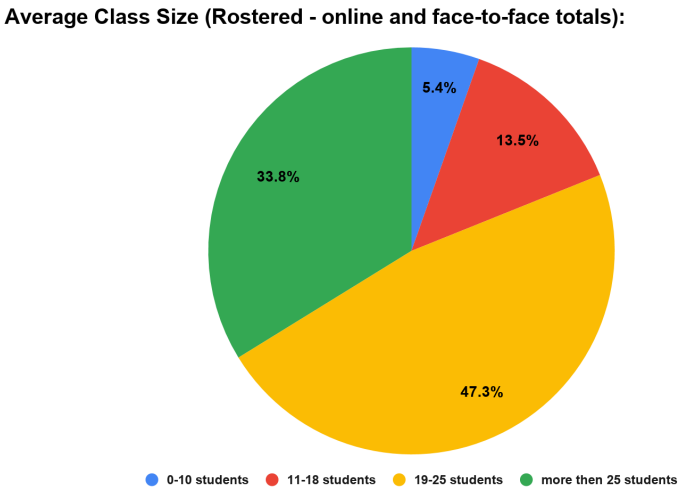
Using a Google account through the Parkland School District, a survey was created and shared with all secondary teachers in grade 6-12 (Appendix B). The survey consisted of five sections. The first section collected data based on particular demographics of each teacher. Section two collected data specifically on the perspectives of inquiry-based learning. This section is a general overview of inquiry and not specific to the characteristics of student voice, choice and equity. The third section unpacks logistical questions to get a feel for the structure of each classroom and the work environment of the teachers. Sections four and five compare the face to face and online environments based on the characteristics of inquiry-based learning. These sections are the heart of this research digging deeper into student voice, choice and equity. Additionally, they are the two sections most frequently cross referenced with data from the classroom observations, teacher interviews and demographic information.

Moreover, one goal in the data collection process was to have a sample that covered as many demographics as possible. Within this process, a sample size covering various ages, experience levels, and contents were a large portion of the validity explained in chapter two. More specifically, out of 74 teachers, there are 42 who teach in the high school, 31 who teach in the middle schools, and 1 who teaches at both the middle school and high school. The classrooms are very average in size. The district's average classroom size is 24 students per roster in a classroom. The study shows that 81.1% of the teachers that responded have class rosters of 19 students or more. Figure 2 represents a complete overview of class roster size. Within this figure, the class size of 0-

10 students topped at 8.4%. Also, the sample is reflective of a majority of veteran teachers.

Figure 2

Average Class Size for 74 Teacher Grades 6 - 12



In Figure 3, 83.8% of the teachers have 11 years of experience or more. Taking a look at the next decade of teachers, 39.2% of the teachers surveyed had 20 or more years of experience.

In addition, it is important to identify the content areas that were represented in the data collection. In Figure 4, there are 11 different content areas represented and three responses in the other elective areas. The four core subject areas are heavily represented with 11 in English, 13 in mathematics, 14 in science, and 12 in social studies. The core subjects represent 67.5% of the survey responses.

Figure 3

Teaching Experience for Two Middle Schools and a High School

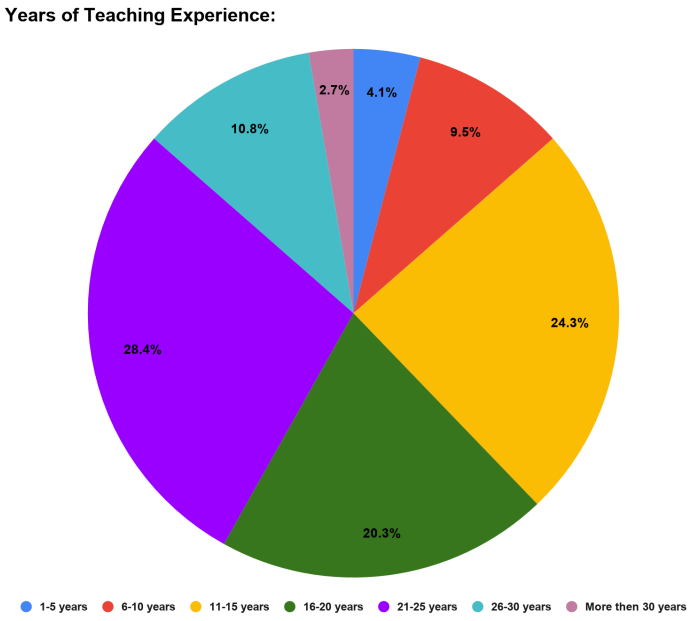
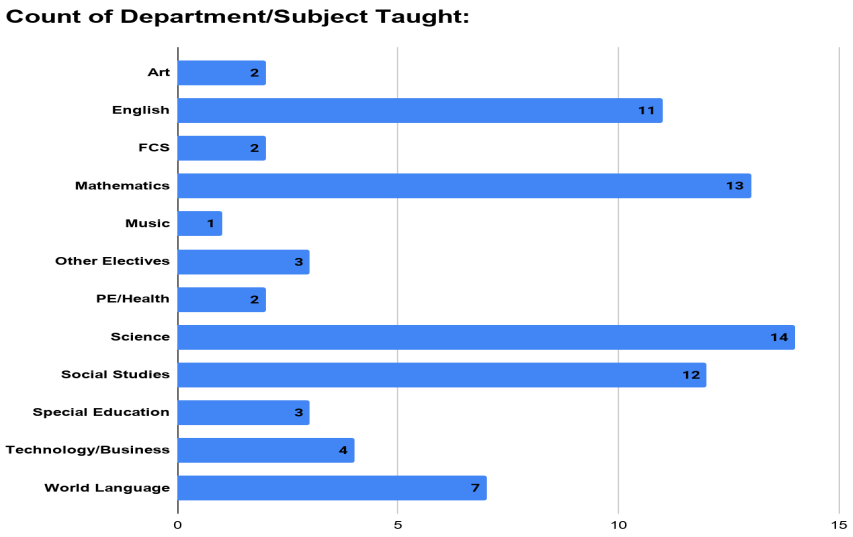


Figure 4

Overview of the Departments/Content Reflective in this Survey



The original survey was the beginning of the data collection process. The goal of the classroom observations and teacher interviews was to have a smaller more concentrated group to dig deeper but also represent multiple demographic areas. The volunteers for the teacher observations and interviews were broken down into three high school teachers and three middle school teachers. More specifically, the six teachers covered the four content areas of Mathematics, English Language Arts, Social Studies and Science. In the data collection process the teachers were labeled as Teacher 1 to Teacher 6, and all information was kept confidential. During this part of the data collection process, open dialogue was used to allow reflection. Even though open dialogue was encouraged, data collection tools (Appendix F) and interview questions (Appendix G) were used to help structure the data flow.

Finally, the last stage of the data collection process was to utilize our student database system and pull demographic information of the students in the Project Lead the Way course pathway in the fields of Bio-medical, Computer Science and Engineering. These pathways are very high-profile inquiry-based learning opportunities in Parkland School District. Furthermore, gender, ethnicity, and economic status were the focal points in the review of the demographic information. The overview of the demographic data can be found in the upcoming section.

After all the data was collected, an organizational chart was created based on the three research questions. Data was sorted into areas that best fit for each research question. At that point, comparisons were made between the survey, interview questions, and classroom observations. To better analyze the data from the survey, calculations were made to create a comparison based on standard deviations of a Likert scale. In order to

calculate a standard deviation, a calculation was made for a mean and a mean 2. The mean is a calculation where the response value equaled a multiplier of: Strongly Disagree =1, Disagree = 2, Neutral = 3, Agree = 4, Strongly Agree =5. The total was then divided by total responses. The mean 2 values are calculated in a similar manner; however, the response value equaled a multiplier of: Strongly Disagree =1, Disagree = 4, Neutral = 9, Agree = 16, Strongly Agree =25. This creates a weighted mean that is needed to calculate the standard deviation. This allows for the data to be spread in a larger curve for analysis as the standard deviation is then calculated from the square root of the difference of mean 2 and the mean. The purpose for calculating the standard deviation allows for an analysis of the full set data for each Likert Scale question. The extremes on the high and low end of the standard deviation scores were then analyzed to generate comparable points for the sharing of the results as it related to each research question.

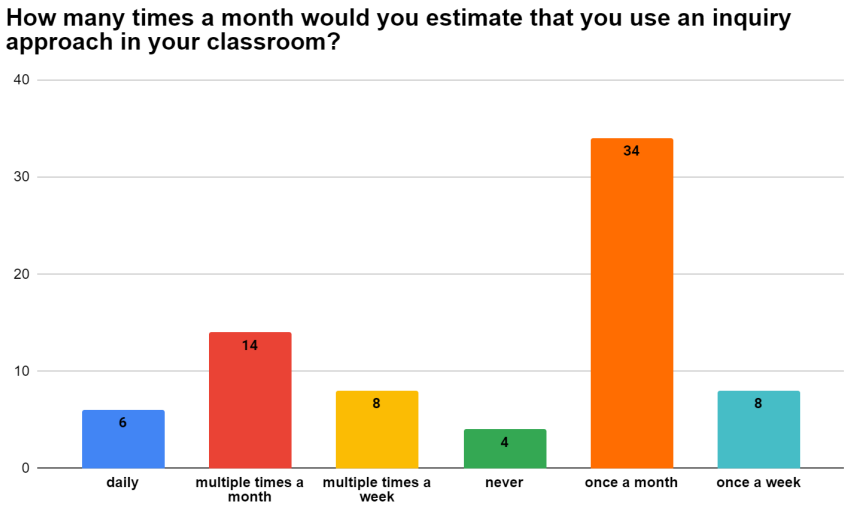
Results

To start, this section will address each research question from multiple data points. The organization and analysis of the survey allowed the researcher to compare the larger view to the focused classroom observations and interviews. This comparison allowed for a thorough understanding of the teachers' perspectives, and the common threads from the survey, observations, and teacher interview became critical data points for each research question. In other words, data from the survey, observations, and interviews was relevant for all three research questions. However, the quantitative data on student demographics was pertinent to research question three only. The pieces of data from all data collection tools are presented within the section for that individual question.

The research data shows a high number of veteran teachers that gave feedback during the survey (Figure 2). However, a more reflective piece of data for inquiry-based learning is how often those teachers express using inquiry-based learning in the classroom. When asked, "How many times a month would you estimate that you use an inquiry approach in your classroom", there are six teachers in Figure 5 that express doing inquiry-based learning daily, and there are four teachers who share that they never use inquiry-based learning. The teacher volunteers for the extended study do not fall on either of these extreme ends. In particular, all the volunteers responded between weekly and monthly to the question asking how often they use inquiry-based learning in the classroom. This was not intentionally planned by the researcher, as all teachers who volunteered were accepted into the extended study. However, it is noteworthy to identify that the extended study is not a voice of either extreme end of inquiry-based learning use.

