# A PHENOMENOLOGICAL STUDY OF THE LIVED EXPERIENCES OF HIGH SCHOOL SENIORS IN MATHEMATICS CLASSROOMS: ANALYZING METHODOLOGIES THAT INCREASE ENGAGEMENT

by

Andrea Lynn Crews-Brown

Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

Doctor of Philosophy

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## Abstract

The purpose of this transcendental phenomenological study was to understand the methods high school seniors found engaging in mathematics classrooms at a private high school in Northern Florida. This study focused on engagement theory, which explains processes that help students learn based on attentiveness to presented content. Data collection for the phenomenological study consisted of interviews, focus groups, and journal entries as students shared their perspectives on engagement in their mathematics courses throughout upper school at a private Florida high school. Data collection took place by interviewing 15 students with the intention of students following into the other phases allowing individual thoughts (interview), group thoughts (focus group), and concluding thoughts (journal entry) to support the triangulation of the data. A larger sample size in the initial phase increased the probability of participants completing all three data-collection phases. Data triangulation occurred by creating a virtual code book and developing themes subject to adjustments throughout collection and analysis. The purpose centered on understanding the importance of engagement in learning from the student's perspective. All stages of data collection occurred on a private high school campus containing students with similar experiences in their last four years of mathematics education. Three major themes developed from data analysis centered around variability in classroom set-up, positive emotional responses, and the creation of a learning community.


*Keywords*: engagement, mathematics, high school, learning, achievement

## Copyright Page

## Dedication

I dedicate this dissertation to God, my creator, as I am nothing without Him.

To my parents, who have supported me my whole life and always drive me to perform my best.

To my grandfather and late grandmother, who are perfect examples of what can be achieved with hard work and dedication.

To my brothers and sister-in-law, who both judged and supported me with their wit and sarcasm at every turn of my educational career and throughout my life.

To my husband, who never hesitates to listen to my thoughts, no matter the hour. Without him I could not carry out anything and would not be where I am today.

To my children, Ari, Rylan, and Ryder, may you always achieve your goals and never doubt my love and support.

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Firstly, I would like to thank Dr. Farrell, Dr. Bruce, and Dr. Stanley for their continued work and support during this process as they answered my questions and worked through many revisions.

Secondly, I would be remiss not to thank my husband again for his support in editing my writing and managing my stress while working through an informally scheduled process.

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## List of Abbreviations

Advanced Placement (AP)

Attention Deficit Hyperactivity Disorder (ADHD)

Campus where the study will occur, pseudonym (Mun)

Problem-Based Learning (PBL)

Science, Technology, Engineering, and Mathematics (STEM)

# CHAPTER ONE: INTRODUCTION

## Overview

Borup et al. (2019) found that, for a student to learn, they must first be engaged and interested in the content. Students must also understand the material and draw connections to everyday life (Rich et al., 2010). Connections to the real world are necessary for proper understanding, as ties to earlier content and future context aid with understanding and become necessary for application (Abassian et al., 2020). By actively engaging, students will be able to garner greater understanding, teachers will be able to hold more meaningful conversations, and hopefully, a continued interest in mathematics can blossom for students who generally would lose interest in the content matter (De Keyser et al., 2020). The following chapter will discuss the background of mathematics education instruction, the importance of engagement in the educational foundation for learners, and the background information, problem statement, purpose statement, and significance of the study. This transcendental phenomenological study answers a call for more information about the benefits of engagement. It intensifies understanding of a specific content area, mathematics, and further understanding of older students, as most research has focused on the elementary and middle school level. Even though researchers have found the benefits of different methodologies used for a variety of subjects to foster engagement change, more research is needed when looking at each discipline separately (Skilling et al., 2021).

## Background

While student engagement has always played a significant role in learning, its prevalence in discussions has increased throughout the past 50 years. The importance of engagement has come to a head in the past ten years due to students' lack of interest in school and more significant issues within the discipline of mathematics (Belsha, 2021). Students spend a great deal of time

outside of school on their cell phones and using technology that gives instant gratification, leading to a potential lack of focus in the classroom where gratification is not so readily available, and focus is easily lost (Silk et al., 2011). Various techniques have been used to increase engagement over time and are potential areas of interest for students; methods for increasing engagement include building relationships, using computers in class, doing group work, and increasing active learning (Harding, 2018). Students are losing interest in mathematics at an alarming rate, leading to gaps in the workforce that must be addressed as the need for science, technology, engineering, and mathematics (STEM) professionals grow (Boswell, 1979).

**Historical Context**

The need for engagement has progressed over the past century, thanks, in part, to John Dewey (Cremin, 1959). His first premise centered on the idea that students learned best through experimental conditions that allowed them to draw connections between the outside world and what was occurring in the classroom rather than a simple lecture-based system where students listened to the information while taking notes (Schwartzstein & Roberts, 2017). As the students in the classroom and workforce were changing, Dewey believed education must follow suit (Cremin, 1959). Educational trends continue to evolve, evoking different learning methods in the classroom as time progresses (Holt, 2020). Engagement became a major buzzword in the 1990s, with various definitions coming to frequent use (Opsal, 2013). Even though usage of the buzzword started 30 years ago, the trend has not halted and the need for engagement is now readily accepted, but the means of obtaining it continue to shift and change as time progresses. Various methods have increased student engagement, correlating to higher test scores and more positive associations with what has been taught (Collins & Valentine, 2010).

Although engagement is necessary, achieving it is still heavily researched across multiple disciplines and age groups, leading to findings on its benefits and raising added questions (Cevikbas & Kaiser, 2022). The most heavily researched areas have been relationships, active learning, group work, and problem-solving methodologies (Doo & Bonk, 2020). Following Dewey's thoughts about active learning, problem-based learning (PBL) originated in the early 1900s to increase cognitive engagement (Kelly et al., 2005). It must often be paired with scaffolding or a method that shows student support (Hwang et al., 2017). Methods of support increase problem-solving engagement and students' anxiety as they work (Meriyati, 2018).

As time has progressed, the importance of computer usage has also increased, allowing the use of technology in the classroom to not only enhance lessons but also to increase student's ability to actively problem solve or review at their own pace to ensure all students are engaged and accountable for their learning (Cannings & Finkel, 1993). Lastly, the frequency of communication with teachers and approachability have come to the forefront of engagement and teaching (Collins & Valentine, 2010). Relationships are the cornerstone upon which communication thrives, leading to the importance of understanding the content material and teaching content at the proper level (Briley, 2012).

**Social Context**

The education landscape has continued to change over time, with a more significant percentage of students having learning differences and needing special instruction (McCardle et al., 2005). Twenty percent of students in the classroom currently have learning differences that call for adjusting how the material is presented and assessed (Barto, 2018). Students' learning styles must be understood and supported to allow for success. The focus then should be on drawing students into classroom exercises, learning that added work is necessary on the student's

part to find success in the classroom (Perreault & French, 2016). Additionally, teachers must actively work to understand their students through conversations and monitoring to ensure their needs are understood, or engagement will not improve (Weimer, 2003).

Rose et al. (2022) explained that many teachers must teach on-level content without consideration of the materials that have caused issues, causing a lack of engagement and capabilities to complete current material. Lack of knowledge creates a vicious cycle of students struggling and unable to succeed when looking at the content of strengthening their skills (Nelson & Powell, 2018). Lack of knowledge often cycles into students becoming overwhelmed, leading to a lack of interest (Anderson et al., 2019). Mathematics is known to cause high anxiety levels as the subject matter builds heavily (Rozgonjuk et al., 2020). Hence, weakness in one stage drastically affects further learning, often making it impossible for continued growth (Dowker et al., 2016). Confusion could be reduced by asking leading questions or giving hints to help ensure students are following a productive path (Rotgans & Schmidt, 2011). In addition, unfocused students have issues understanding concepts. A lack of focus and understanding can often lead to disciplinary issues (Anderson et al., 2011). These issues negatively affect students and those around them, who become distracted and miss learning opportunities (Lee et al., 2022). Additionally, students' attitudes can contaminate those around them, causing other negative feelings or disinterest.

McCallen and Johnson (2020) recently published an article sharing that math scores and students' problem-solving skills are declining in America. One reason for low scores is that many teachers still focus on teaching formulas and steps instead of ensuring that people understand why different methods are necessarily leading to memorization instead of understanding (Gallin, 2022). Memorization, in turn, means that students are not actively participating in the problem-

solving process and cannot apply their learning as a foundation for other problem types (Szabo et al., 2020). Tubb et al. (2020) expressed that creativity is decreasing in many mathematics classrooms, leaving students with gaps in their knowledge and a lack of interest in the environment as they approach more challenging concepts. Students' feelings of defeat are causing fewer students to show interest in mathematics and a decrease in competent students over time, leaving gaps in the education field.

Gulnaz and Fatima (2019) explained that the condition in which a student learns plays a significant role in their interest in a class, particularly if it is challenging, as it is much easier for them to focus on a more accessible subject. Challenges, in turn, mean that complex mathematics moves into an even more precarious position as students lose interest in favor of other subject areas (Salters, 2019). Educators must ensure that students are actively taking part and intrigued by what they are learning to counteract the difficulty of the content. For many, their dislike of mathematics begins at the beginning of high school, which leads to a lack of continued engagement throughout high school and movement away from STEM disciplines throughout college, where students simply take the minimal requirement in mathematics (Gulnaz & Fatima, 2019).

**Theoretical Context**

Many students quickly answer mathematics when asked for their least favorite or most challenging class. Murphy (2021) found that 82% of students feel that significant issues in mathematics classes relate to the quality of education, describing lessons from their teacher as unlikely to affect learning positively. Students also expressed that they could not learn through only demonstrated content and did not feel that problems led to academic rigor, instead focusing on memorizing materials (Bohrnstedt et al., 2015). Qualitative studies have shown that students in

traditional classrooms not only grow to dislike the content but also struggle to apply the material they have learned as they move into real-world scenarios (Boaler, 2006).

One issue with traditional learning is that students are not actively involved. Instead, the material is presented directly, not leaving time for questions or thoughts (Hafeez, 2021). In 2011, the U.S. Department of Commerce expressed that lack of interest was becoming an even more significant issue as the country is becoming more technology-dependent, causing STEM jobs to be needed at a rate twice as high while the number of students losing interest grows (Langdon et al., 2011). Woodward (2004) found that, while many policies change and suggestions occur, the policies often do not trickle down to the classrooms. Lack of interest leads to the question, if students were more engaged in the classroom, could the problem begin to be solved? Also, what could lead to needed change in engagement (Boaler & Staples, 2008)?

Kearsley and Schneiderman (1998) first developed engagement theory to focus on supporting students' meaningful engagement in their activities by completing worthwhile tasks. The theory supports using projects, problem-based learning, collaboration, and anything that shows an authentic focus on learning (Bond et al., 2020). Knowledge is no longer in books and the classroom but instead focuses on an application that allows for growth. Engagement centers on relating to others, creating an interesting component, and donating to outside sources (Jones & Nangah, 2021). Working to find engagement in the mathematics classroom is still an evolving process, as a variety of techniques have been tried from flipped classrooms (Lo & Hew, 2021), group learning (Zizka et al., 2021), and even simply looking at achievement (Putwain et al., 2018). As research continues to answer some questions, there are further questions regarding the effects of engagement on attitude and performance (Panadero & Lipnevinch, 2002).

One standard engagement maximization method is classroom technology. Attard (2018) expressed that, while technology use is beneficial, research is incomplete in the mathematics classroom; therefore, assumptions should not be drawn about the benefit of technology, as the environment is different from those in which it occurs. Lack of information requires further study of the use of technology, such as calculators, online systems such as Desmos, or even Khan Academy, where students can receive additional aid independently. Student and teacher relationships are necessary and heavily researched in increasing student support, where students who feel more comfortable and confident tend to have better scores (Rattan et al., 2012). Other researchers have found that relationships do not correlate with students' classroom engagement but with the subject's difficulty level leading to further analysis (Roorda et al., 2019).

## Problem Statement

The problem is that students often do not find mathematics classrooms engaging (Ihrig et al., 2018; Mullins & Panlilio, 2021; Quintero et al., 2022; Roos, 2019; Smerillo et al., 2018). The number of students taking advanced mathematics courses continues to decrease, and the contributing factor cited is a lack of engagement in the classroom (Attard & Holmes, 2020). Fung et al. (2018) further expressed that engagement predicted student success, leading to greater interest in engagement. Lack of engagement could cause fewer students to take math courses, contributing to deficient performance. Various methods help engagement, such as relationships, technology, and group work in collegiate and high school classes (Eason et al., 2022). However, there needs to be more research, specifically looking at the effect of engagement in a mathematics environment (Schuetz et al., 2018).

By speaking with high school seniors, students will be able to express the changes in engagement over four years of high school mathematics, giving a greater breadth to the findings

about relationships and other methodologies employed for their benefit. Group work, for instance, is known to have positive effects on learning but has adverse effects on students' attitudes, so there is still debate on its actual benefits to long-lasting education, as studies have shown varied results (Poort et al., 2022). Lack of direction leads to conflicting results in engaging students, as many feel underprepared and can begin to feel defeated (Choi et al., 2018). These findings are heavily quantitative, with a previous focus on change in grades, but qualitative analysis has not occurred to focus on the feelings that occur. By gathering student opinions, insight is necessary into how students feel the material's content changes their engagement and if it affects their motivation in the classroom, leading to even more significant questions on the importance of relationships, group work, and technology in the mathematics classroom (Viswambaran & Shafeek, 2019).

## Purpose Statement

This transcendental phenomenological study aims to describe the engagement experience of secondary school students in mathematics in a private school in Northern Florida. Engagement is defined as a passion, interest, and desire to understand and fully employ the material taught in problems (Schaufeli, 2013). A new perspective can occur by gathering data from students about their experiences in education and giving students a voice, allowed comparing commonly accepted engagement practices to assess their relevance.

## Significance of the Study

This study fills gaps in the current literature while responding to calls for further study from earlier research (Milner-Bolotin & Marotto, 2018). Engagement has been a hot-button topic for an extended period and is the goal of educators as they want students to pay attention in class and learn the content. Student engagement has a tremendous effect on decreasing discipline issues

and increasing test scores, which will be beneficial in multiple ways (Luiselli et al., 2005). Núñez & León (2019) expressed that self-determination is related to teacher relationships, showing that students work harder in classes where they feel seen and supported. In many cases, means of showing support is not easy in a mathematics classroom, as teachers often stand at the board and teach content and do not interact, which does not allow the opportunity to form bonds with students (Canzoneri, 2017).

Finding methods to increase engagement in the classroom can be beneficial for all individuals. Firstly, students with more engagement will likely gain greater understanding. By obtaining the student's perspective on engagement, information will no longer be from a second-hand source making indirect assumptions or hopes. Martin and Collie (2019) expressed in their research that students who are more engaged in one class and have more positive feelings tend to perform better in their other courses, so further understanding and positivity in mathematics could begin a cascade effect. Increased engagement in mathematics could also positively affect other courses (Perkmann et al., 2021). Educators can tailor lesson plans to their student's needs, allowing for more responses, better performance, and fewer interruptions due to behavior issues as they gain further understanding of their students (Hawkins, 2018).

Also, tailoring lesson plans to fit students' needs will ensure that teachers give the necessary information to ensure they are appropriately spending their planning time and taking advantage of class time. Mathematics teachers are making assumptions about what could work in their classrooms based on findings in other disciplines, potentially leading to wasted resources (Bozkurt & Koyunkaya, 2022). Lastly, as students become more engaged, there is hope that their level of interest will continue, allowing the opportunity to begin filling the gap and rectifying students' desire to move away from mathematics (Murphy et al., 2019).

Similarly, struggling students intensify an issue, as they are unwilling to speak up and fall further behind (Iachetti, 2022). Growth opportunities could also occur by using group work and problem-solving skills. Teachers must first understand their students to ensure they can support their needs and ease conversations as necessary (Crittenden & Ainsworth, 1989). These components circle back to methods to keep students engaged in the classroom and the content (Dewan et al., 2019). Further research is needed to solidify the importance of engagement in a mathematics classroom, specifically (Laursen & Rasmussen, 2019).