Figure 5

Frequency of Inquiry-Based Learning from the Teachers' Perspective



Analyzing research question one, “What characteristics of inquiry are most frequently addressed in both face to face and online instruction?” It is important to note that sections four and five of the survey gathered information from a broad brush of 74 teachers in regard to this question. There were 16 categories of inquiry-based learning characteristics based on a Likert scale used to analyze the teachers’ perspectives investigated in research question one. The results of the survey show that most categories have a very different perspective between online and traditional face to face learning. When looking at respectful interactions between teachers and students, it is important to highlight the difference between the 43 total responses strongly agreeing with face to face and only 15 responses for online inquiry. During the interviews and class observations, there were no noticeable differences in respect between teachers and students. On the contrary, data was collected during the class observations on participation and cameras being on that could be interpreted as respect. Through six classroom observations, 84% of the participation came from the students in the face to face environment and 22% of the students online did not have cameras turned on. This leads into another area to highlight in Table 1: active student participation. The data from the classroom observations directly correlates with the data collected in this category on the survey. More specifically, student participation for face to face students ranked much higher than students joining in class online. Overall, the responses in Table 1 highly support student voice and choice along with a strong sense of inquiry-based learning. During the teacher interviews, four out of the six teachers, when asked to define inquiry-based learning strategies, all stated students having voice and choice as a critical characteristic. That is very consistent with the face to face environment in Table 1 for categories questioning

student ownership and student voice and choice. Similarly, to participation, these areas also reveal a lower ranking on the Likert scale when shifting to an online environment. The responses of face to face mostly have standard deviations of three or higher, and the results show many standard deviations below three for online learning.

Table 1

Characteristics of Inquiry-Based Learning (online vs face to face)

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	Mean 2	Standard Deviation
Respectful interaction between teacher and students	Face-to-Face	2	1	10	18	43	4.34	19.72	3.92
	Online	1	8	24	26	15	3.62	14.05	3.23
Respectful interactions among students	Face-to-Face	0	3	11	24	36	4.26	18.85	3.82
	Online	1	14	25	21	13	3.42	12.74	3.05
Student and teacher pride in the work	Face-to-Face	0	6	12	23	33	4.12	17.91	3.71
	Online	4	14	25	19	12	3.28	12.01	2.95
Active student participation	Face-to-Face	1	6	11	24	32	4.08	17.68	3.69
	Online	10	27	21	11	5	2.65	8.22	2.36
Nurture student passions and talents	Face-to-Face	1	4	18	21	30	4.01	17.09	3.62
	Online	8	17	23	18	8	3.01	10.42	2.72
Encourage the growth mindset	Face-to-Face	1	4	14	20	35	4.14	18.08	3.73
	Online	5	17	25	17	10	3.14	11.08	2.82
Foster curiosity and a Love for Learning	Face-to-Face	1	5	11	25	32	4.11	17.84	3.71
	Online	8	13	27	17	9	3.08	10.81	2.78
Equitable resources for all students - knowledge of students' needs	Face-to-Face	1	6	14	27	26	3.96	16.66	3.56
	Online	14	21	19	13	7	2.70	8.81	2.47
Meaningful research and strong research skills - students show curiosity about research	Face-to-Face	3	6	16	22	27	3.86	16.19	3.51
	Online	8	20	22	22	2	2.86	9.30	2.54
Increased motivation and engagement	Face-to-Face	1	9	14	25	25	3.86	16.05	3.49
	Online	13	23	21	13	4	2.62	8.14	2.35
Rigorous learning tasks - Is the problem challenging the students' thoughts?	Face-to-Face	1	4	12	35	22	3.99	16.69	3.56
	Online	7	21	18	22	6	2.99	10.20	2.69
Higher-level student thinking - solving tomorrow's problems in today's classroom	Face-to-Face	2	6	12	27	27	3.96	16.77	3.58
	Online	8	20	23	18	5	2.89	9.57	2.58
Students take ownership in what, why, and how they are doing it	Face-to-Face	1	7	14	29	23	3.89	16.14	3.50
	Online	7	20	21	19	7	2.99	10.20	2.69
Instructional tools and strategies support student choice and voice	Face-to-Face	1	7	16	26	24	3.88	16.07	3.49
	Online	5	16	26	17	10	3.15	11.15	2.83
Encourage good questioning from students	Face-to-Face	1	6	12	24	31	4.05	17.46	3.66
	Online	7	17	22	22	6	3.04	10.47	2.73
Understanding of the content beyond the facts	Face-to-Face	1	5	11	28	29	4.07	17.47	3.66
	Online	7	17	22	23	5	3.03	10.35	2.71

Moreover, the highest-ranking category in Table 1 falls in encouraging a growth mindset. Throughout the teacher observations and interviews, a common theme of discussion was that, "failure is success." Five out of the six teachers interviewed emphasized a passion for reflecting on failures to learn from mistakes and still progress forward. However, the teacher responses when directly asked to define the growth mindset did not reflect this. Teacher 2 stated, "I am not confident and comfortable answering that question." Yet, in response to other questions, Teacher 2 included elements of a growth mindset such as students advocating for themselves, students taking responsibility for their own learning, and students not shying away from failure and the opportunity to improve. Likewise, Teacher 2 in the observation process allowed an open project that gave students voice and choice within the final product. Students completed projects using wordart, anagram's, Venn Diagrams, and written reports. The choice was up to the students. On the contrary, when asked to define a growth mindset, Teacher 3 stated, " A growth mindset, opposed to a fixed mindset, is one that believes every student is capable of making progress/getting better. Classrooms that follow a growth mindset are intentional about reflection. Students are encouraged to set goals and then to notice their successes, the progress they have made, and to link those with the work they have done. Growth, rather than achievement alone, is noticed and rewarded." Within the classroom observation, Teacher 3 used an online tool called Desmos to keep the student in a guided form of inquiry. In addition to Teacher 2, Teacher 6 was also not able to define a growth mindset. During the classroom observations, Teacher 6 did a random analysis using dice and allowed for students to collaborate building conclusions. Although some teachers were not able to provide a definition of a growth mindset in that particular question, all

six teachers explained characteristics of a growth mindset and student voice and choice within each interview and showed evidence in the classroom observations. During the observation process, all six teachers had clear evidence of building relationships and trust with their students. Teacher 1 used a picture of a little girl that was her as a little girl to tell a story to guide the inquiry process. Teacher 3 made a great connection to the real world with a bicycle demonstration in class. The interview process allowed the teachers to share their thoughts on the observation, as each interview followed the observation process. Highlighted below are questions that were used in the teacher interview to help triangulate data for research question one (Appendix F).

Interview Question 2 (Appendix F): How do you define inquiry-based teaching strategies? What does this involve?

- Teacher 1 responded, “Inquiry-based teaching strategies require teachers to give up some control of their instruction. Yes, it still must be planned and organized, but it involves providing students some freedom to learn from experiences about topics that are truly important to them. It emphasizes the students’ role in the learning process. In its most basic form, students must begin with questions about a larger concept, then they must research in order to find some answers, then they communicate their findings.”
- Teacher 2 responded, “Well it's a tough one. I mean I know that inquiry is not new kind of new to us being exposed to. I believe his last name was Mr. MacKenzie, that we met with about a year or two ago or the beginning of last year. And I think it's more of a, getting away from just here's the answer to a, what could be the answer or what's another way to get about it. As far as, you know, I think back to like when you think of when you're making a test. Are they all knowledge based questions. So for

me inquiry is more of a kind of a, what's another way to do this, what's, what's a different way to do this, how can we do this, and there might not be just a set answer, it can be more of a, you know there's multiple answers multiple options for, you know, like when kids are brainstorming ideas."

- Teacher 3 responded, "I believe inquiry-based teaching strategies are defined by their focus on student choice. To varying degrees, students have choice in what they study or what materials they use to study."
- Teacher 4 responded, "Inquiry-based teaching strategies are those that start with an end goal in mind, and provide a framework to students, but allow them to build within that framework as they more organically develop an understanding of the material, guided by key questions along the way."
- Teacher 5 responded, "Inquiry by definition is the process of asking questions and driving understanding from those questions. Inquiry teaching strategies can take many different forms and reach different levels of inquiry. The act of a student asking a question from a lesson, video, or activity can be classified as inquiry, but this is at the most basic level of inquiry instruction."
- Teacher 6 responded, "I feel that inquiry-based learning challenges students to find ways to both ask and answer overarching questions (more "whys" than "hows"). It is the job of the teacher develop/acquire skills which allow students to inquire successfully."

Interview Question 6 (Appendix F): What do you consider to be the important outcomes of inquiry-based teaching and learning?

- Teacher 1 responded, “Important outcomes of inquiry-based teaching and learning are fostering curiosity about a topic that is relevant and important to the specific student, providing students a voice to share their own ideas, questions, and research, deepen understanding of a topic, increases engagement, and allowing students to take ownership and agency of their learning.”
- Teacher 2 responded, “I think the important outcome would be that students feel comfortable maybe stepping out of their shell, because sometimes inquiry-based learning requires that. I think it's feeling comfortable to say something they may not be 100% comfortable in, or as confident in themselves. Being able to work with students collaboratively.”
- Teacher 3 responded, “The most valuable outcome of inquiry-based teaching is engagement. Students are tasked with finding a piece of the curriculum that interests them or connects to an interest. They feel ownership over their learning because it is somewhat self-directed, and this promotes engagement as well.”
- Teacher 4 responded, “To provide students with a framework of looking at the world and the problems they encounter through a lens of, ‘I don’t understand this yet, but I will if I ask the right questions’ rather than ‘this is too hard for me.’”
- Teacher 5 responded, “One of the most important outcomes is to instill the inquiry process of being curious, asking questions, and conducting the necessary research to dive deeper into understanding. With that said, it is beyond critical to teach students how to research and find primary sources that can be trusted.”
- Teacher 6 responded, “I think that a successful inquiry-based environment will give students the courage to question data.”

Interview Question 7 (Appendix F): What are the most essential skills you want your students to demonstrate during inquiry?

- Teacher 1 responded, “The Four C’s! Critical thinking, collaboration, communication, and creativity.”
- Teacher 2 responded, “Everybody gets a voice, everybody gets to speak if they're working in a group, if they're not working in a group that they have that option. You may not be good at everything, but you know you can with the inquiry having those choices.”
- Teacher 3 responded, “During an inquiry lesson, I want students to demonstrate a willingness to go down a path that may not lead to the answer they set out to find. I want them to reflect on whether they are making progress toward finding that answer and turn around to try something different.”
- Teacher 4 responded, “Taking academic risk and putting themselves out there to gain knowledge. Sharing their ideas in a way that others can learn from them. Being resilient and persistent in finding the answer/achieving the goal. Being willing to both accept and offer assistance as needed.”
- Teacher 5 responded, “I want my students to be able to engage in the question asking process (when learned often completed in your head) and researching without me prompting them. This is a skill I did not truly develop until engaging in college level research. I try to be mindful of this and think how I can promote them to be curious and engage in learning without me driving it.”
- Teacher 6 responded - “analysis of data, make connections, evaluate methods and ultimately create and answer their own questions.”

Interview Question 10 (Appendix F): Define a classroom that follows a “growth mindset.”

- Teacher 1 responded, “A classroom the follows a growth mindset embraces the idea that making mistakes are a part of the learning process. Students are determined to achieve a goal and show tenacity and resilience when trying to achieve it. They understand that the journey to meet a goal will be challenging, but that doesn’t mean we shouldn’t do it. Lastly, students recognize that their attitude determines their success.”
- Teacher 2 responded, “I don't I don't know if I feel comfortable that I can answer that the right way.”
- Teacher 3 responded, “A growth mindset, opposed to a fixed mindset, is one that believes every student is capable of making progress/getting better. Classrooms that follow a growth mindset are intentional about reflection. Students are encouraged to set goals and then to notice their successes.”
- Teacher 4 responded, “A growth mindset classroom is one where grades are seen as taking a backseat to learning, asking questions is a way to show you understand AND a way to get more information, sees the power of “yet” (as in, I don’t understand “yet”) and works collaboratively, not competitively.”
- Teacher 5 responded, “My classroom! I STRONGLY believe this is a life skill. Everything in life can benefit from positive growth. It must be intrinsically driven and it is never settling with “this is good enough” or “this is too hard”. It is goal setting. It is productively struggling as defined above. If there is a will there's a

way! At the end of the day, growth is what matters and it looks different for everyone."

- Teacher 6 responded, "As the name implies, a growth mindset is more about a way of thinking than a method of teaching. The exact definition is something that I can't comment on at this time."

The data collected for research question two has some overlap with research question one, as the instructional practices relate closely to the characteristics of inquiry. However, the data for research question two focused more on the logistical aspects and perspectives of planning instruction for inquiry-based learning. During the classroom observations, one thing was very apparent in all six observations that helped analyze research question two, **"**How do teachers perceive inquiry learning as we focus on best instructional practices that include student voice and equity?" That one recurring idea was that balancing the online students and the face to face students doubled the amount of time teachers spent on planning lessons. All teachers use live streaming through Google Meets to have a planned lesson and activity that functioned coherently within that single class period. Teacher 5 staggered the activity and hands on work so the in person students could be completing group and physical experiments while the online students were focused on the inquiry questions to dig deeper. While all other teachers observed, conducted class concurrently with online students engaging from home. Table 3 shows that teachers feel they do not have adequate time to plan inquiry-based lessons. This stress and extra planning were clearly evident in all classroom observations. Research question two is followed by sub questions used in the interview process. During those interviews, four out of six teachers expressed concerns regarding not having adequate

time for planning inquiry-based lessons as well as not having adequate class time as a result of balancing face to face and online learning. The teachers interviewed stressed a strict classroom management routine was critical to make sure students were engaged in order to progress through the lesson. The most utilized type of inquiry-based learning was a guided inquiry lesson. More specifically, during the classroom observation five out of six teachers implemented inquiry lessons that were structured with teacher guidance. Only Teacher 2 conducted a lesson that offered student choice and voice in the way they wanted to complete the final project.

Data collection for research question two became more evident in the teacher interviews over the data collected in the observation process. During the observation process, all teachers appeared extremely confident within inquiry while conducting instruction to their students. It was during the interview process that teachers 2, 3, and 6 showed questionable confidence in an aspect of inquiry. Teacher 2's observation was a high level of student voice and choice with open inquiry for projects and problem solving. During Teacher 2's interview, they showed the most instructional method used in their classroom is stand and deliver. Teacher 1 and 4 showed evidence during classroom observations of student voice and choice by using breakout rooms in Google meets. The following interview questions were used to dig deeper into research question two.

Interview Question 1 (Appendix F): What instructional methods of teaching and learning are used most often in your classroom?

- Teacher 1 responded, "Considering the global pandemic we are living through, instructional methods have changed in a few ways this year. Typically, I prefer

students to have hands-on learning experiences where they are manipulating materials, collaborating closely with peers, and having opportunities for discovery learning. This year, I found myself focusing on short, meaningful whole group instruction with most of the class period being focused on application. I am not the type of teacher to stand and lecture for 40 minutes. I teach quick mini lessons on a concept and then provide time for guided and independent application. Students will often work with peers while utilizing breakout rooms in Google Meet, but will also have opportunities to work independently. I make it a requirement to work one on one with students who need the extra push, but also to check in with students who are doing well."

- Teacher 2 responded, "This year due to COVID. It's a model of teaching with students that are currently in front of me, which can range from 11 to 14 to another 11 to 14 of them that are on a Google meet live streaming through home. So the instruction is based on the subject. If it's math, you know where I'm teaching the lesson on my board, the kids in front of me can see that the kids at home can see that as well they're working along at home with a file that they have the cost is working along here, science and social studies we read the book together with kids taking turns at home and in the classroom reading and then they work on some notes some outlining. There's times where they individually work. And there's times where we'll do breakout rooms with Google meets."
- Teacher 3 responded, "Direct instruction is used most often and usually accompanied by a guided notes page. Direct instruction is sometimes delivered through a prerecorded video lesson to be viewed outside of class so that class time

can be utilized for practice. Prior to 2020, the station-rotation model of blended learning was used often so that students had designated times to work both collaboratively and independently. I also make an effort to use focused questioning and discovery techniques, often in conjunction with Desmos."

- Teacher 4 responded, "I'm willing to try any and every instructional method out there to get my students to comprehend a topic or concept, but I probably rely most heavily on discussion and demonstration. As a language arts teacher, discussion is important for two reasons: one, the discourse allows me to hear their thinking and gauge their understanding, and two: it allows them to develop the skills necessary for clear communication – listening to others, formulating an opinion and rebuttal, arguing a point and not a person, etc. Demonstration is also really big in my class because I want students to be able to show that they know something deeply, not just regurgitate facts to me. There's a lot of "prove it" said in my room."
- Teacher 5 responded, "During the 2020-21 school year I deliver instruction to concurrently enrolled sections of hybrid and remote students. To deliver instruction for two environments, I require students to attend google meets synchronously because all students are members of the class and benefit from classroom interactions and collaboration whether in person or virtually. For science instruction, laboratory experiments drive student learning, inquiries, and retention of concepts and skills. To deliver science instruction has been difficult this year with concurrent sections. For example, hybrid students will conduct labs in class while remote students will conduct a virtual lab. Sometimes the concepts,

inquiries, and skills parallel when students conduct alternate laboratory activities; however, other times there is no "good" replacement."

- Teacher 6 responded, "In recent years, I have tried to adopt the "Experience first, formalize later" (EFFL) approach. This is an approach to statistics which makes the content much less boring. Rather than needing to lecture constantly, the students acquire much of the requisite content by working through problems and activities."

Interview Question 3 (Appendix F): What are the most important routines in your classroom instruction on a typical day?

- Teacher 1 responded, "On a typical day, before jumping into any content, it's vital to connect with the students and build those important relationships. Sharing stories, experiences, or just a simple "how are you?" are ways to allow my students to feel connected and comfortable with me. I've found that once students see you as more than someone that delivers content, the more willing they are to focus and work. After greeting each other and connecting for a brief time, we begin some sort of grammar review."
- Teacher 2 responded, "Timeline and Goals! For online this year, I have found that when I'm done teaching and I give something for them to do or just for me to just say, Okay, you guys can go work on it, a kids will just close out and be like, I'm done and they'll go eat lunch or they'll play video game or whatever at home. Whereas if I make them stay on the Google mean, and I say I'm here if you have any questions, they stay on more kids get it done that way, then I have less kids

that I have to hunt down the next day and say hey you never handed in this assignment because they walked when they forgot about."

- Teacher 3 responded, "Greeting each student and interacting intentionally with each student daily is one of the most important routines in my classroom. This includes asking open ended questions as formative assessment. Questions do not always have a "correct" answer. The goal is to establish a safe environment for exploration, mistakes and for students to ask their own questions."
- Teacher 4 responded, "Given our current learning situation (some students at school, some at home but coming to school other days, and some totally at home, all learning in the same class at the same time), one of the most important routines is how I start class. All students are expected to join me live, whether online or in person, by the time class is scheduled to start. I try to keep some friendly chatter going with them to help foster relationships between them and with me."
- Teacher 5 responded, "My most important routine is facilitating students' learning from a real-world connection or story line from the Project Lead the Way. Further, I explain the goals for the day and often let students dive into their learning with activities I create on Schoology. I employ different models of inquiry where some instructional days are more scaffolded than others. Also, some instructional days have more flexibility for exploration of biotechnologies, career exploration, or laboratory experiences beyond the foundational content knowledge."

- Teacher 6 responded, “On most days, my goal is to create a happy and safe place for students to ask questions. I know that sounds kind of general, but I feel that students shut down if they are unhappy or if they feel guarded.”

Interview Question 4 (Appendix F): What skills are you hoping your students will achieve in your class?

- Teacher 1 responded, “I hope that my students learn to be independent thinkers and gain a collaborative work ethic.”
- Teacher 2 responded, “Be an advocate for yourself. When they don't understand something. There's not always that ability when there's one teacher and 25 kids in the room and she can focus on them all day long. I've got two groups of kids, I may not know that a student might be struggling until it's assessment time. I mean, if I do like, even if I do like a daily check in, they might be able to get one or two right, but sometimes it could be assessment time. Do you realize they don't know what they're doing, advocacy and speaking up and taking responsibility for your learning?”
- Teacher 3 responded, “My biggest goal is for my students to gain the ability to use logical reasoning and to evaluate information in context. I often refer to this as “sense-making”. Many students find success in math classes by memorizing formulas and procedures without any understanding of where these formulas come from or why the procedures are useful. They can find answers but cannot determine whether those answers are reasonable.”
- Teacher 4 responded, “Think critically about their reading and writing. Develop a strong vocabulary and understanding of how roots work in words. Be able to

verbally share an idea in a clear way that others can follow. Be able to listen to others and respond appropriately in both written and oral format. Be able to look at a story – visually or in print – and recognize how key elements work together to convey that message."

- Teacher 5 responded, "My goal as an educator is for students to actively engage in the learning process even if it is challenging. My goal is to provide students with the necessary skills to "productively struggle" towards learning versus giving up when concepts are challenging, and I am not there to help them. I teach students about growth mindset at the beginning of the school year and emphasize the idea that growth looks different for everyone."
- Teacher 6 responded, "I hope to help students critically analyze data so that they can make informed inferences and conclusions. A lofty goal, for sure! But you must help your students "reach" so that they gain confidence in their abilities."

Interview Question 9 (Appendix F): Have you tried inquiry in online lessons? If so, explain the successes and the challenges.

- Teacher 1 responded, "Yes, students created a "Shark Tank" project online. I placed students in groups that were mixed with both face-to-face and online students. The objective was to consider the current economy and trends, and create a product, or service to sell. They needed to first identify a product or service they would like to provide, determine their target population/consumer, identify the location, discover who their competition is, identify and negotiate the necessary capital to get started, determine problems they may encounter, consider advertising, and create long and short-term goals. I was so incredibly impressed

with what the students created. I would consider every outcome a success. There will always be the challenge of a student who isn't "into it" and needing to find a way to motivate them."

- Teacher 2 responded, "The successes were that they had a choice. The successes were that they got to go with what they felt they were good at, meaning, some kids, you know, don't want to write. So, the idea of, there's an option of a just and there was an option of reading an article and writing about it, or there was an article or as an option of doing a Venn diagram where they didn't really have to write, they just had to kind of know the differences and the similarities so I think that was definitely a positive."
- Teacher 3 responded, "I have tried some two to three day inquiry lessons in my geometry and precalculus classes during periods of remote or hybrid learning. It is interesting to observe the different ways that students approach problem solving when it is open-ended. Most of the successes and challenges are not unique to the online platform, but just from a new/different lesson style. Many students wonder "what this has to do with calculus" or "why we are doing this". If students were in the same space and working collaboratively, they might feel more permission to be open and creative."
- Teacher 4 responded, "Since literally every lesson I teach is online in some capacity, yes. Some of the challenges have been getting kids to actually have discussions in this format. It's a lot harder than just "circle up and let's go" for various reasons. The successes have been that a lot of the kids will participate and

just roll with it, so much of this year has been different that they just figure it's one more "covid creation" of the teachers."