Putwain et al. (2018) found that engagement was necessary for authentic learning in younger students and further tested methods of maintaining engagement over time. However, he suggested further studies in higher grade-level students to test his theory. Since that time, various authors have responded to calls for research. Lin et al. (2018) further studied the effects of group work in mathematics, while Attard and Holmes (2020) verified the importance of technology. Martin and Collie (2019) looked at the importance of engagement in all classes in a student's schedule and the effect one course could have on another.

Much research has been completed on each engagement component separately, but research is missing comparing the given components. Bennison et al. (2018) completed a similar study focusing on underprivileged students by interviewing their teachers. Teachers felt that more engaged students caused fewer disruptions in class, showed more self-efficacy, and a greater desire to learn; however, research was not from the student's perspectives (Padilla-Petry & Vadeboncoeur, 2020).

Wang and Degol (2014) explained that many studies still looked at mathematics as either fun or not fun for students and failed to consider the impact of emotional experiences on their learning and understanding, leaving a large gap for others to come in and analyze the needs of

students. More research in STEM is needed as described by Murphy et al. (2019), especially whe considering data from the student perspective. Using continuous analysis will allow for comparing topics deemed necessary by educators, such as group learning, problem-solving skills, computer knowledge, and a positive attitude (Corbin & Strauss, 2015). Analysis will answer a call for further research by allowing comparisons of multiple topics positively correlated with engagement and giving a voice where one has been previously missing.

## Research Questions

The following questions will be used to collect data about engagement and its effect on learning in the mathematics classroom. The study asks the following research questions:

### Central Research Question

How meaningful is engagement to high school seniors in mathematics classrooms?

### Sub-Question One

What are the experiences that high school senior mathematics students describe as engaging?

### Sub-Question Two

Why are specific methods beneficial in some disciplines and less effective in others?

## Definitions

The following definitions and terms were used during research and will aid in understanding the content:

1. *Active learning* - Approach to instruction that engages students through discussion, problem-solving, role play, and student interactions (Grabinger & Dunlap, 1995).
2. *Autonomy* - Deals with the ability of an individual to make their own choices about how to approach a problem or ethical decision (Ruiz-Mirazo et al., 2004).

3. *Behavioral engagement* - The visible and discernible act of students being invested in their learning and providing effort to the presented academic challenges (Schreiner et al., 2021).
4. *Competence* - Clarifies a given topic's level, focused explicitly on background knowledge and capabilities (Garneau & Pepin, 2015).
5. *Cognitive engagement* – Explains the extent to which students are willing to approach a given task and the level to which they apply their effort (Helme & Clarke, 2001).
6. *Emotional engagement* - Has to do with the active desire to participate in class and to become a positive influence on peers (Heath, 2009).
7. *Engagement* - Refers to the amount of interest, curiosity, optimism, and passion students have when taught a lesson (Mandernach, 2015).
8. *Problem-based learning* (PBL) – A student-centered approach where individuals learn by solving open-ended problems instead of learning via a lecture format (Savery, 2015).
9. *Relatedness* - Content is easier to understand when topics are related to something in real life or related to previous learning (Blatt & Zuroff, 1992).
10. *Scaffolding* - Provides background information or leading questions to support problem-solving methods and ensure students are on the right track (Benson, 1997).
11. *Self-actualization* - Means students can reach their full potential and have the drive needed to a challenging problem (Maslow, 1965).
12. *Self-determination Theory* - Explains that all humans have basic psychological needs that underlie their capability of growth. The three components are autonomy, competence, and relatedness (Ryan, 2009).

## Summary

This transcendental phenomenological study aims to describe the engagement experience of secondary school students in mathematics in a private school in Northern Florida. Additionally, information on whether engagement yields further interest in mathematics as time progresses by obtaining information on why students took their current mathematics course and future college plans. Martin et al. (2020) completed a similar study by conducting an online survey of high school students, showing that they felt engagement was decreasing. However, they did so by retrieving quantitative data without explaining why students felt a specific way. By using engagement theory, the current transcendental phenomenological study will analyze the effect and importance of engagement on students' feelings about mathematics.

Engagement is necessary to keep students interested in their learning and for true success, which likely leads to different outcomes. Additionally, engagement in STEM has received constant requests for further research (Tamur et al., 2021). The research will fall into the engagement category but goes a step further by analyzing the *M* in STEM specifically by looking at the mathematics part (Attard & Holmes, 2020). These gaps require further understanding to obtain information that can support student learning and fill continued gaps in education as time progresses. Colleges and careers call for problem-solving skills that have continued to dissipate, so a shift to an engaging classroom could begin aiding individuals, not only in schools but also in their future (Mahanal et al., 2022). Lastly, teachers can benefit as students could become more active members of the class, leading to better discussions and fewer classroom interruptions. For engagement to occur, a conversation and an understanding of expectations are necessary to ensure clarity of needs (Martin & Collie, 2019).

# CHAPTER TWO: LITERATURE REVIEW

## Overview

Much research has occurred to assess the effect of teachers' actions on students' engagement with a focus on three major components: relationship, technology, and active learning (Hedman & Sharafi, 2004). Based on Vygotsky's findings, Lyle (2008) explained that students can only truly learn in a class when they feel comfortable. Styles of support at home impact children positively, and the same is true for educators, as they must seek to understand their students to support them as they approach challenging problems (Stevens et al., 2019). Most commonly in literature, engagement is linked with active learning, set expectations, achievable goals, and positive classroom environments (Bateman & Yell, 2019). Research leads to the conclusion that education is most effective when student-centered lessons are applied, while teachers are willing to shift their set-up in the classroom to support the needs of their students (Aspelin, 2017).

Additionally, recall and learning occur more readily when topics connect to the real world, allowing students to see how content could be related to their everyday lives (Harlap & Riese, 2021). Chapter Two discusses the descriptions of engagement theory as a foundation for further study and other research on perceptions of engagement. Earlier studies have shown the benefits of engagement across various students but have failed to do so from the student perspective. As students are the target audience, giving them a voice in their education logically makes sense. In that case, their options on what matters the most to their engagement should be essential for the theoretical findings of earlier studies and suggestions for future research.

## Theoretical Framework

Engagement theory's premise is that, for students to be meaningfully engaged in classroom activities, they must interact with the material or participate in a worthwhile task (Kahn, 1990). How an individual can be connected varies based on the situation, with some researchers believing it is by technology (Kearsley & Shneiderman, 1998), connection with their peers (Reeder, 1994), interaction with a superior, such as a teacher (Fredricks, 2018), or even the value that student feels about the given content (Tinto, 2004). The qualitative aspect of research can begin distinguishing what students feel is important by discussing these components with students. Quaye et al. (2019) explained that methods that might work for some students wouldnot work for all and are based on the connections needed, the size of the class, or other outlying factors. Additionally, high school seniors could lead a variety of perspectives as they have experienced engagement across numerous mathematics courses and educators (Eggens et al., 2008).

Astin (1984) proposed that, even though engagement feels heavily researched, it is not truly the case, as everyone approaches the topic differently. Even those who think they are exploring the same topic approach it differently, leading to new findings and a lack of consensus on the actual needs of students (Simmons, 2013). Most engagement research has been completed from the educator's perspective, leaving room for growth by adding another voice into the conversation. Participants' perspectives of engagement also vary based on the foundation upon which students enter the classroom, affecting their ability to find their groups (Brown & Pehrson, 2019). Student connection with the core values of their teacher also drastically affects students' engagement, which could lead to varied opinions depending upon the course (McCabe, 2016).

Jimerson (2003) explains that engagement occurs across multiple levels and by various means. The three central components remain constant: affective, behavioral, and cognitive engagement. Affective engagement centers on the ideals of students' feelings about the class or content that is covered (Ogueyungbo et al., 2019). Students' emotions will play a significant role in their attention, as developing a negative attitude leads to a lack of interest in a topic (Appleton et al., 2008). For students who continuously see themselves struggling in a subject, attitude leads to a sense of defeat and, ultimately, a lack of effort in many cases (Malik et al., 2020). Hurtado et al. (1996) further support with the belief that students' feelings of their understanding and engagement affect their outcomes even more so than the actual engagement itself, showing further the importance of students' feelings on their learning. By interviewing students across various mathematics courses, different confidence levels will likely be discovered, allowing for breadth in opinions on engagement.

Behavioral engagement focuses on students' classroom actions and how they affect their efforts and participation (Fredricks et al., 2004). Behavioral engagement also looks at how students follow the rules, concentrate, and participate in discussions that take place in the classroom (Suárez-Orozco et al., 2009). Significant effects of group work have been shown to affect learning, community building, and social interactions as students build their confidence and learn to share their thoughts (Renn & Arnold, 2003). Social network analysis has proven that students who are more connected to those around them perform better in class. Dawson (2008) found that the greater the contact points and means of connection, the larger the engagement.

Students will be able to give their perspectives on the importance of their teacher and peers by sharing views about group work and other collaboration methods. Additionally, their teacher can draw better connections, and students better keep information by working and

discussing material together (Wasserman & Faust, 1994). Ultimately, the educator and peers can affect the engagement of individuals in the classroom (Taylor, 2021).

Cognitive engagement focuses on the ideas about the ideas needed to understand what has been presented instead of simply focusing on the material (Marks, 2000). Students' ability to take on their learning tasks and invest their time and energy into the learning increases as they become engaged (Corno & Mandinach, 1983). Engagement is shown in group work or problem-solving skills, as students do not purely focus on others but internalize the information that has occurred (Richardson & Newby, 2006). Ceci and Papierno (2005) found a feedback loop between motivation and engagement, supporting the idea that one indeed affects the other and that, without motivation to learn or express interest, the content does not matter.

Appleton et al. (2006) postulated that engagement should also consider a fourth subtype focused on academic engagement. Academic engagement is defined as a time students focus on the task, their grade, and the methods used to measure engagement during the presentation of new material (Christenson et al., 2012). Additionally, as students are the target audience, they should have a voice and share their opinions of what works for them in the classroom instead of presenting a second-hand belief (Miliszewska & Horwood, 2004). These components have all been found to be impactful, but further research should be done on the benefits of their use simultaneously. The transcendental phenomenological study will allow students to share their perspectives on what has been engaging and their thoughts about why different components could have a pleasing effect on their learning in mathematics.

## Related Literature

How educators approach their classroom sets the tone for student interactions, conversations, and methodologies. Engagement occurs in many ways, based on the student's

background and preconceived notions about not only the content but also the method of instruction (Rodríguez et al., 2019). Current needs in education have shifted from their previous historical set-ups to a more active style. Active teaching, in turn, focuses on group work, computer usage, student-based instructions, and discussion of race and culture (Jones & Galliher, 2015). Below is a set of components that are effective when studied individually or provide conflicting information, but further information is needed.

**Current Attitudes**

Understanding the content and a thorough understanding of students' backgrounds is needed, as every lesson and interaction can shape the brain and affect the material that is understood now and, in the future, (McTighe & Willis, 2019). Over time it has been shown that education, as it is now, is too narrow and does not allow students insight or learning in the classroom instead of further understanding (Sabates & Karki, 2019). Instead, the focus is on testing assessments or standards rather than developing proper lasting understanding, as content knowledge tends to be checked at the end of a school year (Bonner et al., 2018).

A foundation of understanding allows students to feel comfortable expressing their needs and concerns. Research can be done by setting classroom norms and ensuring understanding (Makar & Fielding-Wells, 2018). Additionally, the learning environment should be adaptable to the needs of the students in the room and encourage active learning as often as possible. Lastly, group work is beneficial, as it allows students to not only build relationships with those around them, which is good for mental health, but also supplies a chance to develop a further understanding (Grossman, 2001). Working together also strengthens students' social cues and conversation skills and is generally viewed favorably by students, leading to positive feelings (Zentall, 2006).

Academic support is also essential, as mental health issues are rising. Additionally, peer and teacher support can lead to positive gains in understanding (Jester & Kang, 2021). Support requires the educator's knowledge of the students, content, and classroom environments. Students must feel safe and comfortable attempting problem-solving independently, using scaffolding based on the type of instruction supplied to strengthen student understanding (Ansari et al., 2020). While some have found that positive effects occur, others have shown that they may not have as much effect as reported (Allen et al., 2009). Further research on the effect of relationships on student engagement and how it can affect teaching needs to be evaluated (Heatly & Votruba-Drzal, 2017).

The idea of engagement in the classroom continues to grow, and the research should continue expanding. By engaging with the environment, peers, educators, and the material, students can develop extraordinary problem-solving abilities, as ongoing learning, instead of simply memorizing materials (Rico & Ertmer, 2015). Further consideration of teachers' actions in the classroom affects student engagement by looking at a combination of many factors that are successful or have conflicting results (Engin, 2020).

Corbin and Strauss (1990) focused on the importance of the engagement concept in the workplace; O'Brien and Marakas (2008) formatted a framework for engagement; Meece (1988) focused on modeling an engaged classroom; Schneiderman and Kanade (1998) began the integration of technology into the classroom. No matter the method used or the goals, the researchers believed technology allows for greater student growth and engagement (Kuh & Hu, 2001). These insights have led to novel studies in engaging those with learning differences, using problem-based learning and group work, developing an engaging classroom environment, and using technology to the best of an educator's ability. Researching these topics gives insights into

students' needs for engagement; while ultimately engaging the students, conflicting information exists on what is most beneficial.

### *Comfort and Support*

In education, there is a need for active means of taking in presented information, calling for a movement from simple memorization to a proper understanding of the skills and reasons different solutions work (Merritt et al., 2017). Dewey (1938) began developing the idea of learning by doing, which was taken up in the 1970s by McMaster University in their medical school program before trickling down to other disciplines and levels (Barrows, 1996). A variety of frameworks support the learning of students in the classroom. A heavily used support is Maslow's hierarchy, describing the necessities for learning to occur. Additionally, cognitive load theory explains learning at a given time. Engagement theory describes the importance of students'; and lastly, attachment theory centers on connections that can occur (Fisher & Royster, 2016).

Maslow (1943) believed that human needs are on a ladder or pyramid where the bottom shows necessities while it grows to the top. His basic needs listed on the hierarchy were air, water, food, and sex. Those that are physiological needs someone must first have to stay alive. After physiological needs came the need for safety, which focused on security and stability; social needs of belongingness and acceptance coming next. Love and belongingness focus on intimacy, family, and connection to those present. When considering engagement, belongingness occurs through group work where students can connect and focus on the relationship with the teacher. The esteem part, which focuses on the freedom to try tasks, status in the classroom, and recognition, focuses on the teacher aspect of ensuring all students show understanding in the classroom (Sorbet & Notar, 2022). Self-actualization is at the top of the pyramid, which most

people do not reach (Farimani & Shahri, 2020). Self-actualization is the need to fulfill ourselves or reach all we can become (Gopinath, 2020). In the case of education, self-actualization would occur as reaching excellence as an educator or student. Students can problem-solve and think beyond their current level of understanding toward the later implications (Okafor & Abraham, 2021).

Students' success is linked to comfort if teachers feel overwhelmed, which directly affects students' ability to feel safe in the classroom (Assor et al., 2005). Once students are comfortable and safe, they can form bonds and connections (Fisher, 2011). If students cannot receive the base level of support, they will not be able to form bonds or develop learning methods. Lack of connections means students will not feel connected with the teacher or their peers; in both cases, they feel ostracized from the group and do not find success (Anderson, 2018). Teachers must actively work to include each child to ensure they can understand (Ansorger, 2021). Support is the first step in sharing engagement. If people cannot be comfortable and safe, they cannot step out of their comfort zone to try new things and actively ask questions (Astin, 1984). Individuals work better in groups while learning, as it solidifies their ideals and applies their knowledge to situations. However, group work cannot occur if they are uncomfortable at first (Ainsworth, 1973).

### *Motivation*

Students have an increase in motivation in class when working with their peers and through discussion, which allows the growth of an individual and motivation to find success (Custers & Aarts, 2007). Interactions during group work will allow students to gain self-confidence, find success, and transfer into their learning. The teacher's motivational behaviors in the classroom often play a role but not as much as peers' (Papi & Abdollahzadeh, 2012). Papi and Abdollahzadeh (2012) found no difference between highly motivated and low achievers when the

teacher is overly motivated, which means the student's feelings about the teacher can influence their motivation.