- Teacher 5 responded, "I've tried facilitating inquiry online through exploration activities and discussion boards. They work well but lack the collaborative, hands on experiences in person instruction lends itself to. It is also harder to conduct formative assessment online as I cannot monitor their explorations like walking around the classroom and instead have to question them which sometimes makes it awkward and or not student driven. Online students miss out on inquiry-based labs that do not have a virtual, interactive option. Watching videos of a lab is okay. But, not the same as the classroom experience."
- Teacher 6 responded, "I am not sure what I do would be called pure inquiry, but I have tried to have students experience stats in contexts which are more meaningful and, therefore, more memorable to them. We have done lots of simulations as a class. It would be a lot better if the students could easily work in small groups, but I find that breakout rooms do not function quite as well as in-person group work."

In Table 2, it is important to highlight that the teacher comfort level is high. In spite of this, they do not feel very confident in inquiry-based learning helping to prepare students for state standardized tests. With a standard deviation of 2.83, the teachers' perception of inquiry-based learning helping standardized testing is among the lowest ranking in the survey as illustrated in Table 2. The other low-ranking category is a standard deviation of 2.81 on teachers participating in outside professional development sessions for inquiry. In contrast, the highest ranking in Table 2 is that almost all teachers

participated in the Parkland School District Professional Development session showing a standard deviation of 3.81. The second highest value is contradictory to the standardized test question. With a standard deviation of 3.62, teachers are saying inquiry-based learning is important for achievement. However, this does not hold true for the survey responses regarding achievement on standardized tests.

Table 2

Teacher Perspectives on Inquiry-Based Learning

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	Mean 2	Standard Deviation
Inquiry-based lessons are important for my students' achievement.	5	2	14	22	31	3.97	17.11	3.62
I am confident in teaching through inquiry	3	6	22	20	23	3.73	15.14	3.38
I have no issues with managing inquiry-based lessons	1	7	18	26	22	3.82	15.64	3.44
I have attended school-based professional development for inquiry-based learning	3	5	8	18	40	4.18	18.69	3.81
I have attended professional development outside of the school-based offering on inquiry-based learning	27	11	9	4	23	2.80	10.69	2.81
I feel inquiry-based lessons prepares my students for state standardized tests	7	14	29	11	13	3.12	11.15	2.83
Inquiry-based lessons benefit all students including students with disabilities	2	5	17	21	29	3.95	16.70	3.57

In Table 3, the comfort and support of teachers comes out in survey results with standard deviations higher than 3.15 in all categories but one. Teachers do not feel they have adequate time to collaborate with colleagues. This low score in Table 3 is very consistent with the results of the teacher interviews. To clarify, four out of six teachers recorded that they felt a hurdle of inquiry-based teaching was time to collaborate with

colleagues. The teachers in the interviews expressed limited time in planning and limited time in working with colleagues. The limited planning time is consistent with the standard deviation of the survey statement, "Teaching through inquiry is time-consuming and I don't have enough planning time to prepare for inquiry-based lessons." With a value of 3.34 this data point was negative in nature: therefore, it needed to be analyzed as a data point in reverse of the positive outcome. It holds true to the perceptions collected during the teacher interviews.

Table 3

Inquiry-based Learning Logistical Needs

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	Mean 2	Standard Deviation
I have adequate time to collaborate with colleagues on inquiry-based lessons	11	22	18	10	13	2.89	10.08	2.68
I have enough supplies to teach inquiry-based lessons	7	12	16	21	18	3.42	13.31	3.15
I feel supported to teach inquiry-based lessons	5	6	14	29	20	3.72	15.12	3.38
My classroom has adequate space to teach lessons through inquiry	11	7	14	24	18	3.42	13.50	3.18
Teaching through inquiry is time-consuming and I don't have enough planning time to prepare for inquiry-based lessons	4	5	21	24	20	3.69	14.82	3.34

Outside of the classroom instruction, the third research question was designed to investigate equity within the inquiry-based learning environment. The third research question asks, "Within inquiry learning environments, what sub-groups (economically disadvantaged, gender, race, ESL) are seen most frequently enrolled and to what level of inquiry-based learning is the most evident?" For this research question there is an equity

question in the survey cross referenced with the data collected through our Performance Matter and eSchool data base. In the survey, teachers responded that in a face to face environment most students have equitable access to learning, but in an online environment, equitable access to learning is much lower. The standard deviation seen on Table 1 for face to face is 3.56 compared to 2.47 for online learning as it relates to "equitable resources for all students-knowledge of students' needs."

Furthermore, Figure 6 is based on the record of free or reduced lunch and the economic status of students within the school program. The baseline data is the overall school data. The economic data of the classrooms observed was compared to the baseline data. Additionally, this study also analyzed data in the Project Lead the Way Pathways to look for answers on research question three. Data observation during classroom observations on research question three was not evident. All students had equal access to computers, internet and no evidence of inability to engage in classroom activities was seen. The following interview questions were used to see if the teachers noticed challenges or goals that would show equity concerns.

Interview Question 5 (Appendix F): What are the critical goals that students learn about or learn how to do in your class?

- Teacher 1 responded, "Develop a strong foundation in grammar and writing, become an active listener and an effective speaker, foster strong comprehension in both literature and nonfiction in order to analyze complex texts, and become a creative, critical thinker."
- Teacher 2 responded, "How to find information, learning, learning how to use context clues, learning how to use those subtitles and headings. Because scientists

are studying a lot of this, they don't have a lot of background knowledge, so they can't make a lot of connections, so they really need to know how when they're looking for information in a book and they have a question and when they have a discussion they have to know what exactly am I looking what am What am I looking for what are some key words."

- Teacher 3 responded, "They can find answers but cannot determine whether those answers are reasonable or what they mean in the context of the larger world. My hope is that students being to think more deeply about these things in my class."
- Teacher 4 responded, "When they leave me, I want them to feel comfortable reading both critically and for pleasure, be able to write clearly and have their voice heard and understood and be able to formulate their own opinions based on research they have done themselves, rather than following blindly something that someone else claims is true."
- Teacher 5 responded, "Some non-content goals include but are not limited to growth mindset, self-advocacy, and demonstrating respect."
- Teacher 6 responded, "Students learn to question data. Students look beyond numbers by questioning the design of studies and experiments. Additionally, they become attune to biases and confounding variables which can make data irrelevant."

Interview Question 8 (Appendix F): What are the roadblocks or hurdles you face during inquiry-based lessons?

- Teacher 1 responded - Time! It's a challenge to balance the demand of standards-based learning, following the curriculum, and ensuring you're hitting all the

content needed to prepare for state assessments, while still providing adequate time for inquiry.

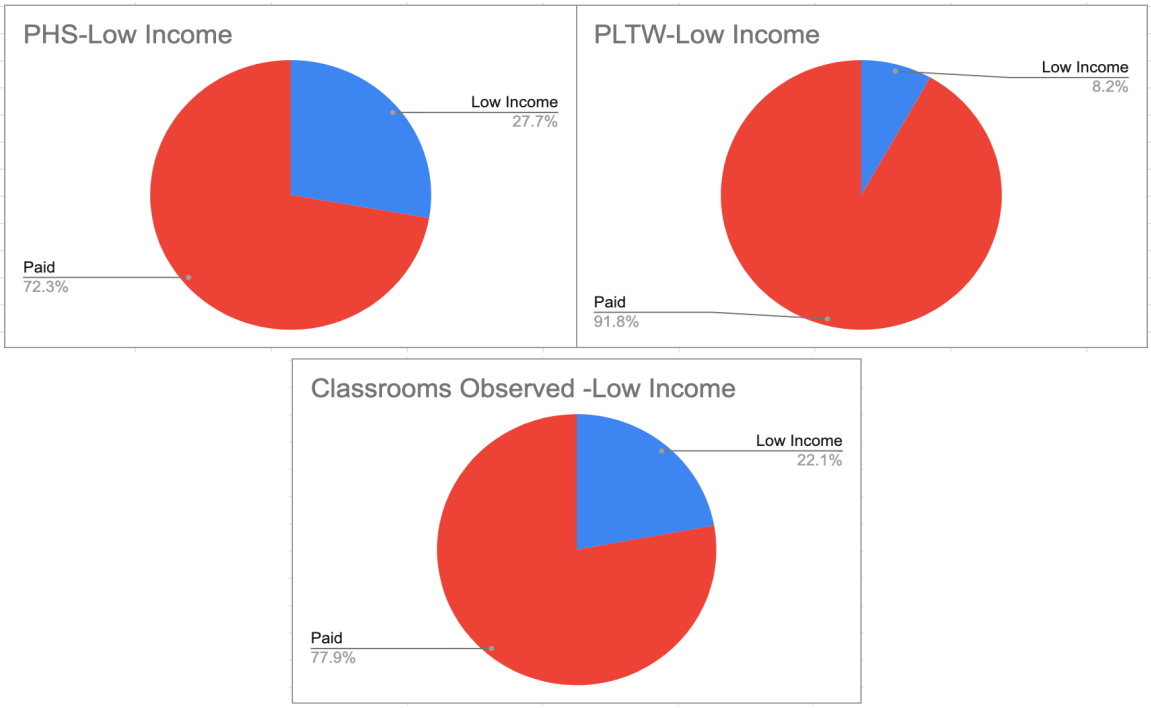
- Teacher 2 responded, “The students that don't like to work with other people, students that just want to get the work done because inquiry is not always just about A, B and C, and D and knowledge-based questions, there's a little bit more to it.”
- Teacher 3 responded, “It is difficult to plan for an inquiry-based lesson because I don’t know what questions students might ask. If the questions are truly student generated, it’s unlikely that multiple students will be working toward the same goals. It is also unlikely that I will know the answers to their questions. This is ok, but it’s daunting to think about how much time would be needed to guide each group when I’m also starting at square one. And then there’s the question of evaluating the end result, which might be the biggest roadblock.”
- Teacher 4 responded, “Time is ALWAYS a factor in everything. Sometimes “sage on the stage” is just faster, and sometimes that speed is necessary. Also, middle schoolers can be really hesitant to put themselves "out there” in front of their peers, so it can sometimes be hard to encourage them to take those academic risks.”
- Teacher 5 responded, “Inquiry is challenging to drive in concurrent sections due to lack separated sections and specifically designed instruction for student needs and environment. Truly I have tried my best and feel I’ve been split in half and cannot give my entire effort and attention to one style of learning for the appropriate environment.”

- Teacher 6 responded, “I think that there is still a place for direct instruction, but we need to create classrooms where it is safe to explore. Unfortunately, exploring does not follow a neat timeline. Also, the online learning environment introduces new challenges to the exploratory process.”

Having a classroom sample for the observed classes is very important to the research, and the data in Figure 6 shows that the Parkland High School as a whole has 27.7% free or reduced lunch program students, which signifies lower income families. The classrooms observed come very close to that figure with 22.1% in that same category.