Direct instruction in a controlling manner arouses anger and anxiety in students, leading to a lack of intrinsic and extrinsic motivation, as students do not seek to perform well (Amelia et al., 2020). Non-active learning decreases students' motivation, as they are not actively engaged with the content and do not see a benefit to gaining understanding. A lack of interest can undermine motivation, creating a toxic classroom environment (Assor et al., 2005). Haerens et al. (2015) determined lack of interest, often called oppositional defiance, in which students aim to fail to prove a point. Lack of confidence leads to a vicious cycle, spiraling into even more negative feelings on both sides (Haerens et al., 2015).

### *Learning Differences*

Humans tend to fall into behavior patterns, leading to a lack of alterations in their plans, even when needed, which hinders the ability to problem-solve or try new techniques (Keskin et al., 2020). When students with disabilities enter the classroom differentiation is necessary to ensure they can reach their full potential and be engaged in learning (Parrish, 2019). Accommodations support students in their learning and help them overcome the personal characteristics that limit the capabilities of a given student (Elliott et al., 2000). For instance, when a teacher receives a list of the best for the student. Instead, educators make assumptions and hope they support the student who sometimes feels overwhelmed by asking and do not use the plan (Morin, 2014). Collaboration is needed to fully understand their needs to support students in a manner that will bring them success (Scanlon & Baker, 2012). Collaboration requires support and conversation to determine each student's specific needs. Again, for the student to truly be engaged, the teacher must fully understand their background (Dettmer & Dyer, 2021)

Students who tend to have more negative exchanges than their peers have more significant conflict, have more parental involvement and struggle academically (Heatly & Votruba-Drzal, 2017). Additionally, many with attention deficit hyperactivity disorder (ADHD) struggle with inattention, hyperactivity, and impulsivity, making class time challenging for them and causing a distraction for peers. In a traditional setting, students sit quietly and quietly take notes, creating an impossible scenario for students with ADHD (Heatly & Votruba-Drzal, 2017). Additionally, one-third of youth held in detention centers have some type of learning difference (Bateman & Yell, 2019). Students need more support to find success inside and outside of the classroom. Traditional curriculum-centered classrooms tend to present challenges for these students, as adaptations are complex, and it is impossible to support their differing needs (Parrish, 2019). Attitudes can become frustrating to educators because they might not understand why students are behaving in a particular manner and feel that, if the student is not trying, they should not try either with manipulatives or methods of added support (Morin, 2014). Accommodations supply a method for disadvantaged students to find a level playing field (Galas, 2021).

Teachers should also work to ensure that material is presented in as many ways as possible to accommodate learners of assorted learning styles. The material should be clear and concise, following a structured plan designed with the learners in mind (Zentall, 2006). Again, if the educator does not understand the learner, support can not truly occur. Understanding can come from student services discussions, time spent with parents, or having conversations with students again, though understanding cannot be simply assumed. Instead, a true understanding must occur to allow for classroom adjustments (Harlap & Riese, 2021). Without developing a relationship, students cannot share their strengths and weaknesses; without familiarity, the ability to engage them will be impossible.

### *Relationships*

Personal contact and influences affect meaningful student-teacher relationships, which can drive student success (Henry & Thorsen, 2018). Conflict with the teacher-student relationship leads to mediocre performance and lower levels of understanding. Students with learning differences are prone to conflict due to hyperactivity, which can often lead to a negative relationship with teachers (Hinde, 1987). Engagement is even critical for students with accommodation because if students do not feel comfortable with the teacher, they will likely not be able to express their needs and, therefore, will be at a disadvantage (Zentall, 2006). Students with learning differences, therefore, will need repeated directions and examples to solidify their understanding (Ansari et al., 2020).

Berthelsen et al. (2017) found a positive correlation between student-teacher relationships. In the study, a higher correlation indicated that a higher grade occurs when students feel that their teacher cares about their learning. One must note that the relationship is a correlation; one is not necessarily causing the other; instead, they tend to go together (Walton et al., 2012). As said previously, even if they have seen accommodations before, there is no way to decide why it is needed or how the issue manifests for a given student. Added consideration should go into ensuring students feel comfortable sharing their thoughts and creating an environment where teachers feel safe asking questions (Ansari et al., 2020). Zentall (2006) shared that students should know that their teacher is present in the classroom and in their lives. Hamre and Pianta (2005) found that students who struggled found success equivalent to their peers when they were strategically put into an environment with extra support.

The classroom environment affects the students' success, as they must feel safe and supported. Students also tend to have fewer disciplinary issues and the need for behavioral

consequences if they feel supported. Fewer distractions, in turn, allow students to be present more often and not a distraction to their peers, leading to more significant engagement opportunities. Student's ability to resist distractions relates to their sense of control, engagement in their learning, and perceived teacher support (Gregersen, 2016). Disengagement in the environment results in lower teacher satisfaction and decreased performance (Jang et al., 2016). Jang et al. (2016) also found that if students found their teacher condescending,

***Support***

Support methods vary based on the professional, but some norms are consistent across most educators. Bateman and Yell (2019) found that effective support methods relate to maximizing engagement, asking questions, varying assignment types, varying assignments to ability levels, scaffolding, using varying instruction methods, and closely checking progress. Teachers' positive attitudes relate to the gains of students in their classrooms and could correlate to their achievement (Tsybulsky & Oz, 2019). Unfortunately, even though these attitudes and relationships can relate to a positive correlation with student success, Wu and Hughes (2015) found that the trend began decreasing in middle school and suggested further research is neccessary.

Interactions with students and their teachers can lead to closeness in terms of warmth and approachability, while conflict (lack of support) can predict a negative impact on test scores in humanities classes (Posner, 2013). Further study is called for in the math and sciences to corroborate these findings and decide if perceived support can play a role in the attitude of students in the classroom. Counselors have further suggested that relationships could relate to the actual development of students' social skills inside and outside the classroom (Quin, 2017).

Teacher support can make a difference in students' self-efficacy as they gain faith in themselves and try harder. Hamre and Pianta (2005) found that students who struggled found success equivalent to their peers in a classroom environment with extra support. Similarly, Zhou et al. (2021) found tremendous success in students' scores when they were in a happy and supportive environment. Leman et al. (2017) found that student positivity directly correlated with their results, as happier students tend to see better performance. If students are happier and more confident, they are more likely to speak up in class and actively engage in the material taught instead of sitting in the back (Alvarez-Huerta et al., 2021).

Teachers and students constantly interact, supplying opportunities to either support one another or act negatively. Van den Berghe et al. (2016) found that the first five minutes of class are the most informative, as the start of class is time that will either bring in students or allow them to slip into their thoughts. Students who spend the first five minutes of class disengaged will likely remain so, leading to teacher frustration and adversely affecting the teacher-student relationship built at that time. Additionally, engagement tends to increase as the semester progresses, as students become more confident and comfortable (Jang et al., 2012).

Numerous researchers have shown that teachers' support of learners in their classrooms directly correlates to their success. Teachers aim to create verbal reasoning, analysis, hypothesis testing, data gathering, understanding likelihood, and general problem solving (Glaser, 1992). Critical thinking skills are related to creativity and students' ability to express their thoughts freely. Student learning has been directly and indirectly tied to teacher knowledge, leading to the thought that other factors must play a role (Leary et al., 2015). Instead, more ties occur between the classroom and school climate and student feeling of education quality (Schoenfeld, 1985).

### *Positivity*

Alessandri et al. (2014) found that students with positive attitudes tend to have positive self-opinions, which, as said earlier, significantly affect their outcomes. Students can thrive if they feel supported and are in a positive environment, while those who do not feel supported tend to shut down (Cooper et al., 2018). Additionally, negative or marginalized students tend to see adverse health impacts throughout their lifetime (Marques et al., 2011). A vicious cycle is created of the students who need the most support potentially not being available to receive said support. Hofmann et al. (2004) explained that self-feelings often negatively affect students over the long term, as it creates a self-fulfilling prophecy. Successful students are more likely to have happy feelings at school, leading to greater positivity (Zhou et al., 2021). Success again follows from Maslow's (1943) hierarchy of needs, whereby students in a more positive frame of mind would be less distracted and, therefore, able to focus their attention elsewhere. The added focus could allow students to actively engage with the material and begin to process content instead of being unable to keep the information (Bhagwagar, 2021).

## Classroom Environment

Teachers' support of learners in their classrooms directly correlates to their success, as many researchers show (Glaser, 1992). Engagement is affected not only by the teacher but also by the class size (Finn et al., 2003), layout (Amedeo & Dyck, 2003), and method of obtaining student responses (Fiex & Marshall, 2006). The classroom set-up must be consistent with the learning method for students but, again, requires an understanding of the students in the classroom (Ralph et al., 2022). For instance, students with preferential seating could have it for distinct reasons and therefore have unique needs in the hopes of success in the classroom. The teachers must understand these needs to plan lessons and use time accordingly to ensure students' success

(Setren, 2020). For example, if students come into a classroom with a straight desk facing the board, they are already in the head space for lecture-style teaching, making discussion hard for all students (Hudson et al., 1993). A quick mental transition would be difficult for all students but nearly impossible for students with learning differences, as they cannot keep up with the quick shifts to new methodologies (Fatmi et al., 2013).

Additionally, a teacher wandering the room increases engagement, but when doing so, a teacher must consider the students in the environment (Colvin et al., 1997). For instance, if a student sits at the front because they need to read their lips when speaking due to hearing issues, wandering the room means they will now miss part of the instruction. However, if the reason is unclear, the teacher would have no idea confusion was occurring, and neither would the student. Calling on students increases engagement, as students pay attention when their name is called and remain prepared to answer questions. However, it also positively correlates with anxiety (Brigati et al., 2020). The process of *cold calling*, when the teacher picks a student if no one is answering, does cause anxiety in some cases but, in the end, does increase students' focus (Graham et al., 2007). Anxiety is likely because they want to work through the material and explain their thoughts when confident, decreasing the odds of being called on when they feel unsure (Graaff & Kolmos, 2003). Even with the knowledge that active learning is favorable for learning, adoption has been slow (Fredrick et al., 2004).

In addition to warmth from the teacher and engagement, students with learning differences will still need a structured environment to explore their education and capabilities. Matos et al. (2018) found conflicting information on how teachers interact with their students affecting the learning environment and student method. Zentall (2006) explained that minimizing distracting displays and focusing on things a student must know while minimizing instruction is necessary.

Also, for students who often lose focus or become overwhelmed, developing a private signal or manner of communication without outwardly speaking can supply added support and a level of caring that cannot be shown by accommodation alone (Finesilver et al., 2022).

Students with learning differences often struggle with self-awareness, making group work or social norms difficult to interpret. Incredibly, if the class occurs during a confusing time, students will need more time to break problems into smaller steps. By working in smaller sections, the teacher can support the needs of everyone in the classroom (Beech et al., 2013). Group work allows students to discuss their learning and remain focused on the material. Again, the student's needs must be met by considering the type of problem proper for them at a given level and ensuring that the assignment is proper.

***Consistency***

Zentall (2006) explained that the structure and environment of classes need to change to find success and support. The current processes show that teachers cannot give high-quality education, and in some cases, educators have not been trained on a protocol to support their students (Beech et al., 2013). Educators as well as students will most likely lack comfort in the classroom where such training and support is lacking (Yell & Bateman, 2019). These struggles tend to lead students to feelings of failure and social isolation and, in some cases, even cause expulsion, referring to other schools or simply ignoring a student instead of actively supporting him or her (Nicol et al., 2018). If a shift occurs, these students, who generally feel unsupported, could change their attitude and motivation. Understanding is fundamental in the current stages, where mental health concerns have reached an all-time high (Kelly et al., 2021). The American Psychological Association (2019) found that students receiving consistent support could sharpen their skills and begin approaching more complex problems. teachers' classrooms

**Student-Centered Learning**

Teachers can lead their classrooms in many ways, from direct instruction, where they sit and teach material on a whiteboard, which is entirely teacher-centered, to problem-based. No matter the classroom's style, the teacher plays a vital role in implementing the method and planning the presentation of material (De Corby et al., 2005). Teachers must ensure they have a supportive relationship in whatever method they use and are not viewed as too authoritative (De Meyer et al., 2014). Teachers must actively ensure equity in their presentation of material and that their students are learning it.

Student-centered education allows tracking progress and supplying student-centered approaches (Neville et al., 2009). Student-focused approaches allow for more excellent discussion and collaboration only when students are comfortable and engaged in the class work (Xu & Clarke, 2019). Mercer and Littleton (2007) found that classroom discussion and open dialogue are the most beneficial for students' confidence. The studies have been completed in humanities classrooms, calling for further studies in the mathematics field (Xu & Clarke, 2019). Discourse, as defined by Wetherell et al. (2001), considers the words that are said and the concepts. Conversations can help pique students' interest, consider their current knowledge, and index them for the future (Phillips et al., 1998).

Tsybulsky and Oz (2019) found that, as students struggle through problems, they gain highly negative feelings about the content and, in many cases, begin to give up; leading to a need for the problems being a suitable level. Additionally, the students will have small moments of success, increasing their motivation to keep working (Sabates & Karki, 2019). Motivation can be intrinsically found or encouraged based on teacher relationships (Hollins, 2006). Unfortunately,

due to the small size, further research is needed to solidify these findings and assess the importance of extrinsic motivation in goal achievement.

There is conflicting evidence on the importance and effectiveness of discussions amongst peers. Heward and Wood (2009) found that choral responding increased student engagement and encouraged its use in the classroom. Unfortunately, while it increases conversation, choral responses do not necessarily increase student engagement or understanding. Students instead simply mimic those around them or mumble, so further research is needed to figure out if choral responding affects anxiety or if it is learning (Kamps et al., 1994). While others have found that cold-calling students increase the amount of anxiety relating to speaking up in class; therefore, these results are confounding.

***Computer Usage***

Technology provides a new and effective method that can supplement lessons, teach new materials, or increase student interaction with supplied content or other students (Scanlon et al., 2011). Over time, interaction is becoming more central to learning, as it allows for simulators and built-in support for students and even allows for new collaboration opportunities (van Joolingen et al., 2007). Activities allow students and educators to work across time differentials and support learning as students can move at their own pace instead of waiting on peers. It also supplies the opportunity for individualized attention for those struggling to a greater extent while not dampening the learning environment for those moving faster (Bagapova et al., 2020).

As teachers adopt modern technologies, professional development must strengthen the connections (Lawless & Pellegrino, 2007). Computer usage has a positive effect, but many educators do not feel they are prepared to use technology in the classroom, leading to incorrect usage (Bergeson & Beschorner, 2021). In these cases, educators might counteract the positives as

they struggle to use the technology. There are still various options available and research on how technology truly enhances learning. Many educators attempt to use online methods as a means of simply checking off a box or avoiding instruction. Ebner et al. (2007) suggested that overtime is becoming more central to learning, as it allows for simulators and built-in support for students and even allows for new collaboration opportunities (van Joolingen et al., 2007).

### *Teacher Background Knowledge*

Teachers must be able to support learning in the classroom by supplying expert knowledge, as their ability to communicate their understanding sets the stage for their entire classroom structure. However, conflicting research exists on the importance of background knowledge compared to the ability to ask thought-provoking questions and supply support (Hendry et al., 2002). A good leader in the classroom is crucial for novices as well as advanced learners. In contrast, others found that the teacher's experience is not correlated to the learning method, leading to the belief that there must be confounding variables or correlations that are not being tested and analyzed. Teachers can help students on the path to understanding material leading to self-efficacy and suggesting further understanding (Marsh et al., 2004). know to lead the classroom and guide learners by asking questions (Malloy & Stolzenberg, 2019). Guiding learners come in the form of organizational methodologies for leading the classroom. Students are put in an environment where they are capable of being successful as they understand the expectations and, therefore, can achieve their goals. Just as educators are more likely to take risks when supported, so are students (Hollins, 2006).

Importance is strongly correlated with foundational knowledge and the time the technique has been used (Schmidt et al., 1993). Novice students who were newly learning material received help from content experts to answer their questions. Schmidt et al. (1993) followed up by

explaining that content knowledge is not necessarily needed to ease thought and, at times, could negatively affect skills as the teacher asked many more leading questions.

## Active Learning

An active learning model allows students to participate in their learning instead of simply sitting and listening to those teaching (Zappe et al., 2009). Active learning increases engagement and interest in the classroom, specifically for those who struggle to remain focused (Chen et al., 2018). Accountability of students increases, and engagement, in turn, shifts attitudes positively. Active learning also removes misconceptions about students' perceived knowledge (Grant, 2021). Active participation leads to students having greater satisfaction and more positive feelings toward their peers and their learning (Lamon et al., 2020).

The purpose of education is not only to engage the students in their learning but to allow for the creation of problem-solving skills that can translate outside the classroom (Lawson, 1995). By increasing active learning, students can work through inquiry-based activities, which allows them to formulate a solid understanding of the material and work with groups of other students at similar levels, allowing for conversation and a more in-depth understanding (Gabel, 1994). Additionally, built-in support for the content by providing understanding and open explanations. Unfortunately, a standard lecture-style environment, often used in mathematics, leads to the withdrawal of student interest and a goal of replication instead of application (Cavallo & Wood, 2005).

### *Problem-Based Learning* (PBL)

Problem-based learning is hard to define as a consistent definition in the literature; different researchers have varied perspectives and expectations (Strobel & Barneveld, 2009). Instead of being given direct methods to solve problems, students can work through problems,

sometimes ill-defined, and develop their method as they work through the thought process (Ramadhani et al., 2019). Even though it is difficult to define, problem-solving increases knowledge, retention, development, and growth of positive attitudes in the classroom (Merritt et al., 2017). It supplies real-world problems, allowing students to apply information and gain new insights (Donner & Bickley, 1990). PBL increases productivity when evaluating problem-solving, and the goal is to connect topics instead of as a stand-alone instruction method (Gijbels et al., 2005). Educators must consider what assessment method will evaluate the strength of understanding, and explanation should be analyzed (Jones et al., 1984). Analysis trains the brain to work critically and aids in shaping new knowledge networks (Van Hessen & Verwijnen, 1990).

Problem-solving strategies allow the presentation of an ill-structured problem that will enable them to work through solutions by using collaboration, investigation, and working through issues, which helps support their confidence in their understanding (Barrows & Tamb1980). Drake and Long (2009) shared that for authentic engagement, students must learn to inquire with their knowledge, work through their problem-solving skills, and debrief students. These problems often begin as negative experiences and correlate with concern, frustration, and tension in focusing on a new challenge. However, students can confidently move past their first negative attitudes into growth (Jang et al., 2016). Educators must ensure enough time is spent on scaffolding so students do not feel rushed. Instead, educators can sense when to support their students (Tsybulsky & Oz, 2019). Inquiry has been shown to increase engagement but also offers a variety of negative feelings as students progress through, in some cases, having the opposite effect (Fidan & Tuncel, 2019). Students who traditionally feel weaker in a subject area are less

likely to engage in the activities, as they need more confidence to try the problems (Oktadela et al., 2019).

***Problem-Solving***

Students who feel connected to someone's secure base assist in their development through problem-solving activities as they are more willing to take risks (Hamre & Pianta, 2005). In mathematics, students have problems that require earlier skills and a willingness to try new methodologies. It is a subject that constantly builds on prior knowledge allowing students to be comfortable taking problem-solving risks and seeking help when needed. Unfortunately, those who struggled in earlier courses tend to question their abilities and cannot move forward (Zhang et al., 2020). Holt (2020) explained that, for a teacher to support their students fully, they must first understand the needs of those in the classroom. Open communication and a willingness to ask questions and share their current level of understanding are necessary for students to develop true understanding. Researchers have found that 55-85% of students cannot handle conflict and challenges independently (Ettekal & Shi, 2020).

Students struggling with content cannot process these feelings and find solutions without aid to move forward in the learning process. Hinton and Ono-George (2020) expressed that the learning process should be a constant metamorphosis for the teacher and student. Support must keep students engaged and make them capable of progressing through problems (Jang et al., 2016). Alteration in the learning environment must be supported by the students partaking in learning from the lesson and the educator engaging with the students to find the weak points and offer leadership.

Students need instructional support to start problem-solving, but support can fade because the student is learning, allowing students to perform explanations better and support their learning

(McNeill et al., 2006). Scaffold fading involves the gradual removal of scaffolding and the introduction of more independence. If scaffolding is given, the posttest showed more vital explanation skills due to enhanced reasoning. It is essential to distribute resources when teaching to ensure the quality of instruction does not decline due to student-driven instruction (Schoenfeld, 1985). By developing scaffolds and steps, students receive the support they need to succeed and remain engaged in their learning (Jang et al., 2016). Interactions also allow teachers to become more familiar with their students' understanding, showing joy when they succeed or aiding them in their moments of weakness (Azzaro, 2014). Problem-solving allows students to analyze problems at their rate and work through problems confidently because they have the necessary support (Apriyani et al., 2019).

### *Investigative Support*

Creating a relationship and a support system will make students feel that these suggestions are not judgment but much-needed help (Michaelis et al., 2019). Presenting prompts and guided instruction is key to learning, with the timing of the prompts being of the utmost importance. Students feel most positively when questions are posed during learning instead of before to aid in connections (Thillmann et al., 2009). It is necessary to ensure that a positive environment is conducive to learning and that questioning occurs for the inquiry-based, ensuring student growth (Schoenfeld, 1985). McTighe and Willis (2019) suggested the video game mode, which consists of a four-part process. The process begins with setting a goal, then moving on to creating an achievable challenge, supplying feedback, and acknowledging progress toward the goal. These sustained interactions during investigation create knowledge and subject matter (Hansen, D., 2007).

### *Grades*

During inquiry-based learning, students become focused on their scores, as the approach feels very non-traditional, and the teacher must work to reassure the students of their learning (Didem & Balim, 2010). Students find ability in explanations instead of simply memorizing material as they work to understand the material thoroughly. Path-oriented students may become overly focused on material and get lost in the weeds so that they may need redirection (Borovay et al., 2019). Students who are overly grade focused can lose sight of truly understanding the material, as they focus simply on the number and not the content (Senko & Miles, 2008).

### *Cognitive Load Theory*

Miller's (1956) theory of cognitive load deals with how much information an observer can take into their working memory before converting it into long-term memory. He suggested five to nine components; the brain becomes overwhelmed, and new material cannot keep, creating a bottleneck where information is simply lost. When teaching new material, the brain goes into a period of schema acquisition where it must find a means of connecting the information to what was previously learned (Sweller & Chandler, 1994). An overload of new material negatively affects the ability to assimilate, limiting learning at a given time.

Kirschner (2002) suggested scaffold usage, or a combination of methods, to help form long-term memories. The term *multiple external representations*, MER, was suggested by Ainsworth (2006) to circumvent the idea of cognitive load by supplying varied instruction methodologies. Methods could be incorporating technology, for instance, to allow for various schemas and more significant learning. When considering cognitive load, students tend to emphasize task ability more than engagement, focusing instead on simply completing material to check it off (Appleton et al., 2008). Students who focus on recognition, understanding, and

pleasing the teacher and their peers tend to prefer work with a lower cognitive load, as they can efficiently complete the task and find success, so a middle ground is necessary. A lower cognitive load can be acquired by simply breaking tasks into smaller parts and ensuring students with diverse backgrounds are equally likely to find success. The opposite is true when a large amount of prior knowledge exists, as students are more able to move through larger tasks without concern (Ayers et al., 2008). To truly engage students, the educator must ensure they are not overwhelmed by the material presented. Instead, they feel confident they can complete the assigned task or obtain support if needed.

**Outside of Classroom Norms**

Classrooms are now more diverse than ever, with a considerable number of minority students in the classroom than in the past. However, the issue rising across education is not the number of minority students but a lack of knowledge in teaching them (Phuntsong, 1999). Educators must find a way to work to include all students and ensure they are always seen and supported. Gay (1994) showed that for success in the classroom, one must consider an unequal distribution of resources, opportunities, representation, and a lack of equality in outcomes. Hinton and Ono-George (2020) suggested that we must move to non-racism and initiate discourse where students can speak about issues and actively work to correct and support one another. Educators should work to create safe spaces in their classrooms where students feel seen and heard and do not feel overlooked (Hinton & Ono-George, 2020). Teachers handling issues in their classrooms can help alleviate cultural bias (Harlap & Riese, 2021). According to Maslow's hierarchy (1943), if students are not at first comfortable and safe, they cannot hope to gain understanding.

### *Culture*

Culture affects every aspect of life, both inside and outside the classroom. The culture someone grows up in affects how they learn, but also how they respond to questions. When considering the question from Koppelman (2020) about supporting students and learning who they are, it is imperative that one also considers where they come from to ensure the students feel supported in the classroom. Howard (2007) discusses the importance of classroom growth as the students' evolution continues. Vázquez-Montilla et al. (2014) suggested rethinking working with each student and ensuring their success stays the goal. Ignoring background information will lead to a negative impact on performance, as well as participation in the classroom (Phuntsong, 1999). In diverse cultures, what is respectful or simply ordinary varies significantly, leading to potential misunderstandings in the classroom that can undermine engagement (Ahmad et al., 2019). Additionally, class participation is different, leading to varied needs. In addition to the culture that students have grown up with, they must also become accustomed to the cultural expectations of a given classroom to ensure that they can meet expectations (Zhaffar & Rashed, 2022). Consideration must acknowledge that all students do not have the same opportunities for success inside and outside the classroom, meaning, in many cases, disadvantaged students might need extra support (Bohrnsted et al., 2015).

Even as the number of minority students increases, as does the number of minorities worldwide, they are still unseen and unheard of (Banks, 1988). These issues are rarely discussed and often trivialized, leading students to shrink from their subjective experiences and backgrounds (Kishimoto, 2018). A perfect example is how Black Panther, an African prince from the fictional African kingdom of Wakanda, was celebrated with fans wearing traditional African garb to depict portions of their heritage (Nama, 2009). For teachers to fully support their students,

they must look to ensure they understand the culture they identify with and ensure support in the classroom.

***Race***

Reyes (2007) explained that many students do not have a chance to find a trajectory of success based on their starting point. Students often begin to fit into molds leading to opposing views that they must work to overcome. If a teacher cannot overcome the uncomfortable questions to reach these students successfully, students will never find their voice. Therefore, students will remain outside of class discussion and learning (Nieri, 2012). Koppelman (2020) explained that racism relates to ethnocentrism, which is the inherent view that your race or culture is better than others. Individuals are automatically disadvantaged and, in many cases, become self-fulfilling. If students are consistently talked down to, put into low-achieving classes, or unfairly punished for situations at school, they will continue to lack success.

To ensure all students feel supported in the classroom, a teacher must be on the lookout for microaggressions, small statements that come from those in the majority with judgments over racial structures (Hughey et al., 2017). These micro-aggressions can negatively affect students' classroom comfort and identity (Jones & Galliher, 2015). These are not topics vocalized in classrooms, especially those in the STEM fields (Hinton & Ono-George, 2020). Instead, they generally occur in times set aside. Eisen (2020) suggested that instructors engage in robust conversations so the group can overcome microaggressions and everyone can gain a voice. However, educators should be on the lookout for when these macro aggressions occur and address them instead of waiting for a more comfortable situation, as in many cases, silence is an agreement (Hinton & Ono-George, 2020).

### *Home Life*

Teachers, parents, and administrators should partner to address needs and support one another and the student (Zentall, 2006). Prior research found that students' success is related to household income, parental education, and parental distress based on their support (Anderson et al., 2011). Home culture strongly changes students' thoughts, general thoughts about relationships, and transitions. As time progresses, teachers are beginning to shift to care about grade outcomes instead of student needs (Hollins, 2006). It is imperative, though, that a warm support relationship occurs because it can buffer students' negative attachments at home if necessary (Ansari et al., 2020).

### *Current Climate*

Throughout 2020, many meetings and learning methods have been moved to an online format that will be long-lasting (Kelly et al., 2021). Knowledge grows by building upon earlier knowledge (Graaff & Kolmos, 2003). Everyone in the classroom will have different prior knowledge and levels of understanding, primarily based on online learning. Banks (1988) expressed that educators can only be successful if they meet the student at their current understanding, which is only possible through conversation. Teachers might go back and explain the material that seems trivial but is foundational knowledge that would hinder student understanding if not corrected (Fer, 2009).

Additionally, students need to be allowed to discuss their understanding to fully support their learning and fulfill the current need for problem solvers who can build on earlier knowledge and have an inquiring mind (Lyle, 2008). Weligamage and Siengthai (2003) expressed that employers expect students to be trained in problem-solving and develop their unique methods. Problem-solving initially does not come naturally to students but requires training and instruction

by a trusted individual (Banks, 1988). Trusted individuals, such as the teacher, can teach students focus on methods to obtain the solution and the process that allows their success (Almulla, 2020). V. Phillips (1998) explained that the prepared mind could be exposed to logical thinking and problem-solving, but background knowledge must first be present. Students should be able to express a dynamic understanding instead of simply memorization if they genuinely understand the material instead of becoming buried in the question (Hansen, 2007).

### *Current Needs*

High school, specifically the first year, is critical for students' drop-out rate (McCallumore & Sparapani, 2010). It also supplies a moment of growth as they begin developing different skills and setting trends that will continue throughout high school. As difficult problems are attempted, student support is related to self-efficacy (Alenezi, 2017). Additionally, self-determination should be studied further, according to Emerson (1971), especially in high school students, to figure out the best manners of supporting their learning and continued growth into adulthood. Hartman et al. (2019) also suggested the importance of meeting the students at their current level to ensure success. Teachers not only track the progress against standards but that students feel supported at all levels to engage in the classroom environment actively.

### *Student Preference*

Educators must set goals for students to not only learn in the classroom but to be capable of extending knowledge outside of the classroom to the real world. As discussed, students' confidence is tied to their engagement with the material, as they will be more motivated to learn (Li et al., 2020). Another method uses real-world problem-solving skills, such as problem-based learning (Allen et al., 2009). As Allen et al. suggested, these findings are often for a single college

with students in a specific age range or discipline, so further studies are needed to increase the external validity.

The method in which students learn and seek help changes as time progresses. Some of these changes were in response to COVID, where they worked independently, while others are related to social skills. Global Research and Insights (2018) found that before COVID, 59% of high school students used YouTube to understand concepts, and 55% believed that it was one of the most effective means of learning material (Breslyn & Green, 2022). Students are encouraged to shift away from asking questions to the teacher and instead working independently. Students lack the desire for teacher-centered instruction and passive learning but prefer practicing a task and working to duplicate findings, allowing for further understanding (Genota, 2018). Students no longer want traditional settings but want to learn through experiences and interactions. Writing down those relationships with their teachers and peers could change their understanding (Office of Educational Technology, Department of Education, 2017). Students' attempts at learning and success can lead to greater understanding and confidence (Banks, 1988).

## Summary

Mathematics, which tends to be a high point of anxiety for many students, requires scaffolding and explanation but also time for problem-solving (Hinton & Ono-George, 2020). To succeed, students must first feel comfortable and confident in their capabilities, which can only occur with positivity (Pianta, 1999). V. Phillips (1998) explained that, though many findings have occurred, every student learns differently and expresses their needs in various manners. Even though they may be engaged, the reasoning behind interest could vary, and the importance of the different concepts is inconsistent (Hollins, 2006).

Miller (1956) proved that individuals could only take in seven, plus or minus two, bits of information at any given time. Further study has shown that background knowledge can affect how much can truly be taken in at any moment (Dresp-Langley, 2022). Cognitive load limits students' capabilities and varies again based on their comfort and support (Bannert, 2002). Learning is a part of engagement theory and attachment theory, which supports students' growth in the classroom (Bowlby, 1969). Hollins (2006) explained the importance of engagement in the classroom to ensure students can accurately learn material only when they want to find the answer to the provided problems. As students need varying levels of support and relationships, further studies are needed to determine their overall effect and benefit (Pianta, 1999). Harlap and Riese (2021) suggested that attitudes can cause changes in the methods in the classroom to learn new skills, but requires teachers to continue to work to understand their thoughts.