Figure 6

Low Income Comparison Inquiry Pathways



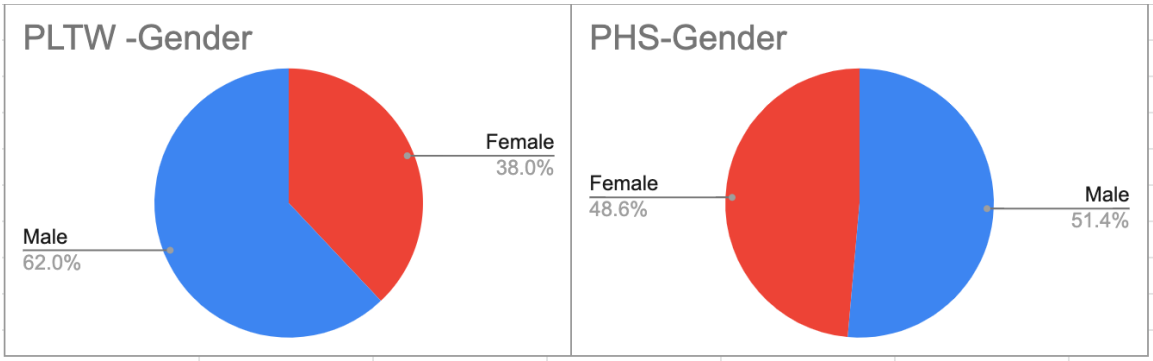
The teachers' perspectives voicing a significant concern for some students not having the necessary resources at home is reflective of that data. The teachers stress that

being in a face to face classroom allowed for resources to become more equitable. More importantly, there is a significant discrepancy between the baseline data and the Project Lead the Way Pathway (PLTW) data. That data shows that the PLTW courses are not an equitable sample of our student population. Figure 6 displays that only 8.2% of the students in the three PLTW pathways are in a low-income category.

To further investigate the PLTW data, the research analyzed gender, race and the ELL (English Language Learner) population. Figure 7 shows that the female population is slightly under-represented in PLTW pathways.

Figure 7

Gender Comparison Inquiry-Based Pathways



It should be noted that the research did not identify any transgender, gender neutral, or non-binary identifications. It was not excluded, it just did not show in the database. The demographic data illustrated which pathway, within the PLTW pathways, has the largest differences in gender population. For example, in Table 4, the female population in Bio-Medical is larger than the male population by 62 students. On the contrary, the computer science and engineering courses are 83% male.

Table 4

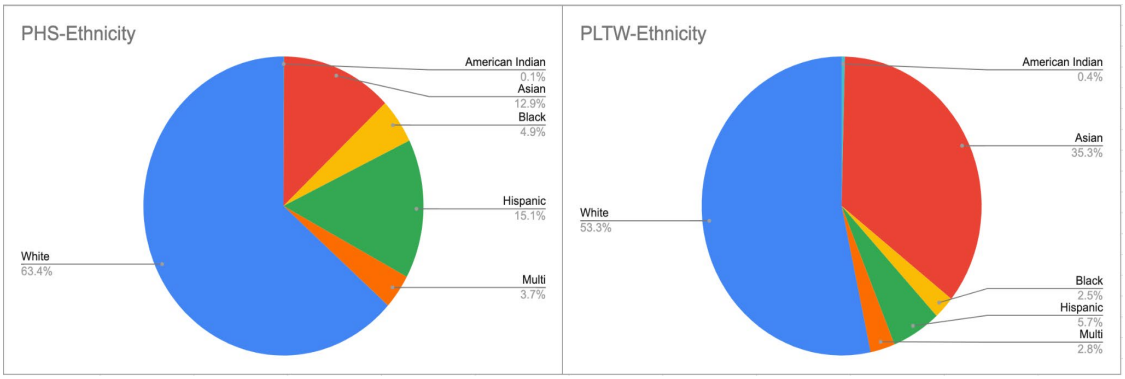
Total Male/Female Count in PLTW

GENDER	*Pathway*	Count of GENDER
Female	Bio-Med	153
Female	Comp Sci	23
Female	Tech Ed	24
Male	Bio-Med	91
Male	Comp Sci	101
Male	Tech Ed	135

In addition to gender, this research explored the data for Ethnicity in the Project Lead the Way courses, which demonstrated a higher population of Asian students taking advantage of this inquiry-based learning pathway. There is an underrepresentation for Black and Hispanic students. Even though the data shows the white population is still a majority of the students taking PLTW courses, the percentage compared to the overall white population is 10% lower. Figure 8 shows a side-by-side comparison of the overall population of the high school and the ethnicity breakdown for the students in the three Project Lead the Way pathways. Within the PLTW pathways, there was only one student who was currently enrolled in an ELL (English Language Learner) program. The high school has a total of 89 ELL students. That is 2.9% of the total enrollment of 3022 students.

Figure 8

Ethnicity Comparison Inquiry-Based Pathways



Discussion

The data collection began with a survey to teachers in grades 6 to 12. The perceptions collected on that survey became a gauge for the deeper dive into the research. Looking for data from multiple angles in order to validate findings became a large part of the data analysis. The categories of the characteristics of inquiry-based learning was the focus. As a result of the educational environment of 2020, online versus face to face comparisons became a natural part of the data collection process. Teachers were faced with many challenges during this study, and all data collected is reflective of teachers balancing classrooms in a hybrid environment having students in both face to face and online.

The deeper dive into the data started with the classroom observations and teacher interviews. There were opportunities for teachers to reflect on their lessons and also share thoughts on inquiry-based learning. All lessons were observed through Google Meets and had students both online and in person within one classroom. The teacher interviews were collected and transcribed using an online tool. During classroom observations, a look for

tool (Appendix F), broken down into building relationships and invested learners, was used to identify characteristics of inquiry-based learning throughout the lesson. Following each observed lesson, an interview was conducted with 10 follow-up questions (Appendix G).

The data was compiled and cross referenced with the original survey to compare teacher perspective with observable measures. Within the teachers' perspectives and classroom observations, notes were gathered on any noticeable equity concerns. During the observations, no equity issues were identified. A few were noted in the teachers' reflections. However, the demographic information gathered from the database shows many inconsistencies in the equity of students regarding the Project Lead the Way pathway. The goal of reaching all students with inquiry-based learning assumes the representation would be a direct relationship in the data.

Conclusion

In summary, analyzing the data from the survey, the classroom observations and the teacher interviews allowed a thorough interpretation of the teachers' perceptions of the characteristics of inquiry-based learning. The survey was developed based on a Likert scale and designed as a broad-brush survey yielding results that can be cross referenced to the observations made in the classrooms and the teacher responses in the interviews. The next chapter will develop conclusions on the data triangulated from the original survey overview and data collected over a few months following that survey. Also, this research provided a larger than normal view of online learning compared to in person learning. It is important that school leaders understand the challenges of the 2020 school year when analyzing this data and building a plan for the future. The data presented in

this chapter was collected during unprecedented times. It provided for unique opportunities in both face to face and online learning that provided challenges in the world of inquiry-based learning. The success, challenges, opportunities and plans will be presented in Chapter 5.

In Chapter 5, the conclusions will address the most frequently seen inquiry-based characteristics, the understanding of growth mindset, students' voice and choice, and equity concerns within an inquiry-based environment. The chapter will also highlight professional development opportunities planned for the future and areas for teachers to individualize their goals and learning. Finally, the opportunities for all students to excel in inquiry-based learning will be explored. A plan to build student programs outside of the classroom to promote equity in inquiry-based pathways will be presented. These conclusions will drive the goal of enhancing the school culture to continue to build on the characteristics of inquiry-based learning within each classroom.

CHAPTER 5

Conclusions and Recommendations

Inquiry-based learning becomes complex with different models and levels as teachers advance into deeper steps of the instructional model. Often, the interpretations of teachers differ, and the definition of inquiry-based learning varies. This chapter will draw conclusions about inquiry-based learning from data collected in Parkland School District from grades six through twelve. The focus of the data collected was aligned to a professional development session on the characteristics of inquiry-based learning. The characteristics of inquiry all tie back to three common ideas of student voice, student choice and equity for all students. The teachers in this study faced many challenging conditions as they managed hybrid learning through a global pandemic. In that hybrid learning model, teachers were balancing courses that were split into students who were participating face to face and students who were participating online. In this chapter, the research conclusions will also separate the teacher perspectives of each environment (online and face to face) as it pertains to student voice, choice and equity for all students.

The purpose of this study was to determine a plan to increase inquiry-based learning in all content areas by evaluating the current teacher perspectives following a focused professional development session. The analysis of the teacher perspectives and the data collected during this research will be used to draw conclusions on the characteristics of inquiry-based learning, which will include both the characteristics the teachers feel most comfortable implementing as well as the ones they find to be the most challenging to incorporate. The conclusions in this chapter will recognize the positives with the intent to reinforce and celebrate those successes with the staff. Conversely, the

conclusions will also identify the shortcomings in inquiry-based learning and develop plans to increase the effectiveness of all characteristics of inquiry-based learning.

Conclusions

This Capstone Project was conducted to identify the teacher perspective of inquiry-based learning following a professional development session that was administered to all teachers in grades six through twelve. The inquiry-based learning professional development had a focus on10characteristics of education as well as providing equitable learning experiences for all students. As stated in earlier chapters, according to research from MacKenzie and Bathurst-Hunt (2018), Figure 9 highlights characteristics that surface in an inquiry classroom across a span of time over several lessons, days, and weeks. The10characteristics were the focal point of research questions one and two.

Figure 9

Ten Characteristics of Inquiry-Based Learning

The characteristics are: (Bold = most commonly seen in data)
1. Nurture student passions and talents
2. Empower student voice and honour student choice
3. Increase motivation and engagement
4. Foster curiosity and a love for learning
5. Teach grit, perseverance, growth mindset and self-regulation
6. Make research meaningful and develop strong research skills
7. Deepen understanding to go beyond memorization of facts and content
8. Fortify the importance of asking good questions
9. Enable students to take ownership over their learning and to reach their goals
10. Solve the problems of tomorrow in the classrooms of today

Moreover, this chapter will draw conclusions from teacher perspectives on the overall instructional practices used most often in the classroom and the characteristics of inquiry-based learning within that instructional practice. The interpretation of perspectives on the10characteristics leads into the second and third research questions, which were specifically designed to know the overall thoughts of inquiry-based learning and the student voice, choice, and equity built into instructional practices. These conclusions will be reviewed based on each research question within this chapter.

The following plans developed to address the conclusions will have both a group plan and an individualized plan for inquiry-based learning. The researcher has learned from the data that although there are many consistent measures, there are also teachers at multiple levels of their learning. It will be critical to create individualized professional development plans as the teacher's perceptions should include a range of comfort and knowledge in the inquiry-based learning characteristics. The conclusions shared within this chapter will show multiple levels of comfort and learning on the instructional practices shared throughout this research. The data collected throughout this study revealed areas to increase learning for teachers through future professional development sessions and will be included within the conclusion of each research question.

Furthermore, within the individual plans for our teachers to grow, it is important to keep our eye on reaching and inspiring every student through inquiry-based learning. When considering student voice and choice, it is essential to provide opportunities for students to take ownership of their own learning. The equity data in this research provides a view of the need to inspire students who may not normally look into careers of bio-medical, engineering or computer science. Opening doors and exposing students to

the problem-solving process (Appendix A) in all content areas will help to build a comfort level for students to explore with an understanding that failure is success if you are willing to learn from those failures.

Research Question 1 Conclusions

The first research question, "What characteristics of inquiry classrooms are most frequently addressed in both face to face and online instructional environments?" for this study is focused on factors that surround the10 characteristics of inquiry-based learning. It also examines these aspects for both face to face and online environments. During a professional development session in a year prior to this study, the 10 characteristics were presented to all secondary teachers with a focus on questioning techniques for any content. The presenter, Trevor MacKenzie, had an English teaching background and concentrated on amplifying learning in English and empowering student voices. The data collected on research question one supports the goals of past training sessions and is aligned to those instructional practices.