The concepts shown to have earlier effects are group work, problem-solving, computer skills, and support. Henry and Thorsen (2018) explained that individuals seek to form bonds with those around them, showing that forming a connection with their teacher can aid learning in the classroom. Attachment is supported by growing literature as professional development occurs to improve student learning through problem-solving and inquiry. Barrett et al. (2012) also suggested that students can actively learn and appreciate classroom learning by using computers, which supply incremental success. These relationships can affect every other part of education, as students can seek help in class, from tutorials, and independent learning. If students are comfortable, they can overcome anxiety about group work, risk in class, and many other components (Ansari et al., 2020).

Various methods potentially affect engagement, such as group work, relationships, scaffolding, computer usage, and many theories related to findings (Shenderovich et al., 2018).

However, many of these concepts lack an analysis from the student's perspective. The studies involve educator feedback or surveys that students have sent but do not give the students an authentic voice. By asking students to share their thoughts during interviews, focus groups, and journal summaries, they can take ownership of their education by sharing what works for them. Additionally, conflicting information about the actual benefits persists, as different studies have found varying results. By combining the information and looking at multiple methods affecting engagement in one study, clarity on methods may be a true benefit.

# CHAPTER THREE: METHODS

## Overview

This qualitative transcendental phenomenological study aims to describe and understand the lived experiences of engagement in mathematics at a private secondary school in Florida. Academic engagement is defined as an eagerness to learn the indicated material and participate in the classroom community (Jenkins et al., 2020). The engagement theory developed by Kearsley and Shneiderman (1998) focused on the importance of engagement in students' learning through meaningful connections and relationships. Chapter Three supplies information on methods employed through non-probability, purposive sampling completed on high school seniors on Mun (Creswell, 2013). Chapter Three presents the design background, research questions as previously presented, a discussion regarding the research goals, information about the setting and participant pool, and details about my role in the study. Further information includes all three data collection strategies and analysis methods used. Data is obtained through interviews, focus groups, and student journal entries to triangulate the findings to increase reliability. Additionally, the analysis plan is defined by Moustakas (1994) and other prominent researchers in phenomenology. Finally, The following chapter will discuss the study's trustworthiness, as described by Lincoln and Guba (1985).

## Research Design

A qualitative study was best suited as conversations are necessary to develop an understanding of student's opinions. Qualitative studies supply information about a situation when little is known and allow for discussions about the observed phenomenon by gathering information from those that took part in its occurrence (Creswell, 2013). As Moustakas (1994) and many others have suggested, phenomenological research is beneficial when describing an

experience and discussing the effect and feelings ocurring. Focus on feelings leads to the ability to study lived experiences and the information on how participants view their experiences (Natanson, 1973). In this transcendental phenomenological study, students openly discussed their engagement in mathematics classrooms and how it affects them, leading to an understanding of how they perceive different opportunities (Shahabi & Rassi, 2015). The study addressed two questions, what and how different situations occur, which are two questions commonly assessed by phenomenological research (Neubauer et al., 2019). By discussing feelings with students, they shared their feelings and understanding of a phenomenon (Neubauer et al., 2019). Sharing their thoughts will allow for a first-hand view of experiences, judgments, feelings, and emotions, giving an immense opportunity for growth (Ball, 2009). A transcendental phenomenological study was necessary, as the goal was to focus on the emotions and understanding of high school seniors (Creswell & Poth, 2018).

Phenomenological studies allow for gathering information from several individuals about their shared experiences (Moustakas, 1994). Stewart and Mickunas (1990) shared that four perspectives are foundational to phenomenological studies. The first is that a study must ultimately be a search for wisdom, allowing the growth of knowledge. Secondly, a researcher should begin their research with no preconceived notions and actively suspend their judgments about what is fundamental to allow the complete focus on the gathered information and the perspectives of others. Understanding is necessary because even though multiple people have gone through the same experience, they could have different views on its effects on their lives (Natanson, 1973). One must actively consider the intentionality of consciousness, which divides subjects and objects when completing the analysis, allowing for focus on the correct components.

Lastly, the refusal of subject-object dichotomy allows for the reality of an object only within the meaning of the experience (van Manen, 1990).

Various terms are essential when considering phenomenological research (Adams & van Manen, 2008). Moustakas (1994) suggested the importance of noesis, noetic-noematic, noema, and epoché. Noesis is the act of experiencing noema due to internal perspectives that define the noema (Sheehan, 2014). Noema is the meaning of a given act, while noesis is the giving of the act and the thoughts it leads. These two terms are often interlinked, as one often feeds into the other. Noema imparts meaning to what it sees, touches, thinks, and can be felt, noting that each experience has meaning for an individual (Moustakas, 1994). The noetic-noematic also shows a connection between the individual and the world (Sousa, 2014). Epoché, or bracketing, is setting aside one's thoughts, beliefs, and judgments (Blum, 2012). Setting aside one's thoughts is difficult but necessary, as discussed by Moustakas (1994), to better understand the data. A researcher must "suspend everything that interferes with fresh vision" (p. 86). Even though suspension is the goal it is impossible to detach from the participants completely and the findings' implications; therefore, clarity is necessary during the qualitative process. Proper understanding requires a suspension of natural attitude and, instead, a clear mind and focus on what is now presented (Blum, 2012). Bracketing differentiates two types of phenomenological research (Shahabi & Rassi, 2015). Bednall (2006) shared the importance of being clear about one's preconceived notions before the analysis begins and that these concepts should remain at the forefront of thought throughout the process.

As defined by Husserl (2012), phenomenology is divided into two types, descriptive and iterative (Connelly, 2010). Both methods supply a source of all meaning and value as they describe human lived experiences, as the researcher uses consciousness, imagination, and

relations to obtain information about an occurring phenomenon (Armstrong & Baron, 2005). Bracketing or removing oneself from the analysis is the difference between these two methods (Munhall, 2007). Epoché allows for the reduction and focus of attention on information from the participants (Armstrong & Baron, 2005). The transcendental phenomenological approach is proper, as the focus will not be on the researcher's thoughts but on the response given by students. While the location is unique to the researcher, it is not unique to the participants. Moustakas (1994) suggested that the research work ensures the consideration of all information during the first iteration of the analysis. The researcher will hypothesize, evaluate, and assess for specificity (Brannen, 2017). All data were considered to allow the complete analysis of the data using the phenomenological process (Munhall, 2007).

When considering the data, the framework analysis must be considered (Sparkes & Smith, 2009). After finding the phenomenon and setting aside assumptions, individuals can move on to data collection methodologies. Polkinghorne (1989) suggested interviewing between 5 and 25 people who have experienced the same phenomena at a point. Moustakas (1994) offered the use of a small purposeful group. Additionally, it allows gathering information to figure out the generation of themes by asking questions to obtain meaningful statements by becoming involved in the data (Armour et al., 2009). Horizonalization and gathering of data that can then be grouped into a universal essence is the overarching goal (Moustakas, 1994). The transcendental phenomenological design aligns with epistemological and ontological assumptions and the focus of the study because each student will have a unique experience, even if they are in the same situation, leading to a variety of information (Bhaskar, 2008). Additionally, van Manen (1990) suggested phenomenology for educational research, which various scholars have supported over time.

A transcendental phenomenological study was appropriate because it allowed for the interpretation of lived experiences by individuals who have experienced something that I, as the researcher, have not (Mohajan, 2018). As I addressed the significant literature gap, qualitiative data gave further voice to those who cannot speak for themselves (Watts et al., 2015).

## Research Questions

The study's design allowed investigation of the lived experiences of high school seniors through ideas on engagement during their mathematics learning. Engagement positively affects learning outcomes by keeping students interested in the presented content, and by asking students questions, they shared their perspectives on its importance (Parent & Lovelace, 2018). Prior research has investigated the importance of engagement but has not looked at the information from the student's perspective or focus on the mathematics classroom.

### Central Research Question

How meaningful is engagement to high school seniors in mathematics classrooms?

### Sub-Question One

What are the experiences that high school senior mathematics students describe as engaging?

### Sub-Question Two

Why are specific methods beneficial in some disciplines and less effective in others?

## Setting and Participants

Mun (a pseudonym) is a private high school in Northern Florida with an enrollment of over 2,000 students across numerous campuses (descriptives provided in Appendix A). Of the currently enrolled students, 153 are high school seniors. The gender is divided evenly, with 77 males and 76 females. Of those enrolled, the majority are White (73%), with black (8%) being the

second most common (Mun Registrar, personal communication, December 14, 2022). Racial discrepancy is common among private schools and is an ongoing issue across the coutnry(Roehl, 2022). Additionally, over a quarter of students are identified as having learning differences, and less than 5% receive financial aid (Mun registrar, personal communication, December 14, 2022).

**Setting**

The site for the study is a private preparatory school in Northeast Florida, with 100% of current graduates (2003) selecting collegiate pursuits after graduation (Mun College Admissions Advisors, personal communication, May 17, 2023). No barriers occurred in finding a suitable site for transcendental phenomenological study, as I am currently employed at the institution, and Mun quickly approved the collection of data on any method that could benefit the community. Data collection will occur at a college preparatory high school with approximately 900 middle and upper school students. There is a head of school over all four campuses, each division having its principal across four campuses consisting of two lower schools, one athletic campus, and a joint middle school/upper school campus. The upper school campus spreads over five acres, encompassing eight entire buildings. A focus on upper school seniors who have experienced the same community for four years of high school will be the goal. Also, each department (core subject areas) has a chair who acts as an immediate supervisor, deans of faculty, curriculum, and students.

The students benefit from a small teacher-to-student ratio (9:1) with a significant focus on individualized instruction and support (Mun Registrar, personal communication, December 14, 2022). The school's focus on support from the administration also intensifies the need to ensure that students feel supported in their education, as it is a significant selling point for the school, which charges over $30,000 in yearly tuition for upper school students. Tuition leads students and

parents to feel that they should receive the best education possible and means that they are quick to vocalize their needs.

**Participants**

I purposively selected 15 participants for initial interviews (Martins, 2008). Interviews occurred, intending to achieve data saturation across the analysis. Kerr et al. (2010) explained saturation as the point at which new themes do not arise, and instead, new interviews support previously developed findings and codes. Analysis happened throughout the interview process to determine when saturation had occurred (Hennink & Kaiser, 2021).

Students have the potential to be in different classes due to extensive course offerings of precalculus, honors precalculus, honors calculus, AP calculus AB, AP calculus BC, multivariable calculus (post-AP), AP statistics, probability and statistics, mathematics of finance, math seminar, college algebra, and math for college readiness (see Appendix B for progression options). To participate in the study, students must have been enrolled in at least one math course offered. Seniors can select twelve courses during their senior year alone, with some taking multiple courses concurrently (shown in Appendix B). Additionally, seniors can take courses from nine current math department members from a group of 22 teachers who have been present during their time in upper school (Mun registrar, personal communication, December 14, 2022). Transfer students may have taken courses from countless individuals and thus were not included in the sample. The sample will include individuals from the different levels of mathematics courses (AP, on-level, remediation) via purposeful sampling amongst the participants. Seniors have experienced four different years of math and potentially had four different instructors with varying styles.

The graduating class in the 2022-2023 year intends to attend over 80 colleges around the United States, with many on academic scholarships (Personal Communication, Mun library, 2022). The school has a population of highly motivated students who put in a great deal of time to succeed. Students at Mun are also incredibly open to sharing feedback, such as surveys and meetings with deans, department heads, and teachers, which occurs often. These components will hopefully work together to ensure students can freely discuss their needs and thoughts on their current situation.

## Researcher Positionality

A researcher must stay as unbiased as possible throughout the analysis and data collection. Moustakas (1994) shared that researchers must move away from their judgments and instead focus on the presented information. Information and theming is based on data, not due to the researcher's expectations. Background must be considered throughout the framework of interpretation and based upon philosophical assumptions, which create the lens through which research will occur. The ontological assumption deals with understanding and focusing on reality (Alberti et al., 2011). When analyzing, while people experience the world differently, they are indeed experiencing the same world, so any variations in stories will hold vital information about how each student's mathematical journey has occurred (Stajduhar et al., 2001). Van der Gaag et al. (2006) stated that researchers must explain their thoughts and backgrounds to ensure rigor in the analysis.

### Interpretive Framework

Creswell and Poth (2018) explained that interpretive frameworks give a region for practice within social science research and defining and understanding of reality. Lavy (2017) shared that social groups create an ideal learning environment through group work and shared meanings. The

ideals of social constructivism by Vygotsky (1978) consider learning a genuinely collaborative process based upon social interactions, as individuals work to join the knowledge community. Goals can be extrinsic or intrinsic, with goals set for the group's good (Ozcan & Uzunboyl, 2012). Olsen (1999) shared that some motivation must come from the teacher because, while the driver of the student is essential, it cannot have a significant effect if the environment does not condone growth. Ability to learn is related to everyone's background and reality, which sets them apart from everyone else in the classroom (Voigt, 2013). I believe the idea that the community and network impact everyone's reality and learning capability parallel teachers' ideals. We all have the capability of learning content but must be put into a scenario where it is possible and supported. I think that the educator's role in making a classroom engaging can be the first step in supporting learning and ensuring that the reality that everyone experiences is positive.

## Philosophical Assumptions

Research philosophy must be threefold: ontological, epistemological, and axiological (Creswell & Poth, 2018). Together, these components supply a foundation and aid the reader in understanding bias that could concur. Additionally, it supplies information about the lens through which data is obtained and analyzed. Ontological assumptions focus on the idea of reality. Corbin and Strauss (1990) explained that the researcher must explain the external reality as accurately as possible. Bryant (2003) expressed that, as we make conclusions based on our epistemological assumptions and what researchers know about the data, we must continue to consider our own biases. Ontological assumptions concern the understanding of reality. Lastly, the axiological assumptions explain the bias already present in the researcher that could affect the data gathering or analysis process.

### *Ontological Assumption*

Crotty (1996) explained that the ontological assumption is the "study of being" (p.10). Ontological assumptions center on classifying and explaining objects in terms of observable characteristics (Bahari, 2010). Therefore, the focus is on understanding what kind of world we live in and investigating its nature and structure. Alberti et al. (2011) explained that there is one measurable and observable reality that a researcher must consider. I believe that, while the interpretation of reality is subjective to the person based upon their experiences, there is only one actual reality that God has created. I mean that we all are experiencing the same components, as created by God, but the way we experience them is different based on our background. Alasuutari (1996) explained that communication could affect how each person experiences reality as part of the social world. In my case, I believe God creates one reality, but participants can experience reality differently based on their preconceived notions (Crotty, 2003).

***Epistemological Assumption***

When considering the phenomenon, characterization must appear from the data and not analysis from the sum of parts (van der Gaag et al., 2006). Epistemological assumptions are centered on conducting qualitative studies by researchers to get as close as possible to the participants (Becker & Niehaves, 2007). Analysis will be based on grounded theory, built on objectivity, where I will analyze considering my background while remaining unbiased (Annells, 1997). Many argue that research is not as critical as other methods, as there is no obvious way to analyze it (McCann & Clark, 2004). I will continue analyzing the moves through the "moments" by interviewing the students in their surroundings to increase support (Denzin & Lincoln, 2003). I must ensure that I am not forcing a fit where one does not occur but instead focusing on conclusions that can support the data (Duchscher & Morgan, 2004).

***Axiological Assumption***

Axiological assumptions center around the idea that objectivity is central while subjectivity is discounted (Peers, 2018). As a researcher, I must report the values and biases I bring to the study (Creswell & Poth, 2018). Reporting leads to the ideals for the design, as they explain the biased thoughts when analyzing data and conducting research (Alexander, 2008). As the researcher, I will do my best to remain unbiased and to draw information from the data. As a teacher, I passionately believe that the relationships and support I give students truly support their success. I believe engagement is necessary for the classroom because students must pay attention to truly learn the content. I also actively find them beneficial in students' learning, so I will work to ensure that I listen to students with an open mind as to what they find beneficial.

**Researcher's Role**

Peredaryenko and Krauss (2013) explained that they are ready to take on measurements reliably to reliably take on measurements. Stake (1994) found that, out of all the roles that researchers play, the role of gatherer and interpreter is central: "Most contemporary qualitative researchers nourish the belief that knowledge is constructed rather than discovered. The world we know is a particularly human construction" (p. 99). occurs, but I will not have direct relationships with the participants or have one in the future. As I am interviewing seniors, there will be no chance that I will instruct the students in the future, as the participants will be in their last course at Mun before graduation. While I teach several courses containing seniors, I will focus on those taught by other instructors, removing some students from the potential pool of participants to remove bias. I, however, am very student-focused, so there is a chance that the students will know about me, but they will not have me as a teacher.

Additionally, I have a bias toward numbers based on my educational background. I have a Bachelor of Science from Georgia Institute of Technology, as well as three master's degrees:

Statistics (Texas A & M), Educational Evaluation with a focus on quantitative measurement (Georgia State University), and Curriculum and Instruction (Liberty University). Additionally, I am currently completing an M.Ed. from the University of Texas in mathematics education. I will have to work to ensure I do not attempt to turn the data into quantitative instead of a version of mixed-methods research but instead focus on the stories that the participants tell.

I will ensure I remain bracketed during research and not let my preconceived notions affect the data analysis. Munhall (2007) shared that a researcher must want to know about the experiences they are learning about without simply having to hear information. I will explore and gain information perceived by the individuals. My opinion as a researcher and a teacher is unimportant, as students will share how things have affected them (Lester, 1999). I will actively try to halt my preconceived beliefs and judgments (Moustakas, 1994). Even though I find engagement necessary and will focus heavily on group work and relationships, I will put my own thoughts aside as much as possible. Instead, I will focus on listening and understanding what students view as crucial to their learning. Van Manen (1990) does express that true bracketing can be impossible. However, any shortcomings will be generally named and discussed as the process occurs. I am also a novice researcher in terms of asking qualitative questions, so Pereira et al. (2012) suggested practicing my questions with those with more experience; I will also discuss them with my chair to ensure that I am setting myself up for success.

## Procedures

This section covers procedures for gaining data for the transcendental phenomenological study. Participants provided data in various forms, including in-depth interviews, focus groups, and journal entries. Interviews will be used to determine the how and why of a particular phenomenon. Due to the nature of the interviews, the interviews were conducted in a fluid style

allowing for shifts based on information sharing. Creating focus groups of approximately five participants occurred next, allowing for further discussion. Lastly, upon completing the focus group, students completed a journal entry answering several concluding questions.

**Permissions**

Mun's associate head of school, division principal, and dean of students gave permission data collection on campus. Together, the faculty (mentioned above) assessed the effect that the study could have on students and ensured that no adverse impacts would occur. Following site approval (Appendix C), I applied to the Institutional Review Board of Liberty University (Appendix D). Participant selection occurred via an email sent to all applicable seniors (Appendix E), and a reminder email was not needed although it was drafted (Appendix F). Individuals who indicated interest in participation submitted informed consent (Appendix G) via e-mail and assent letter (Appendix H) as applicable.

**Recruitment Plan**

The sample will be taken from seniors in various courses at Mun with a sample pool of over 130 students. These will be students who will not receive grades from me in the classroom to ensure that there is no bias, removing approximately 12 students from the sample pool. Students heard a short introduction from their advisors during their weekly advisory time (Appendix I). The assent and consent forms were sent via email to the students who were willing to participate. Students brought their informed consent (or assent if appropriate) to their scheduled interview. A reminder email indicated the location, date, time, and indication to bring their signed forms as well as ensuring students satisfied the requirements for the study via the screening questions (Appendix J).

Criterion sampling was used to identify participants who met the requirements of having taken all four math courses at Mun, removing transfer students from the sample as they received a different high school experience. Given the transcendental phenomenology methodology, criterion and purposeful sampling are appropriate to ensure that partisans have experienced the phenomenon (Hennink & Kaiser, 2021). As interviews and focus groups occurred during lunch, students will be incentivized by being provided lunch from an off-campus vendor, as the student and I will both likely miss a portion of the scheduled lunch time. If an interview occurred during another time (such as a student's free period), then a meal was not provided.

Saturation is a concept defined differently, but the ideals say that you should stop collecting data once added data becomes counter-productive (Bowen, 2008). Data collection would be halted sooner if the information garnered became repetitive, but repretition only occurred for journal entries (Bryman, 2016). The participants went through an interview one-on-one before moving into a focus group and completing their journal entries. Order was selected so the participants could share individual thoughts before moving into an environment where their peers could affect their thoughts—allowing students to consider their earlier answers before working in a group. Lastly, journaling allowed participants to present their thoughts.

Corbin and Strauss (1990) expressed the importance of continuous data analysis and collection to allow the data to support patterns further and ease sound samples and analysis methodologies. It is important to note, though, that data analysis process for qualitative studies is not a mechanical method but a creative process used to derive meaning (Denzin & Lincoln, 2002). As a new study, I focused on the ground-up analysis, allowing me to find parts of the data that will help create contemporary trends.

## Data Collection Plan

Data collection occurred through interviews, focus groups, and journal entries. Documentation from the collection of data took place using recording and transcription by Otter on a MacBook Pro, and field notes were handwritten and then stored in the same locked folder, which will allow for transcription of the verbal data later, as well as notes on social cues and behaviors during descriptions (Creswell & Poth, 2018). A responsive interview protocol helped understand the phenomena better by using probing and follow-up questions and continuously updating the question bank (Rubin & Rubin, 2012). Data collection began upon approval from the Institutional Review Board of Liberty University. Documents and analysis for themes of interviews will be completed before the beginning of focus groups. By completing interviews first, the participants' thoughts and decisions have all been shared individually before being impacted by their peers. Participants completed journal entries following interviews and focus groups sharing their concluding thoughts.

### Individual Interviews Data Collection Approach

Patton (1990) explained, "the purpose of interviewing is to find out what is in and on someone else's mind. We interview people to find out from them those "things we cannot see" or experience on our own" (p. 196). The researcher should go into the interviews as unbiasedly as possible, genuinely looking to develop an understanding and not asking guiding questions that could sway the results. Data collection will require active listening and a lack of judgment on the researcher's part during each interview. Merriam (2002) expressed six questions during interviews: experience vs. behavior, opinion vs. belief, feeling, knowledge, sensory intake, and background information. These questions should be open-ended to ensure students (or faculty) can truly express their views. Sharing background information about the study or myself to begin

the conversation. Seidman (1991) described that interviews put behavior in context while assessing one's understanding.

There are many benefits to using interviews as a primary source of information, as shared by several researchers. Kvale (1996) explains that sources allow information to be shared about the life and situation of every individual in a manner that does not invoke judgment but instead their thoughts. Patton (1990) shared that the actions of individuals could sometimes not be indicative of what is genuinely occurring in their mind, but asking questions prevents the offloading of information. Lastly, as shared previously, having a variety of data collection methods allows for triangulating the data to check the reliability of the findings (Stake, 1995). Patton (1990) identified interviews as key information about the inquiry setting understanding of what has happened and the reasons for which a given event occurred. The interview process took place over a week, allowing for analysis to begin as focus groups convened.

I focused on a semi-structured interview approach (Merriam, 2002) by using open-ended questions to gain information about demographics, background, and feelings about their own experiences. Explanations allowed the layout of a general interview guideline, allowing students to respond in a way that encourages them to share added thoughts or ideas while allowing follow-up questions and further elaboration to clarify understanding (Denzin & Lincoln, 2003). Additionally, I took notes on body language and attitude, which might not have become apparent during the recording. I conducted all face-to-face during the school's scheduled activity time, a maximum allotted time of forty-five minutes, or during students' free periods. These interviews were recorded, with permission from the participant, and transcribed to ensure accuracy via Otter.Ai (Merriam, 1988). The recordings are stored in Google Drive under password protection.

Semi-structured interview questions were designed to collect data from each research participant. The interview protocol consists of 14 questions that will help guide the conversation about the experiences of high school seniors. Below, I have listed the interview questions (also shown in Appendix K) for the interview process with students. Participants were asked in an open-ended format, allowing students to share their thoughts and adjust to address follow-up questions about their lived experiences within the phenomenon (Patton et al., 2015).

***Individual Interview Questions***

1. Tell me about your experience in mathematics. BG
2. Describe your ideal classroom. CRQ
3. What makes you feel supported in a classroom? SQ1
4. How does that affect class when you come into a classroom and a teacher seems unprepared or rushed? SQ1
5. Describe the first five minutes of your mathematics class. SQ1
6. What is the most engaged you have ever felt in a mathematics classroom? Why? SQ1
7. What affects your willingness to speak up in class? SQ1
8. What could your teacher do to encourage you to ask more questions? SQ1
9. How do you feel that your participation in class affects your focus? SQ1
10. Give me three words to describe your favorite mathematics class. SQ1
11. Word by word, explain why you chose those three words. SQ1
12. How does teacher support affect your engagement in the classroom? SQ1
13. How did you decide what math class to take this year? SQ2
14. Are you planning to continue your mathematics studies in college? Why or why not? SQ2

Questions one and two established rapport with the student. Based on previously presented ideas about methodologies that increase engagement (Portela, 2020), questions three to 11 aimed to gain information about what students find most important in their learning. These ideals centered around support and relationships (question three), teacher preparedness (questions four and five), and participation (questions seven, eight, and nine). Engagement is discussed in questions six and 12. Questions 10 and 12 centered around students indicating what they found favorable to determine if they related to engagement or ideals that have been favorable previously. The remaining questions (13 and 14) looked at how students choose to participate in mathematics both currently (13) and in the future (14).

### *Individual Interview Data Analysis Plan*

Saldaña (2015) explained that creating a code is a method of qualitative analysis where repeating a short word or phrase explains a set of narrative data from various sources. Created code assigns a "summative, salient, essence capturing, and/or evocative attribute for a part of language based on visual data (Saldaña, 2015, p.15). Coding was done without an algorithm or formula but by the researcher's creativity based on earlier knowledge and research goals by discerning potential patterns (Basit, 2010). When coding, I focused on the five attributes of importance, according to MacQueen et al. (2008). Analysis requireed the process of horizontalization, where each statement had equal value, allowing for analysis with a clear mind and no leading expectations (Kockelmans, 1986). Horizontalization was especially vital as the focus is on students' opinions and explanations (Spiegelberg, 1965).

By using a code book, I was able to begin by focusing on individual textual descriptions which supply the basis for developing themes (Zahavi, 2010). Patton (1990) expressed that epoché might be the beginning step. However, a need to unbracket will became apparent as

analysis continued to supply perspectives for developing final themes. Gearing (2004) defined *reframing* by analyzing the results through the researcher's lens and imaginative variation. Moustakas (1994) viewed reframing as the researcher's freedom to analyze the data and draw conclusions. Many have viewed reframing unfavorably, so if the researcher can simply make things up. Creating information will not be my goal; instead, a focus will be applied to looking at the data clearly via code book to remain organized.

As Saldaña (2015) suggested, I used multiple coding methods simultaneously as I worked through the data manually to become better familiar with the information instead of using computer software. The first will be attribute coding, often referred to as *descriptive coding*, which occurs at the beginning of a data set to find typical characteristics of participants and demographic information (Bogdan & Biklen, 2003). Descriptive coding is a helpful method when multiple participants are present and especially helpful with interview transcripts, which was present (Bazeley, 2018). Rubin and Rubin (2012) explained that mundane information could become a marker of information once it has been classified. The first two questions fall into the category of descriptive information that can be useful as markers as the data set continues.

**Focus Groups Data Collection Approach**

The research took advantage of focus groups to gain more detailed descriptions as students can build upon thoughts shared by their peers (Gibbs, 1997). Discussion allowed for open dialogue between the researcher and a single participant, and focus groups built upon thoughts, allowing for group conversation between participants (Creswell & Poth, 2018). Patton et al. (2015) explained that, by sharing information in a group, other participants might be emboldened to speak and potentially reminding participants of information they would know but did not share.

The questions asked where like those asked during interviews, allowing students to respond to each other's ideas for engagement.

Focus groups were open to previously interviewed participants, allowing them to come and share further thoughts. Focus groups occurred after the first interviews, allowing participants time to think through their answers and create a larger participant pool. I created the focus groups by dividing them based on their level of mathematics to ensure that a diverse group was formed. Students were asked questions in a similar format to those answered in their interviews (questions provideded below as well as Appendix L). Students led discussions much more while I asked several driving questions. Again, activity time allowed at least 45 minutes of student discussion with the potential of entering the lunch period. Lunch was provided, as appropriate, allowing for further discussion, if applicable, without students needing to rush to the lunchroom. The goal was to host a focus group of five students who have indicated additional thoughts to share. The focus group must have at least three participants confirmed to allow for conversation (Carlsen & Glenton, 2011).

***Focus Group Questions***

1. After our interview, what thoughts do you wish you had shared about mathematics engagement? RQ1
2. When do you think you are the most engaged in class? SQ1
3. Does your earlier math experience affect what you are planning to do as a career? SQ2
4. Are different things are engaging in your different courses? Why or why not? RQ3
5. What is your favorite class and why? Does this affect your plans to take this type of course in the future? SQ1

The goal of the questions above was for students to expand on their earlier thoughts and discuss things they felt they missed. Again, the first question was a chance for students to gain comfort in their thoughts (Husserl, 2012). The second and fourth questions focused on the importance of engagement and methodologies in classrooms that students find to affect their experience positively. Questions three and five focused on the impact and future of mathematics for each student.

### *Focus Group Data Analysis Plan*

The ideals of epoché, or phenomenological reduction, became especially relevant as one level of research was complete, which supplies a potential bias. I attempted to remove assumptions from the interviews and the new incoming data (Gurwitsch, 1966). The material from individual interviews served as a guidepost in the further development of questions as much as possible but will not affect coding and data analysis process. Descriptive coding will allow an analysis of the focus group data, which tends to be used for non-interview data and is a type of basic coding (Miles et al., 2020). Descriptive coding is often suggested for new researchers and can be especially helpful for cross-referencing earlier data processes.

A new code book will be created and compared to that interview data later. A new categorized inventory and suggestions for further analysis (Wolcott, 1994). Saldaña (2015) expressed that descriptive coding is essential for information gathering, as data sets are analyzed and will allow for further data exploration across multiple focus groups. The hope is that the same general trends and themes will be developed over time, even if initial coding could be quite different. Structural coding was used to help find what is expected and familiar (Shkedi, 2005). Coding was like the interview, where one will code at a time, and cycling will occur where the studies allow for alterations and growth as needed. As explained by Saldaña (2015), concept

coding allows for lumping together the data once first coding. The chance to work on generalizing the code across multiple focus groups allows for verifying all data types (Hurt et al., 2015). Further coding occured by developing short phrases standing for a more extensive system as they continue to grow and combine over time.

## Journal Prompts Data Collection Approach

Miles et al. (2020) discussed the importance of fully understanding responses, and students can explain their thoughts further and hopefully gain insight from others who have been part of the analysis process. Watt (2007) explained that ensuring the information is complete is one of the most important parts of obtaining data. Students shared these intimate thoughts and have time to consider what the data truly means (Glaser, 1992). Journal entries were the first-time participants would compared the different methodologies shown to increase engagement. Students returned their journals within 24 hours of the focus group's completion to ensure they did not forget content but had sufficient time to respond. Students had the link to submit their thoughts via email by use of a drop box. All students who participated in the focus group were given a prompt at the conclusion, also shown in Appendix M.

### *Journal Entry Question*

Please share thoughts on how the following concepts have influenced your engagement in the classroom:

1. Group work versus independent time
2. Teacher attitudes and relationship
3. Computer or technology usage
4. Active learning (time to work through problems instead of a lecture)

Which of the above methods do you find most engaging and why? Feel free to add items to the list if you feel something is missing.

### *Journal Entry Analysis Plan*

A final stage of epoché, suspending judgments based upon previously found information, will occur as students can share their concluding thoughts (Saldaña, 2015). The analysis required the removal of personal views, as multiple rounds of data analysis had already been considered, which I will had to put aside to ensure that it did not bias the findings. Instead, the focus was on completing a third code book that allowed for comparison (Gibbs, 2018). Bednall (2006) explained that the research goal is to understand shared information thoroughly, and suspending judgement will give a final chance to develop understanding.

Analysis was completed throughout allowing comparison to the earlier code books to the final findings. Additionally, the analysis allowed for a chance to triangulate with the focus groups, as students completed journal entries to summarize their thoughts (Bogdan & Biklen, 2003). The final stage of data gathering will allow participants to rank the methods of increasing engagement, a component that has not been directly asked previously. Additionally, if other themes developed they were added to the journal as suggested by Miles et al. (2020). The journals provided understanding (Bowen, 2009).