In reviewing the data, the researcher identified that teachers most often associate inquiry with questioning techniques. The survey results shared in Figure 5 have two major polls to review for questioning and content. More specifically, in the category of, "Encouraging good questioning from students," the standard deviation of 3.66 shows a high correlation to the professional development focus. The researcher also believes that the categories of, "Understanding of the content beyond the facts" and "Solving tomorrow's problems in today's classroom" had a huge impact during the professional development session and supports the high standard deviations. Likewise, when the six interviewed teachers were asked to define inquiry-based learning, five of the six teachers

emphasized questioning strategies as the important factor. The research and data supports that a strength of Parkland School District teachers is the understanding of questioning and problem solving techniques functioning as a critical component of inquiry-based learning. Also, this conclusion highlights characteristic numbers seven, eight, and ten inside Figure 9 as the top strengths of the district's teachers. These particular characteristics are at the core of solving problems and building questions to understand those problems, and this conclusion is supported by the Parkland Problem Solving process (Appendix A) implemented prior to this research.

To address research question one, the data demonstrated that guided inquiry was most often used. The data also showed that most students wanted to be given specific instructions on exactly what they needed to do. Accordingly, teachers stressed that open ended inquiry-based learning was a challenge for their students. With that, there are two conclusions in this research that tend to be a cause and effect within the characteristics of inquiry-based learning.

First, improvements can be made to increase the level of inquiry-based learning to an open inquiry-based learning. Parkland teachers are fluent in questioning and problem solving at a guided inquiry-based learning level. However, in order to stress the "research and redesign" step of the Parkland Problem Solving process (Appendix A), it is recommended to provide professional development sessions on open inquiry-based learning with a focus on the growth mindset.

Second, it can be concluded that the engagement levels or investment of students is not as high in guided inquiry-based learning. Unfortunately, the survey data for the category, active participation, does not support this conclusion as the standard deviation

is 3.69 for a face to face environment. The standard deviation for another category, "increased motivation and engagement," in that same face to face environment is only a bit lower at 3.49. The level of inquiry-based learning will limit allowing students' interests to be included in the process, as guided inquiry-based learning does not easily allow students to research topics of their own interest. Moreover, in all six classroom observations, the content to be researched by the students was set by the teacher, and the approaches to allow student choice in solving the problem varied. Even when teachers allowed for multiple solution methods, the students were limited to a number of choices, which dampens the creativity and interest of the student. To grow into an open inquiry-based learning environment, it is recommended that the district stresses that the process to be researched is driven by the interest of the students and the skills required for that class. Following a curriculum does not always allow for all lessons and instructional practices to be of an open inquiry-based model; however, it is recommended that the district facilitates professional development sessions to build a deeper understanding of when open inquiry-based learning would best lend itself to the curriculum.

To further interpret data relating to research question one, it must be noted that all data was collected for both online and face to face environments. The conclusions and data shared up to this point have been reflective of face to face environments. Every data point was respectively lower in an online environment. The data high points and the data low points were very consistent per characteristics, as the most frequent characteristics were still the same just at lower values. The conclusion overall is that meeting inquiry-based learning characteristics online is more challenging than in a face to face environment. In one teacher's case, the students online were not able to complete the

inquiry-based learning activity. The exact reason for that lower perception and data is inconclusive in this research. However, the nature of the Covid-19 pandemic and students being at home for online learning presented a challenge that was new to both teachers and students. All teachers expressed in their interviews that student participation online was a challenge, and that they worked hard to find ways to keep online students engaged. This conclusion was also supported in the classroom observations as through six classroom observations, 84% of the participation came from the students in the face to face environment, and 22% of the students online did not have cameras turned on. Likewise, the survey data also reaffirmed this conclusion as the largest difference between a face to face environment and an online environment was in the area of participation.

In summary, the researcher concluded the three most frequent characteristics of inquiry-based learning are to fortify the importance of asking good questions, enable students to take ownership of their learning to reach their goals, and solve the problems of tomorrow in the classrooms of today. It was also concluded that even though inquiry-based learning online was more challenging than face to face, these three characteristics were the most frequently presented within the planned online instruction as well. As the district recognizes these strengths, it is recommended to build professional development sessions starting with the administrative team. The administrative team plans to use the classroom observation tool as a framework for conducting walk through observations and data collection throughout this school year. Additionally, the administrative instructional leadership professional development meetings will be followed with a consistent district wide message of supervision for teachers to grow inquiry-based learning to a higher level. This message will also stress the importance of all the characteristics of inquiry-

based learning. Following this research, the district focus will be on building relationships and knowing student interests. Within this plan, the cost to the district is budgeted within the substitute coverage needed for teachers to meet and collaborate during school hours. Specifically, the plan is to work with lead teachers in key content areas to support the building level administrative teams during professional development sessions. The district is not planning any further outside consultants at this time as the intention is to grow within the knowledge base we have. The district goal is to build a solid understanding of the growth mindset within a higher level of inquiry-based learning. To do that, the key will be understanding all characteristics of inquiry-based learning starting with relationship building.

Research Question 2 Conclusions

The second research question, "How do teachers perceive inquiry learning as we focus on best instructional practices that include student voice and equity?" in this study provides a closer look at the teachers' perception of inquiry-based learning as it targeted instructional practices that included student voice and equity. Within the interview process, all the teachers stressed the importance of students having a voice and ownership in their learning. The survey also had a high standard deviation in characteristic numbers one, two and five in Figure 9. These characteristics are focused on student interest, student voice and choice, and the growth mindset. However, during the observation process the data collected did not support a high correlation of student voice and choice. The inquiry-based learning models observed were very guided and limited in open ended questions that gave little opportunity for student voice and choice. The data collected from the classroom instruction highlighted many opportunities for students to explore,

gather data, and make their own conclusions. However, the student voice and student choice characteristics were again limited to guided options for assessments. The students were not given open options for their interests to be included in the learning process or assessment of skills. One teacher allowed for six different methods to complete the activity and allowed for some interest; nevertheless, an open choice allowing students to create their own inquiry-based learning process was not offered.

During another interview, the teacher emphasized the importance of fostering curiosity and topic importance to the student. The activity for that specific teacher allowed students to collaborate, explore, and ask questions. On the other hand, it was completely guided by the teacher. As a district, it is important to celebrate these inquiry-based learning activities that are good quality instruction. Even though it is not supportive of the conclusion to include student voice and choice in the inquiry-based learning activity, it does not mean these lessons are below standard in any way. What the researcher observed in each classroom was a very well planned out inquiry-based lesson on a guided level. Therefore, it is important to expand on student voice and choice and equity within the district.

However, expanding on student voice and choice often becomes a challenge when teachers are focused on standardized testing. Table 2 displays a low 2.83 standard deviation indicating that not all teachers perceive inquiry-based learning as an instructional practice that prepares students for standardized tests. The survey statement, “I feel inquiry-based lessons prepares my students for state standardized tests” yielded this low standard deviation. It is recommended that the district develops professional development sessions on inquiry-based learning that support being prepared for the tested

standards. Furthermore, the district has a purchased product called Defined Learning to help with lesson planning for inquiry-based learning. This cost is already accounted for within the district budget; yet, substitute costs and additional professional development costs from this company would need to be considered. The researcher concluded that teachers are more likely to take risks for open inquiry-based learning in non-tested subject areas; therefore, a search for additional resources to incorporate inquiry-based learning in tested subjects is essential. As identified, it is recommended that the district creates professional development opportunities with both target groups in mind: standardized tested subjects and non-tested subjects.

Whether it is a tested subject or a non-tested subject, when discussing equity within a lesson, students with different backgrounds have different interests. Allowing for students to bring interests into their learning and opening their minds with creative opportunities to solve a problem will build greater interest and invested learners. This opportunity to build invested learners improves learning regardless of the content. This research concluded that the district understands the concept of student voice and choice as it fosters equity through student interest. However, there is an evident need for professional development sessions to help teachers explore the instructional practices to build student voice and choice into lessons. In certain areas like our Project Lead the Way courses, the content, problems to solve, and skills naturally lend themselves to student voice and choice. As discussed in the plan for instructional walk-throughs with research question one, this recommendation needs to be part of that same plan. The planned professional development with building leaders will need to include best practices and

discussion points for observations that support student voice and choice offering equity through student interests.

The recommendations for the district will be to build instructional plans that offer student voice and choice in all content areas. In fact, this recommendation will closely align to the recommendation for research question one. The administrative team has planned to use the classroom observation tool as a framework for conducting walk-through observations and data collection throughout this school year. The administrative instructional leadership professional development meetings will be followed with a district wide consistent message of supervision for teachers to grow inquiry-based learning to a higher level and stress the importance of student voice and choice allowing for equitable opportunity aligned to student interest. In other words, the district focus following this research should again be on building relationships and knowing student interests. It is recommended that a district walk-through form is created to help guide these observations. This form should have five categories for data collection. More specifically, those categories are Instructional Choice and Grouping, Building Trust and Relationships, Engagement and Invested Learners, Inquiry-Based Characteristics, and Assessment Options. Teachers are at varying levels of comfort executing inquiry-based instruction. As a result, the district leaders will need to individualize professional development opportunities that focus on different instructional models of inquiry-based learning.

Research Question 3 Conclusions

The third research question, "Within inquiry learning environments, what sub-groups (economically disadvantaged, gender, race, ESL) are seen most frequently

enrolled and to what level of inquiry-based learning is the most evident?" for this study is focused on equity in inquiry-based learning environments. Throughout this research, the word equity was examined in two different ways. Within the characteristics of inquiry-based learning, equity constitutes an instructional practice that equalizes student interest and enables student voice and choice. This allows for equitable opportunities for students of all backgrounds. Next, the second look at equity inside this study was directly related to the demographics of classrooms in our high-profile inquiry-based learning pathways. These classes are some of the non-tested courses referred to in the prior sections that align to the Project Lead the Way curriculum. The research concluded that when it comes to gender, English Language Learners, economic status, and ethnicity, the inquiry-based pathways are not an equitable sample of the demographics of the district. On the other hand, it was concluded that the classrooms observed during the data collection were a very close sampling of the entire population. However, those observed classes were outside of the Project Lead the Way pathways.

Furthermore, it is recommended that the district focuses on a few areas to develop an interest in inquiry in students at an earlier age. By building curiosity for inquiry-based learning more students from various backgrounds will look to enter the inquiry-based pathways. The data collected showed that the female percentages when looked at from a whole were very equitable. When broken down, this was not true in areas of computer science and engineering. It is recommended that the district creates more opportunities in our middle school for females in computer science and engineering. The district has a "Girls Who Code" club in the middle school that was started in the last two years. It will be interesting to see if that helps increase female participation in the high school

computer science pathway for future years. The district should stay focused on this as a goal and look to expand opportunities. Additionally, the researcher recommends that the district builds more partnerships in the STEM businesses in the community and invites female engineers and computer scientists to speak with students. Although the initial data appears equal regarding the male female population in the Project Lead the Way pathways, the contradiction in the data is caused by the large number of females in the biomedical program. The biomedical program is lower in male numbers, and consequently, the district should create additional opportunities in the middle school that would spark more interest in males to pursue medicine.

Moving beyond gender, the data supported that equity for the inquiry-based pathways was not seen in areas of lower income families, English Language Learners, and specific ethnicities. These are also areas that need to be addressed within any additional programs or student clubs like “Girls Who Code.” These additional programs must not only be accessible to all students, but they must also provide comfortable environments for all students regardless of their gender, economic status, or ethnicity.