## Data Synthesis

The findings from the interviews, focus groups, and journals must be combined into one information set to answer the research questions. Following horizontalization, coding, and thematic analysis of interviews, focus groups, and journals, the themes were organized into textual and structural descriptions allowing for triangulation (Saldaña, 2015). The first two methods (interview and focus groups) allowed the creation of two separate codebooks that

allowed for comparison. Reviewing descriptive details about both data sets allowed for general ideas about the themes present in the data set. Details were relevant in creating sets of three themes to summarize the findings (Bernard et al., 2017). After completion, another round of repetition occured by viewing the data and comparing the code books further by using them to analyze the data again (Saldaña, 2015).

Focus coding was a second-cycle process used to aid theoretical coding to synthesize the given information. Focus coding allowed for the further creation of subcategories and a comparison of data showing that there might not be an actual correlation between the data (Charmaz, 2014). As the coding occurs, Harding (2019) expressed that if ¼ of the participants share a common theme, then it should be considered, while if three-fourths share a standard code, it can be classified as an actual theme participant. An imaginative variation strategy was utilized to view the information from a new lens upon creating textual and striatal descriptions (Moustakas, 1994). The synthesizing analysis allowed the determination of the essence of experiences by high school seniors by connecting to both the central research question and the sub-questions (Creswell & Poth, 2018).

## Trustworthiness

Credibility, transferability, dependability, and confirmability were essential when analyzing data, as qualitative researchers gain confidence in the outcome of their findings (Lincoln & Guba, 1985). Bryman (2016) explained credibility as the belief in the researcher and their findings. Reliability deals with the repeatability of the findings in other scenarios and the ability to extend the thoughts outside the current group (Martin et al., 2020). Transferability deals with replicating and extending the findings to other studies. If the research cannot be further shared, the findings do not hold any weight. Access is different from dependability as it supports

the reliability of the findings. Comparable results should occur in the same study if performed again in the same environment (Bartko & Carpenter, 1976). Lincoln and Guba (1985) suggested confirmability as a final part to test the data's validity. Researchers verify the findings from data instead of the researchers' beliefs and feelings. Triangulation can explain and verify the data and the findings' accuracy and conclusions drawn.

**Credibility**

Cohen and Crabtree (2006) suggested that various methods to establish credibility in research findings consist of prolonged and persistent engagement, triangulation, peer debriefing, referential adequacy, and member-checking. Credibility is the reliability of a study and its accuracy to the truth of what is found (Lincoln & Guba, 1985). Prolonged engagement means being present in the area long enough to build trust with the participants (Stake, 2010). One must remember that there is not a set amount of necessary time but an aim for comfort level. The same is true for persistent observation, as I must work to dig deep enough into the questions and not simply focus on surface-level responses.

Triangulation instills the importance of verifying the data by using multiple sources, data collection methods, and multiple participants (Cutcliffe & McKenna, 1999). The conclusion will not simply be from a single data point. Instead, the focus will be on finding data that can be used to either further support or call the data into question. Additionally, having students in various math courses ensures that variability in responses cannot vary on the background of the information. Interviews gathered foundational data that focus groups can further support. The focus groups allowed students to explain their thoughts further and gain the support of their peers as discussions continue. Lastly, by completing direct observation, I was able to further support the

findings by seeing how students react in classes that they have believed to be situations in which they feel comfortable.

Peer debriefing deals with sharing information with someone who is not invested in the study and can question findings (Byrne, 2001). Debriefing allowed me to question my work by thinking through the process and sharing my results with someone else. As debriefing brgan, I had the opportunity to share my general research plans with my peers via discussion reviews, peer edits about my design, and interview questions. Additionally, before completing the interview, focus groups, and direct observations, I needed approval from several people on the campus of my institution, as I used members of the student body (Angen, 2000). My department head has also requested access to my findings, so there will be another set of eyes on the data as it comes in, allowing the opportunity for added perspectives (Lincoln & Guba, 1985).

**Transferability**

Lincoln and Guba (1985) explained transferability as the ability of your study to be applied to other contexts. Geertz (2008) suggested that the best way to carry out transfer is by using detailed descriptions and explanations to ensure that the goals and everything else about the study are fully understood. It is essential to acknowledge that the researcher can only create the conditions for transferability but cannot assure transferability: judgment is up to the reader (Burchett et al., 2013). Greenhalgh et al. (2003) explained that qualitative analysis is necessary for information to ensure research evidence and quality standards.

When completing the research, I must ensure that I am explaining everything as fully as possible. Details mean that the data must be thoroughly analyzed and explored to the best of my ability, including a full explanation of everything possible to ensure that the reader understands the background information fully. Additionally, the research questions and detailed steps of the

procedure should be shared to ensure that the process is fully repeatable (Saldaña, 2015). As discussed, trust can be developed by sharing as many details as possible about the background, and the data collection continues throughout the process. Also, the reasons for the conclusion should be clear so the reader can question or support the findings (Freise, 2014). It is important to note, though, that even if all the information is shared, it is possible that the findings may not be helpful in all scenarios or age groups.

**Dependability**

Dependability is defined as the consistency of the findings and their ability to be replicated (Lincoln & Guba, 1985). Consistency supplies further reasons to be detailed in describing procedures and processes for the given study. At Liberty University, consistency occurs through the review process completed during the presentation and through coursework with the support of our teachers. The dissertation committee and the Qualitative Research Director reviewed the findings and processes used to analyze the data and the work and peer review in given classes. We further confirmed the findings by having a panel of reviewers review the process (Merriam, 1988). The panel was able to check through every aspect of the study, allowing further questions and alterations as the process creates innovative ideas, gathering my own understanding was necessary to ensure the best possible practices in analysis. Additionally, the panel review after the dissertation further allows peer feedback by three experts in the field, allowing for more excellent dependability.

In many cases, a standard for the reality of students must be understood, as the researcher might have a background unfamiliar to others or know the information participants must share (Miles & Huberman, 1994). By default, students have some information that furthers their understanding. Consideration means that the auditor cannot know the information and the

researcher; as I collected the data, I held a view that an auditor cannot possibly have. Full explanations were necessary to catch up with the auditor as much as possible. In the case of a disagreement between myself and the auditor, I worked diligently to decide which route should occur and that bias is not coming into play (Creswell, 1998).

**Confirmability**

Lincoln and Guba (1985) expressed the importance of confirmability, which deals with the findings being based on the respondents, not the researcher's desires. Audits, audit trials, triangulation, and reflexivity ensured that confirmability occurs. External audits involve examining a research study's process and product to evaluate the data's accuracy and interpretation. Evaluation supplied a chance to summarize information, assess data, and gather added data as needed to support the feedback gathered (Creswell, 1998).

Trials allowed for further data analysis with transparent descriptions of the research steps, alterations made, and the reason for these changes. Halpern (1983) suggested that analysis began with clearly supplying raw data, field notes, and any added documents gathered. The process used to condense and explain the data should also be used in a way it can not only be verified but also replicated. Explanation ocurred by sharing condensed notes, quantitative summaries, and theoretical notes. In my case, comparison could be done by sharing my code books, sub codes, and the process that further develops them into themes. Also, any preliminary forms are completed in document development, as alterations are made based on feedback.

Malterud (2001) explained that the reader must know the principles, reasoning, and choices for deciding underlying patterns and any recognition. There should be nothing left to the reader's imagination. As research develops the questions, we all have thoughts on how the collection will go, as there is a reason that we are wondering about the questions in the first place (Barry et al.,

1999). These thoughts are shared and the reader understands the lens through which the data is being analyzed and collected. Reflexivity dealt with attitude and how it affects every step of the research process. Lincoln and Guba (1985) suggested the creation of a reflexive journal, which is simply a type of journal that makes regular entries during the research process by sharing reflections on what is happening in terms of values. Audits, audit trials, triangulation, and reflexivity can aid in removing bias. Again, added feedback is given on the process and findings by working on the process through courses at Liberty University. Feedback supplies a chance to summarize information, assess data, and gather added data to support the feedback (Creswell, 1998).

**Ethical Considerations**

When considering the timing for interviews and focus groups, I worked to ensure that the chosen time for students' schedules does not interfere with their extracurricular activities. The students are given enough free time during the school day and are used to sharing their feedback via interviews, surveys, and focus groups. Time will come from a 45-minute activity period before lunch and after Tutorial, so it will not conflict with classes or any meetings. Additionally, as I asked students to miss a portion of their lunch period, I provided their lunch. I ensured that timing does not negatively impact the remainder of their day. Students will also be given the option to meet during their free period if the timing matches my availability as well.

Students who took part hadthe ability to withdraw at any time. Hence, one participant did not withdrawl but instead did not have time or desire to complete the journal entry so one less data point is used for that analysis. Additionally, the administration wass supportive of the ideals behind my study, so they agreed to let me gather data during student break times on campus. Using students' free time allowed me to gain more participation, as students did not give up time

before or after school, and conflicting extracurricular practices. The participants had minimal risks as their information was not discussed, and their names were changed. Participants' names were never shared. Students' names became pseudonyms for the data presentation to ensure they are confident and comfortable responding. The files are saved in a Google drive account attached to a Gmail that was only used for my dissertation to ensure that the files will not accidentally influence students opinions. I also ensured that the files are safe and not accessible by other teachers.

## Summary

Chapter Three provided information on the theoretical framework, the goals of the researcher, and the methodological assumptions that will affect the process. Transcendental phenomenology will allow further analysis the student's feelings on engagement, not just the coursework that has occurred, but the feelings associated with what has been learned and the format in which the information has been provided. The decisions for the methods, data types, and analysis have also been supplied for interviews, focus groups, and journal entries, allowing for data triangulation. Additionally, trustworthiness was explained in terms of dependability, confirmability, transferability, and ethical consideration.

Criterion sampling, a type of purposeful sampling, was utilized to ensure that participants not only fit the needed criteria but also to ensure that a mix of mathematics levels are represented (Patton et al., 2015). The initial sampling pool consisted of over 150 possible students, with those who responded and expressed interest providing a simplified pool from which interviews could take place. Interviewing occurred first, leading into a focus group, and finally, journal entries, as suggested by Moustakas (1994). Interview transcripts were thoroughly reviewed until a complete

understanding occurs for each participant, allowing for coding and bracketing of recurring themes (Bowen, 2009).

# CHAPTER FOUR: FINDINGS

## Overview

This transcendental phenomenological study aims to describe the learning experiences of high school students' engagement in mathematics classrooms. Detailed descriptions allow for understanding the experiences of participants. Participants are currently enrolled students who have attended all four high school years on the Mun campus and taken at least one math course each year. Results of the study are the outcome of data collection methods in the form of interviews, semi-structured focus groups, and a single journal response. The purpose of Chapter Four is to briefly discuss the participants and common themes that emerged from data collection and analysis. Following is a discussion of the participants, responses to interviews, focus groups, journal entries, and the development of themes and subthemes.

## Participants

The research participants included 15 high school seniors enrolled at Mun High School in a mathematics course in the 2022-2023 school year. All students at Mun High School must take mathematics for all four years of high school, but various pathways allow for completing the requirement. The Advanced Placement (AP) Calculus sequence is the highest mathematics course offered at the school, with only four seniors already completing it in their junior year. The lowest mathematics a student can take as a senior is Mathematics of Finance for those who cannot go into Precalculus due to their grades. Still, the majority of students are in Precalculus or higher. Additionally, seniors can take Probability and Statistics upon completion of Precalculus if they express no interest in the Calculus sequence.

Of the 15 participants interviewed, one was enrolled in Mathematics of Finance, three in Precalculus, one in AP Calculus AB, one in AP Calculus AB/BC, three in AP Statistics, two in Probability and Statistics, and the remaining six students in Honors Calculus. Two of these students enrolled in two math courses as seniors, one in AP Statistics and AP Calculus AB/BC and one in Probability and Statistics and Precalculus. Table 1 below shows the math sequence taken by each participant. The total number of participants in each terminating class is shown in Appendix N.

Seniors were asked to participate in research either during their lunch period, free period, or class period with permission from their teacher. As the semester concluded, many courses, such as AP, completed their coursework, and students were given free periods. Students were read information during their advisory period as well as being referenced specifically by several senior-level mathematics teachers. Students who were willing to participate were given consent forms (and assent as applicable) to bring signed to their interview.

**Table 1**

*Student Participants Math Sequence*

| Student Participant | Freshmen Course | Sophomore Course | Junior Course | Senior Course |
|---|---|---|---|---|
| Alexander | Geometry (Mrs. Sean) | Algebra 2 (Mr. Shirley) | Precalculus (Mrs. West) | Honors Calculus (Mrs. West) |
| Angel | Algebra (Mr. Cap) | Geometry (Mrs. Riley) | Algebra 2 (Mr. Cap) | Precalculus (Mrs. West) |
| Carol | Geometry (Mrs. Sean) | Algebra 2 (Mr. Cup) | Precalculus (Mr. Lead) | Honors Calculus (Mr. Boat) |
| Dallas | Geometry (Mrs. Sean) | Algebra 2 (Mr. Shirley) | Precalculus (Mr. Dean) | Math of Finance (Mr. Shirley) |
| Dixie | Geometry (Mr. Light) | Algebra 2 (Mr. Lead) | Honors Precalculus (Mr. Dean) | Honors Calculus (Mrs. West) |
| Grace | Geometry (Mr. Light) | Honors Algebra 2 (Mr. Lead) | Honors Precalculus | AP Statistics (Mr. Hustle) |

| | | | | |
|---|---|---|---|---|
| | | | (Mr. Dean) | |
| Jack | Geometry (Mrs. Sean) | Algebra 2 (Mr. Cup) | Precalculus (Mrs. West) | Probability and Statistics (Mr. Hustle) |
| Joe | Geometry (Mrs. Riley) | Algebra 2 (Mr. Shilrey) | Math of Finance (Mr. Shirley) | Precalculus (Mrs. West) |
| John | Honors Geometry (Mrs. Sean) | Honors Algebra 2 (Mr. Lead) | Honors Precalculus (Mr. Lead) | AP Calculus AB (Mrs. Christine) |
| Katie | Honors Geometry (Mrs. Sean) | Honors Algebra 2 (Mr. Lead) | Honors Precalculus (Mr. Dean) | Honors Calculus (Mrs. West) |
| Kevin | Geometry (Mr. Light) | Algebra 2 (Mr. Cup) | Precalculus (Mrs. West) | AP Statistics (Mr. Hustle) |
| Randy | Algebra 1 (Mrs. Capp) | Geometry (Mrs. Riley) | Algebra 2 (Mrs. Hollow) | Probability and Statistics (Mr. Hustle) & Precalculus (Mrs. West) |
| Ross | Geometry (Mrs. Sean) | Honors Algebra 2 (Mr. Lead) | Honors Precalculus (Mr. Dean) | AP Calculus BC (Mrs. Christine) AP Stat (Mr. Hustle) |
| Sam | Geometry (Mrs. Sean) | Honors Algebra 2 (Mr. Lead) | Honors Precalculus (Mr. Dean) | Honors Calculus (Mrs. West) |
| Tammy | Honors Geometry (Mrs. Sean) | Honors Algebra 2 (Mr. Lead) | Honors Precalculus (Mr. Lead) | Honors Calculus (Mr. Boat) |

Each student who was interviewed planned to continue their education at the collegiate level during their freshman year, with no one purely focused on mathematics. Shown below in Table 2 is the students' general schedule, as well as their GPA at the time of this study. Although not a parameter of the study, 14 of the 15 students identified as Caucasian, and seven identified as male. Pseudonyms were assigned randomly to protect the identities of all participants. Also,

pseudonyms for faculty members and any students' names mentioned were translated to random initials to avoid identification. No connection existed between a participant's name, gender, or race and their selected pseudonyms. A brief portrayal of all individuals is detailed further in Table 2 below.