Finally, the recommendation within this third research question is no different than the guidance discussed regarding research questions one and two. To expand on that recommendation, these goals are about building a culture of inquiry. The recommendation will have planned professional development for both administrators and teachers. Moreover, it is recommended that the district makes inquiry-based learning with equity part of their district plan. In addition to fostering relationships with students, the goals and professional development created will need to build relationships between administrators and teachers as well. By understanding the importance of inquiry-based

learning characteristics, all team members can work towards building and maintaining a culture of inquiry within each school.

Limitations

During this Capstone Project, the researcher was able to identify several limitations to the research. The largest limitation was the environment created by the 2020 global pandemic. In order to accommodate the social distancing requirements mandated by the government, the schools had to limit the student population in each school. Classrooms were made up of 50% face to face and 50% students online at home to meet social distancing requirements. This impacted the ability to design full teamwork style inquiry-based lessons that included group work and labs as was done in the past. Although this was a limitation on the study of a face to face inquiry classroom, it provided a very unique opportunity to view inquiry-based learning online. Due to the unique classroom environment consisting of in person and remote learners simultaneously, the research allowed for a study to be conducted with online and face to face classroom settings at the exact same time. On one hand, the pandemic created a school environment that was something unique to study. However, we may never see this blended environment again, and that environment limited the planning of lessons to meet the inquiry-based learning characteristics. Teachers were overwhelmed with the fast pace changes, and their time was consumed by double planning to meet the needs of face to face and online students in the same class.

Another limitation was the number of responses to the survey. The survey was sent out to 185 teachers in grades six through twelve. The number of responses received was a 40% return with 74 total responses. The researcher's goal of gathering a sampling

from all content areas and all grade levels was accomplished; however, a second goal of 60% survey participation was not met. The results could be influenced by teachers that favored inquiry-based learning and felt more compelled to respond. The researcher sent three messages for the survey over a month. If it was possible to identify and reach out directly to non-responders, the researcher may have been able to pull some more alternative opinions into the research. This was not an option because the survey submissions were anonymous.

The final limitation is the authenticity of the teachers' responses during the interview process. The researcher felt as if the responses by the teachers were very sincere, as they expressed both positive and negative aspects of inquiry-based learning. There was no reason to believe that the responses were not 100% truthful. However, this is always a risk in a designed methodology where the supervisor is the interviewer and the teacher being supervised is the individual being interviewed. This was the least concerning limitation in the study, but unfortunately in a work environment, it is a notable concern.

Recommendations for Future Research

This Capstone Project provided the researcher with data related to the teachers' perceptions on inquiry-based learning with a focus on the student voice and choice. It allowed the researcher to examine a growth mindset in both a face to face setting and an online setting during a global pandemic. This research concentrated on the 10 characteristics of inquiry-based learning that the teachers learned about during a prior professional development session. Recommendations for future research include the following:

1. Examine inquiry-based learning within face to face and online learning environments that are not blended. The data collection process would include the same mixed study with a survey, interviews, classroom observations and data on equity. The difference would be targeting classrooms that are solely face to face and comparing to classrooms that are solely online. The collection of data without blended classrooms would allow the researcher to focus on the instructional practices for each environment separately without teachers balancing both instructional practices at the same time.
2. Investigate the perspectives of the students on inquiry-based instruction. There was a comment in one of the classroom observations from a student that said, "Inquiry-based learning is so much harder." This research was not designed to dig deeper into the students' perspective on inquiry-based learning; however, that comment made the researcher more curious about the students' views on the 10 characteristics of inquiry.
3. Explore the reasons that there is a lack of equity seen within the higher-level inquiry-based pathways. This proposed study is very closely related to the suggestion in number two. The research would again collect data on student perspectives as number two suggested; however, this would target groups of students that are not represented inside the inquiry-based pathways to learn why they are not interested or entering in those fields of inquiry. This Capstone Project focused on three pathways of the Project Lead the Way curriculum (Engineering, Computer Science, and Biomedical), but there are many other inquiry-based pathways to explore that were not examined in this study.

4. Conduct a study to look deeper into individualized student voice and choice as it relates to equity. The format of this type of research would require teachers to be at a level of inquiry-based learning with open opportunities for students to incorporate their diverse ideas. Data collection would require reflection interviews and classroom observations on the perceptions of students. A gauge would be needed to conclude the level of investment and engagement from the students.

Summary

This Chapter 5 presented conclusions related to the 10 characteristics of inquiry-based learning. The researcher identified that student voice and choice within the world of equity is a critical aspect of the 10 characteristics. The analysis of the data showed the teachers' perspective of inquiry-based learning also supports student voice and choice as a critical attribute to quality classroom instruction. Moreover, the data also revealed that instruction is often guided and limited on the options for students to have a voice and choice in their learning. Teachers gravitated towards problem solving skills and questioning techniques within the guided level of inquiry. The teachers' lessons varied on level of inquiry-based learning and at times provided an opportunity for student voice and choice.

Furthermore, this study does support the researcher's belief that the 10 characteristics of inquiry-based learning construct a solid framework of best practices of instruction. To incorporate all 10 characteristics is the highest level of inquiry-based learning. Classroom instruction may not always reach the high level of inquiry-based learning; instruction hitting a few characteristics is still considered quality instruction. A single district initiative to focus instruction around the 10 characteristics will also help

meet many other districts goals including building relationships, equity within instruction, and developing a growth mindset. Therefore, the 10 characteristics form a valid framework for instructional discussions and supervision.

Finally, this study has affirmed the researcher's conviction to build professional development sessions and leadership training around the 10 characteristics of inquiry-based learning. The tiered approach starting with building instructional leadership teams, working with the teachers, and following a common instructional practice will help develop a school culture centered around inquiry-based learning. Establishing a culture of inquiry education will inherently meet the needs of district goals for building relationships, equity within instruction, and developing a growth mindset.

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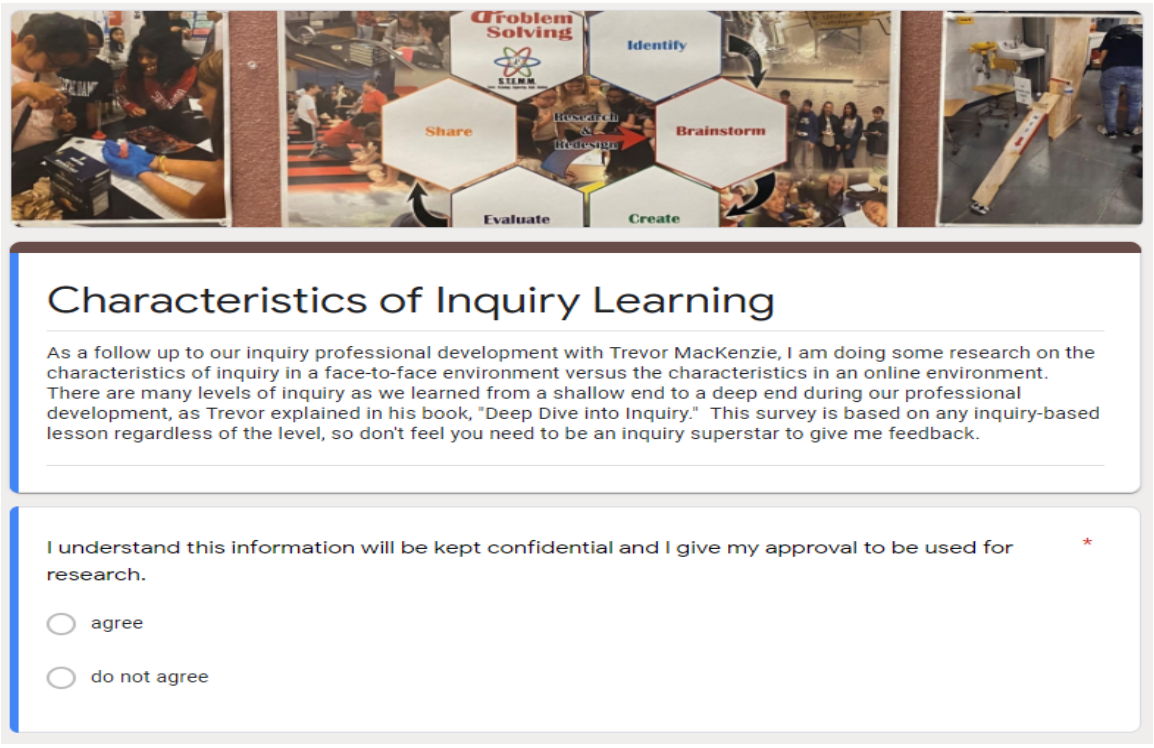
APPENDICES

Appendix A

Parkland Problem Solving (STEM) Poster

Appendix B

Inquiry-Based Learning Teacher Survey



Survey Questions:
Check the Box/boxes that best fit:

1. Your Gender: __ Male __Female
2. Average Class Size: __ 0-10 __11-18 __19-25 __more then 25
3. Grade Level Taught: __6 __7 __8 __9 __10 __11 __12

Complete the following questions:

4. Age:___
5. Years of Experience:____
6. Building you are currently teaching in:____
7. Subject Taught:____
8. How many times a month would you estimate that you use inquiry in your classroom: ____

Select: 1 – Strongly Disagree, 2- Disagree, 3- Agree, 4 – Strongly Agree

	Perspective Questions	1	2	3	4
9.	inquiry-based lessons are important for my students' achievement.				
10.	I am confident in teaching lessons through inquiry				
11.	I have no issues with managing inquiry-based lessons				
12.	I have attended the school based professional development for inquiry-based lessons				
13.	I have attended professional development outside of the school offerings on inquiry-based lessons				
14.	I feel inquiry-based lessons prepares my students for state standardized tests				
15.	inquiry-based lessons benefit all students including students with disabilities				

Select: 1 – Strongly Disagree, 2- Disagree, 3- Agree, 4 – Strongly Agree

	Logistical Questions	1	2	3	4
16.	I have adequate time to collaborate with colleagues on inquiry-based lessons				

17.	I have enough supplies to teach inquiry-based lessons				
18.	I feel supported to teach inquiry-based lessons				
19.	My classroom have adequate space to teach lessons through inquiry				
20.	Teaching through inquiry is too time consuming. I don't have enough planning time to prepare for inquiry-based lessons				

Reflect on your most recent (**face to face**) inquiry-based lesson.

Select: 1 – Strongly Disagree, 2- Disagree, 3- Agree, 4 – Strongly Agree

	Characteristic for Building Relationships	1	2	3	4
21	Respectful interactions between teacher and student				
22	Respectful interactions among students				
23	Student and/or teacher pride in work				
24	Active student participation				
25	Nurture student passions and talents				
26	Encourage the growth mindset				

27	Foster curiosity and a love for learning				
28	Equitable resource for all students – Knowledge of Students				

Select: 1 – Strongly Disagree, 2- Disagree, 3- Agree, 4 – Strongly Agree

	Characteristic for Building Relationships	1	2	3	4
29	Meaningful research and strong research skills - students show curiosity of research				
30	Increased Motivation and engagement				
31	Rigorous learning tasks – Is the problem challenging the students thoughts?				
32	Higher level student thinking – solving tomorrow's problems in today's classroom				
33	Empower Student choice and voice				
34	Students take ownership in what they are doing and why and how they are doing it in order to demonstrate success (learning how to learn)				
35	Instructional tools and strategies support student choice and voice and are aligned to instructional goals.				

36	Encourage good questioning from students and the importance of questions to find a solution				
37	Understanding of the content beyond the facts is evident				

Reflect on your most recent (**online**) inquiry-based lesson.

Select: 1 – Strongly Disagree, 2- Disagree, 3- Agree, 4 – Strongly Agree

	Characteristic for Building Relationships	1	2	3	4
38	Respectful interactions between teacher and student				
39	Respectful interactions among students				
40	Student and/or teacher pride in work				
41	Active student participation				
42	Nurture student passions and talents				
43	Encourage the growth mindset				
44	Foster curiosity and a love for learning				
45	Equitable resource for all students – Knowledge of Students				

Select: 1 – Strongly Disagree, 2- Disagree, 3- Agree, 4 – Strongly Agree

	Characteristic for Building Relationships	1	2	3	4
46	Meaningful research and strong research skills - students show curiosity of research				
47	Increased Motivation and engagement				
48	Rigorous learning tasks – Is the problem challenging the students thoughts?				
49	Higher level student thinking – solving tomorrow's problems in today's classroom				
50	Empower Student choice and voice				
51	Students take ownership in what they are doing and why and how they are doing it in order to demonstrate success (learning how to learn)				
52	Instructional tools and strategies support student choice and voice and are aligned to instructional goals.				
53	Encourage good questioning from students and the importance of questions to find a solution				
54	Understanding of the content beyond the facts is evident				

Appendix C

Volunteer Consent Form

Dear Faculty Member,

As a contracted educational professional that participated in the inquiry-based and equity professional development during the 2019-2020 school year, you are being asked to participate in a research studying teacher perception regarding Inquiry for Student Voice and Equity. The research will focus on the 10 characteristics of inquiry examined during the professional development opportunities. Your participation in this study will help the researcher learn more about how you perceive the effectiveness of inquiry-based learning both face to face and online. Your participation is voluntary and all information will be kept confidential.

What will I be asked to do if I take part in this study?

If you agree to participate in this study, you will be asked to complete one Google Form electronic survey. Following the survey, you may be selected randomly to participate in a controlling sampling to further participate in one interview (no longer than 30 minutes) and one classroom observation (no longer then 30 minutes). This observation could also be an observation digitally online through Schoology. All information will be kept confidential and stored within my personal google account, so no other district administrator can access. All records will be deleted following the completion of the study.

Where will this study take place?

There will be a combination of an online survey using a secure website, interviews (in the teacher's classroom or virtually through google meets), and classroom observation (in the teacher's classroom or virtually through Schoology.) There is also an aspect of student data (demographic data: race, economic status, gender, ELL, and academic goals) that will be collected and analyzed from the voluntary teachers' classroom data. All information will be kept confidential and stored within my personal google account, so no other district administrator can access. During observations, no student names or personal data will be collected. If observation is completed in a virtual environment, the researcher will not be recording the virtual session. The observation is designed to be a real time observation with a list of look-for data to collect. All information will be kept completely confidential.

What happens if I decide to not continue after starting the study?

There is no penalty if you decide to withdraw from the study at any time. The researcher will not ask any questions and no reason is needed to withdraw.

What are the risks?

This data collection is NOT anonymously collected. You will not be asked personal questions or questions of sensitive nature. Participants are asked to be completely honest in their responses. This is often a moment that may make an individual feel uncomfortable, however, there is no judgement on your responses and all information will be kept confidential. Participants are not required to answer questions that they choose not to answer. This is completely voluntary and confidential, however, due to the nature of some questions there is a risk of identification to the researcher through triangulation. All information will be kept confidential.

How will I benefit from participating?

You will help the researcher better understand the teachers' perception of inquiry and equity. We all grow as a team. Your participation will help planning for future professional developments that will better instruction for our students.

Who do I contact if I have questions about this study?

If you have questions about this study, please contact the researcher, Jason Henry at HEN5815@calu.edu or 610-351-5542. If you would like to talk to someone other then the researcher, please contact Dr. Mary Wolf, Assistant Professor at California University of Pennsylvania, at email wolf@calu.edu.

I have read this form. Any questions I have about participating in this study have been answered. I agree to take part in this study, and I understand that taking part is voluntary. By signing below, I agree to participate in this study. I am indicating that I have read this form and had my questions answered. I understand that it is my choice to participate and I can stop at any time.

Signature required for interviews and classroom observation:

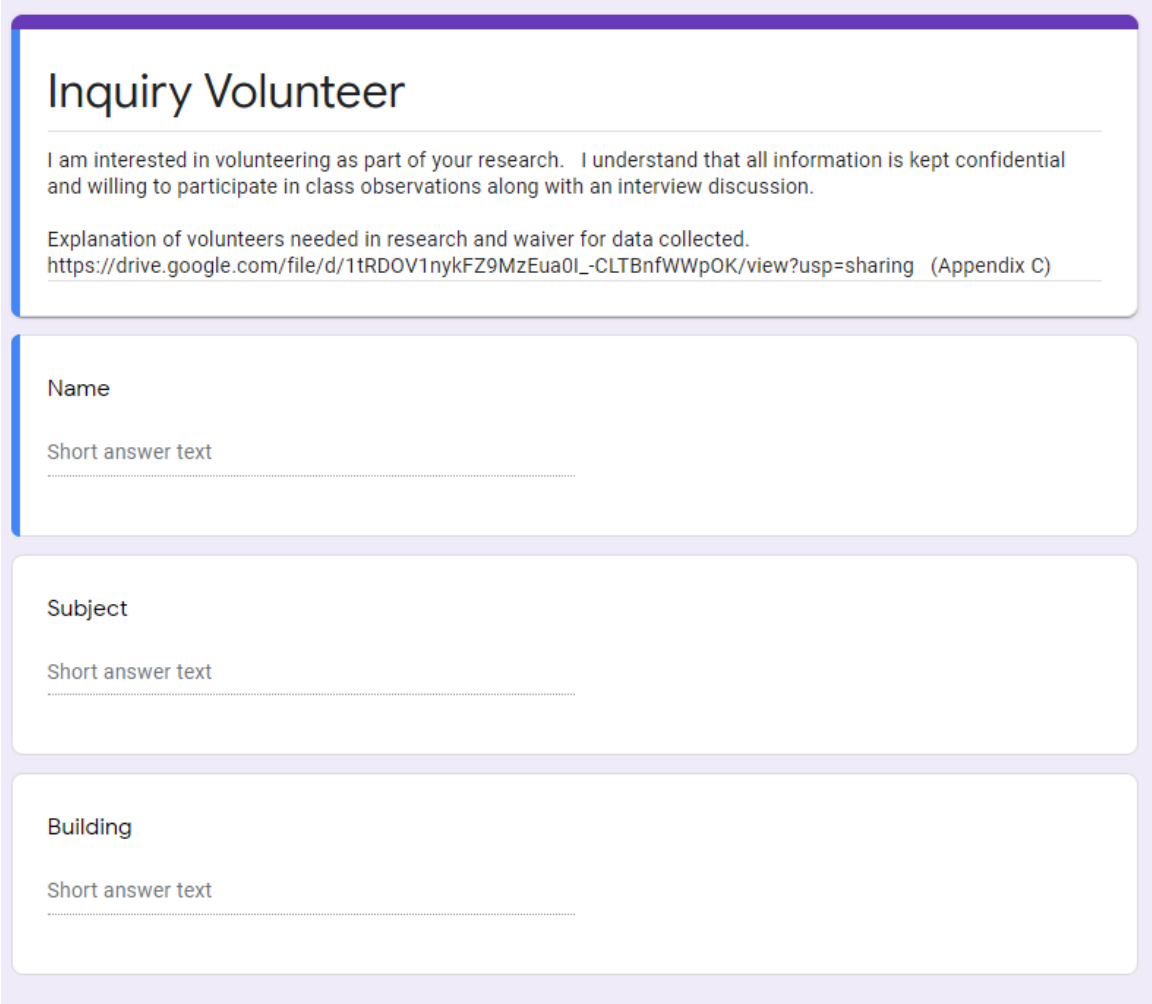
Signature: _____

Print Name: _____

Date: _____

Appendix D

Volunteer Interest Survey



Inquiry Volunteer

I am interested in volunteering as part of your research. I understand that all information is kept confidential and willing to participate in class observations along with an interview discussion.

Explanation of volunteers needed in research and waiver for data collected.
https://drive.google.com/file/d/1tRDOV1nykFZ9MzEua0I_-CLTBnfWWpOK/view?usp=sharing (Appendix C)

Name

Short answer text

Subject

Short answer text

Building

Short answer text

Appendix E

IRB Approval Letter

Institutional Review Board
California University of Pennsylvania
Morgan Hall, 310
250 University Avenue
California, PA 15419
instreviewboard@calu.edu
Melissa Sovak, Ph.D.

Dear Jason,

Please consider this email as official notification that your proposal titled "Inquiry for Student Voice and Equity: Exploring 10 Characteristics" (Proposal #19-074) has been approved by the California University of Pennsylvania Institutional Review Board as submitted.

The effective date of approval is 9/10/20 and the expiration date is 9/09/21. These dates must appear on the consent form.

Please note that Federal Policy requires that you notify the IRB promptly regarding any of the following:

(1) Any additions or changes in procedures you might wish for your study (additions or changes must be approved by the IRB before they are implemented)

(2) Any events that affect the safety or well-being of subjects

(3) Any modifications of your study or other responses that are necessitated by any events reported in (2).

(4) To continue your research beyond the approval expiration date of 9/09/21 you must file additional information to be considered for continuing review. Please contact instreviewboard@calu.edu

Please notify the Board when data collection is complete.
Regards,
Melissa Sovak, PhD.
Chair, Institutional Review Board

Appendix F

Classroom Observation Tool

Building Relationships and Trust:

- Building Blocks of learning/ Foundation for effective instruction

LOOK FORS: Building Relationships and Trust:

1. Respectful interactions between teacher and student
2. Respectful interactions among students
3. Student and/or teacher pride in work
4. Active student participation
5. Nurture student passions and talents
6. Encourage the growth mindset
7. Foster curiosity and a love for learning
8. Equitable resource for all students – Knowledge of Students

Engagement/ Invested learners:

- Disengagement
- Multiple Modalities of Learning
- Authentic Learning Activities
- Highly Invested Students

LOOK FORS: Engagement/ Invested learners:

1. Meaningful research and strong research skills - students show curiosity of research
2. Increased Motivation and engagement
3. Rigorous learning tasks – Is the problem challenging the students thoughts?
4. Higher level student thinking – solving tomorrow's problems in today's classroom
5. Empower Student choice and voice
6. Students take ownership in what they are doing and why and how they are doing it in order to demonstrate success (learning how to learn)
7. Instructional tools and strategies support student choice and voice and are aligned to instructional goals.
8. Encourage good questioning from students and the importance of questions to find a solution
9. Understanding of the content beyond the facts is evident

Appendix G

Teacher Interview Questions

Inquiry Interview Questions:

Teacher:

Grade Level/Subject:

1. What instructional methods of teaching and learning are used most often in your classroom? (Describe these methods in more detail)

2. How do you define inquiry-based teaching strategies? What does this involve?

3. What are the most important routines in your classroom instruction on a typical day?

4. What skills are you hoping your students will achieve in your class?

5. What are the critical goals that students learn about or learn how to do in your class?

6. What do you consider to be the important outcomes of inquiry-based teaching and learning?

7. What are the most essential skills you want your students to demonstrate during inquiry?

8. What are the road blocks or hurdles you face during inquiry-based lessons?

9. Have you tried inquiry in online lessons? If so, explain the successes and the challenges?

10. Define a classroom that follows a “growth mindset”?