**Table 2**

*Student Participants Descriptives*

| Student Participant | GPA | Senior Mathematics Course | Planned College Major | Planned Future College |
|---|---|---|---|---|
| Alexander | 3.91 | Honors Calculus | Physics/Engineering | University of Tampa |
| Angel | 3.70 | Precalculus | Finance | Stetson University |
| Carol | 4.3 | Honors Calculus | Pre-Law | University of Georgia |
| Dallas | 3.08 | Mathematics of Finance | Criminal Justice | Florida State College of Jacksonville |
| Dixie | 4.2 | Honors Calculus | Sports Medicine | University of Kentucky - Louisville |
| Grace | 4.45 | AP Statistics | Double Major Neuroscience and Biology Pre-Med | Haverford |
| Joe | 4.23 | Precalculus | Music Education | Furman University |
| John | 4.29 | AP Calculus AB | Biology (Pre-Med) | Florida State University |
| Katie | 4.24 | Honors Calculus | Business Pre-Law | University of South Carolina |
| Kevin | 3.84 | AP Statistics | Pre-Law | University of North Florida |
| Randy | 3.68 | Precalculus and Probability and Statistics | Business | University of Missouri |
| Ross | 4.36 | AP Calculus BC and AP Statistics | Double Major Biomedical Engineering Business | University of Florida (Presidential Scholar) |

| | | | | |
|---|---|---|---|---|
| Sam | 4.31 | Honors Calculus | Business | University of Florida |
| Tammy | 4.47 | Honors Calculus | Biology Pre-Med | Florida State University |

**Angel**

Angel transferred to Mun High School at the beginning of her ninth-grade year and was behind in mathematics but felt successful "based on the teacher" and how they responded to her. She preferred a very "structured, like taking notes on the board and sitting and writing them down" approach. She did not feel she processed or understood enough during review games or learning activities but appreciated working with peers. She preferred to have time to work in class on homework, as "go ask them [teachers] to see how it relates to the lesson." Outside of mathematics, she took standard-level classes (3.7 GPA) and focused on Vestry leadership, campus Bible studies, and varsity basketball. She also was a member of the competition choir and traveled for thespian competitions.

**Alexander**

Alexander was a student who felt math had "been one of my better subjects." He planned to focus on STEM in college and continue the path of mathematics through physics. He "favors math over English because it has come easier" and allowed him to know when problems were complete. He never moved up to honors or AP science, and senior year was his first time in an honors mathematics course, but he felt comfortable in smaller classrooms. He had been absent frequently during high school for four different surgeries, so he consistently advocated for himself when it came to catching up and working independently to ensure he did not fall behind. He experienced the same teacher for his last two years of mathematics and felt that had dramatically impacted his learning and understanding.

**Carol**

Carol was a student who focused on on-level classes. She found math “kind of boring” but admitted that she did not like school very much in general. Even though she did not find it enjoyable, she felt she “always done pretty well, and like I haven’t really like math isn’t something like that I would study for, you know.” She preferred interactive classes but was heavily focused on peer perspectives when considering what should be shared based on “friends in the class.” She did not play any extracurriculars nor spend time outside of school studying, as she “just needs to look over stuff a couple of times.”

**Dallas**

Dallas was a student who focused on her on-level classes and had taken one AP course during high school. She had a B average (3.08) and felt, "I am OK at it, I guess good, but I don’t like it.” She focused heavily on softball and was plagued with injuries and concussions that caused her to miss several days of school. Additionally, she worked two jobs outside of school, which negatively impacted her ability to do homework. She focused on getting everything done during the school day. To learn, she felt that she needed a teacher who is “open to helping” and willing to give class time to work on “worksheets and homework so I can get it done when I have questions.”

**Dixie**

Dixie felt very strong in math for the past two years but felt stifled because of “lower classes when she could have been in higher ones because of middle school.” Even though she scored an A+ in Geometry freshman year, the lack of transition negatively impacted her confidence leading to concern that it would “not make a difference.” She appreciated breaks in class to allow her time to process and begin asking questions as she moved on. She was

constantly concerned that the “rest of class is understanding it” and that she was “slowing down the pace.” Concern affected her speaking up in class, but she felt she could thrive in suitable classes. Even though she felt she was held back, she was still a member of the National Honor Society and National Art Honor Society. Additionally, she was a member of the state championship crew team. She anticipated rowing in college as a member of the Louisville crew team, so she also spent much time outside the school on the water.

**Grace**

Grace was a Cum Laude (4.45 GPA) inductee heavily focused on science. She spent two years in high school focusing on a science fair project she presented nationally. Grace did science seminar as a zero-hour course, meaning it did not take up a period of her schedule but instead was completed outside of school hours as supported by a faculty member. She was also heavily involved in AP courses across all disciplines and moved down from honors precalculus to AP Statistics. She was a student “who definitely likes to challenge” herself but did “not feel very strong in mathematics after last year.” Additionally, she chose AP Statistics for her final year of study, as it felt “relevant” for her future research.

**Jack**

Jack was a student who worked hard but was focused more heavily on the humanities. He completed solid work across all his courses with a 3.65 GPA but was very social and sometimes became “distracted by his peers.” He always felt “math is the hardest, and it’s never been my favorite.” He struggled during the previous year in Precalculus, failing every test, but he worked hard on all external assignments. Jack was a student who “always feels average” but is focused on having “a good teacher” or felt he would not succeed. He also had his advisor as his mathematics teacher for two consecutive years (Algebra 2 and Precalculus), leading to an additional

relationship layer in each class. Outside of school, Jack rowed crew for Mun High School and worked a part-time job as a lifeguard, which takes up a portion of his study time.

**Joe**

Joe was involved in many extracurricular activities, being heavily focused on the fine arts. He led a musical and play, including singing for Vestry for weekly chapel services. Outside of school, Joe had piano and voice lessons and was very active in the Episcopal church, leading a teen Bible study. Additionally, he completed his Eagle Scout his senior year, resulting in multiple community service projects. He was solid across all his classes (4.23) but chose to take AP courses in the humanities, "all advanced and AP classes except math. I've decided to take regular courses as I've gone through high school." Staying in lower math just "kind of naturally happened after (my) freshman year." Joe also took the uncommon route of saving Precalculus until his senior year to continue with applicative mathematics as a junior in the form of a lower math course.

**John**

John was "relatively comfortable with math... not exceptional at it," according to him, but was in AP Calculus during his senior year. He was diagnosed with "slow processing, so (I) struggle to follow along in class often." He also did not complete homework and instead focused on material grasped in class. He partially blamed his performance on his study habits, "thinking I could rely on my intellect, and now realizing that is a bad idea" and having the same teacher two years in a row who spent a considerable amount of time going over material so he "picked it up in class." He also felt that he needed lessons to be "very visual" and built upon his "web of knowledge" to find success and that if he missed steps, he could not pick them back up quickly,

leading to confusion. He felt "stupid" in class based on how he perceived his peers were doing and how his teacher responded to his questions.

**Katie**

Katie was a student who followed the honors track for math and science because she had "always been way better at it than English," and she "likes having an answer." She received a recommendation for AP Calculus but decided to take a step back and take honors. Her choice was not due to lack of effort or concern but because she knew her senior schedule would be impacted negatively because of the swim team and the time commitment of the extracurricular activity. She was a state champion swimmer (two years in a row) and was committed to South Carolina for swimming, so she focused more on that. She was also in the National Honor Society, so she showed a strong work ethic across her classes and did very well overall. She frequently spoke up in class and was used to learning by taking "notes one day and then a game or review the next." She was easily distracted, so she preferred "super competitive" activities as they drew her in more.

**Kevin**

Kevin was a well-rounded student both inside and outside of school. He concentrated on STEM with a focus on Science. He took three science courses and AP statistics while taking his humanities courses at the standard level. Kevin described his math experience as "average and sometimes boring" but wanted to "learn stuff that matters" as he moved through the content. Outside the classroom, he was an Ambassador representing the schools through tour groups, was a four-year letterman for wrestling, a three-year letterman for baseball, and was selected to be a member of the Honor and Discipline Council. He found it essential to be "successful by understanding" the content and feeling that the teacher "knows-he is trying."

**Randy**

Randy was a student who has always "been stronger in math" even though he felt he was "at a little bit of a disadvantage when I came here because I came here halfway through the year in seventh grade." Since moving schools, he has made steady progress in mathematics, moved to honors Precalculus as a senior, and took a second math in Probability and Statistics. He did move back to regular math because he knew he was " not going to let up, and I knew it's gonna get for one point. I was like, I can do this math, but I just don't know if I have the strength at the end to do it." Overall, he is "usually the one helping people out" and felt confident because he generally "know(s) a little bit about the lesson." Overall, he was a student who liked to challenge himself both in the classroom and on the baseball field.

**Ross**

Ross was a Cum Laude scholar (4.36 GPA) who was "math and science-focused." He had taken every AP Science and AP Mathematics class available at Mun High School and loved "straightforward approaches that move into problem-solving." He was one of the few students who did not have a free period during his senior year, as he wanted to take various classes. He also took the zero-credit hour science seminar, allowing him to work on a nationally renowned research project. He won the state-level science fair, placed nationally last year, and won national prizes. Additionally, he was a presidential scholar at the University of Florida, taking two math courses in preparation for his upcoming double major. He was focused on the "reward of getting it before the teacher" and felt confident in his abilities. During his senior year he was taking three science courses in addition to AP English, his two AP math courses, and a zero-hour course Science seminar as he continued to challenge himself.

**Sam**

Sam was a student who began in higher-level math courses but lost his confidence along the way, leading to a step down in level for his senior year course. He expressed his math aptitude: "I enjoy math a lot, or at least I used to. I loved math in ninth grade; I had a really good passion, unfortunately ending in 11th grade." He had one course that shook his confidence, causing him to make a shift in his trajectory. He was a strong student overall (4.3 GPA) with various AP classes and activities, such as varsity tennis. He was also a grade representative on the student government senate and won the superlative "most likely to brighten your day" for senior superlatives, so he was a genuinely positive student overall. He based many of his opinions on peers and his need for encouragement, so he took it very seriously when he struggled, stating he was "more focused when my peers are trying hard, too."

**Tammy**

Tammy was in the top 20 students in the graduating class, as indicated by her induction into Cum Laude society with a GPA of 4.47. While considering herself to have a "strong math aptitude," she decided to step down from the honors mathematics track because she knew that AP would have "less explanation and … I note consistent explanations to understand." She expressed that she always needed "a little more clarification" than her peers and felt that she wanted more direct instructions while she was capable. Tammy was also the president of the National Art Honor Society, so she focused heavily on the arts and was specifically interested in visual arts. She felt "geometry was super easy because I could see the questions."

## Results

The purpose of this transcendental phenomenological study was to describe the lived experiences of high school seniors in mathematics classrooms in terms of engagement. A review

of the data collected through interviews, focus groups, and journal entries was analyzed and organized in Google Sheets and Google Docs following the prescribed data analysis plan. Responses to the questions were self-reported and cataloged to determine general themes and subthemes across all three data types. Digital transcription of the individual interviews and focus groups was completed using Otter.ai, an online recording and transcription software. The researcher then corrected the data by hand in terms of transcription errors and replacement with pseudonyms for teachers and peers. Statements and phrases were categorized into themes and sub-themes as patterns emerged from the data through clustering and aggregation. Trends continued as focus groups were conducted and analyzed before the initiation of journal entry and journal entry coding. While some subthemes did not emerge across all three data sets, the same three overarching themes were derived, shown below in Table 3 and Figure 1, with further foundational support shown in Appendices O-T.

**Table 3**

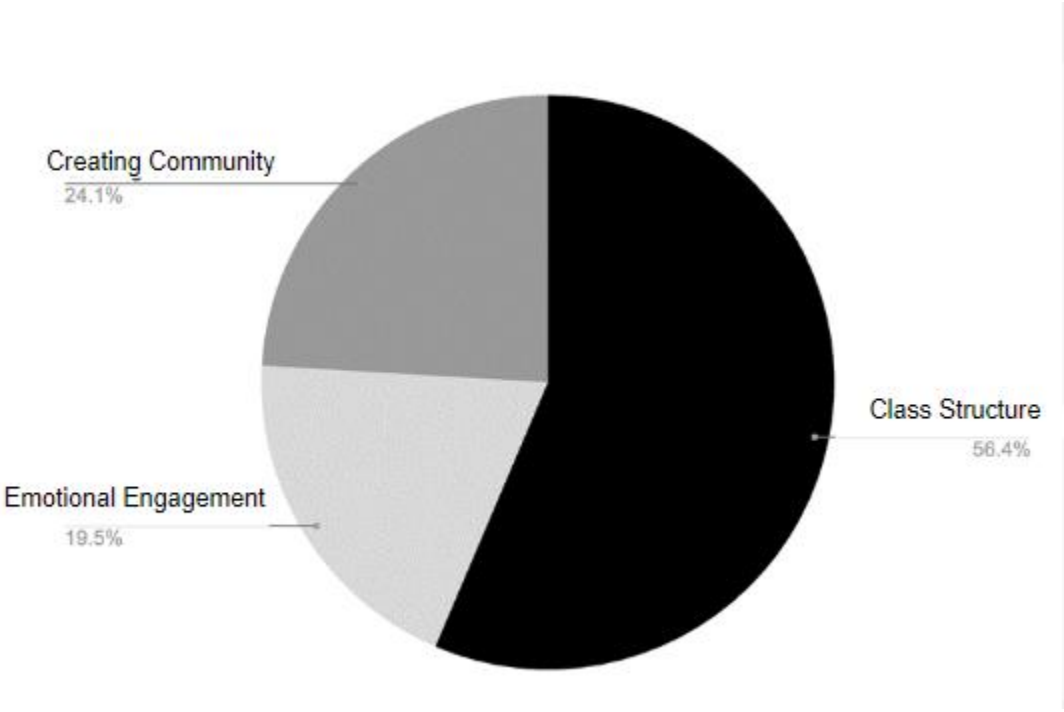
*Theme Development for Research Study Data*

| Theme | Data Codes | Interview Frequency | Focus Group Frequency | Journal Entry Frequency |
|---|---|---|---|---|
| Classroom Structure | Small Class Size | 6 | 1 | 0 |
| | Starting Class | 21 | 3 | 1 |
| | Varied Structure | 94 | 40 | 37 |
| | Style | 121 | 17 | 6 |
| Emotional Engagement | Confidence | 21 | 10 | 1 |
| | Positive Response | 26 | 17 | 0 |
| | Comfortable | 25 | 7 | 0 |

| | | | | |
|---|---|---|---|---|
| | Passionate | 7 | 1 | 5 |
| Creating Community | Peers | 34 | 13 | 2 |
| | Teacher Relationships | 24 | 19 | 17 |
| | Support | 34 | 10 | 5 |

**Figure 1**

*Frequency of Appearance of Each Theme Across Participant Data*




**Classroom Structure**

The first and most discussed theme that emerged from the data regarding students' engagement in their high school mathematics career was the role of classroom structure and various methodologies. The theme of classroom structure centers around foundational ideas about class size, the rhythm of class, and the style of instruction. All students interviewed wanted to see

a variety of "mixed methods in the classroom" with "a good balance between group work and independent work allowing for students to learn and practice on their own while still having a little bit of engaging and meaningful group work." While the demand for practice time was high, so was "student-centered active learning during notes because it is more engaging than a moral lecture, but we still need notes." Students, like Joe and Alexander, wanted to see a variety in the structure of their classes and "like when we switch things up" and do not "just do the same thing every day." Table 4 and Appendices U - AA show the development of the subthemes.

**Table 4**

*Theme Development: The Role of Classroom Design in Engagement Significant Statements*

| Subtheme | Significant Statements |
|---|---|
| Small Class Size | "It's easier to teach to each person's style." (Joe) |
| | "Necessary to be seen to be engaged"(Alexander) |
| Starting Class | "Ease into the lesson maybe like getting settled" (Grace) |
| | "Thought that was more like a good way to get my brain going" (Tammy) |
| Varied Structure | "Better to like to do multiple different things. Shake it off." (Kevin) |
| | "Where you just do the same thing, like take notes every day. And I just feel like I wasn't very engaged" (Carol) |
| | "Like I said earlier, it's like, not just like all notes all the time." (Angel) |
| | "Everyone will just get bored and zone out" (Joe) |

***Small Class Size***

Classroom size was mentioned by five individuals, six times total, focusing on the number of students in the room directly impacting their engagement. Students felt that the teacher's "focus is spread out" if there are too many people in the class, which leads to less individual attention. There was a balance, though, because, as Alex shared, "classrooms that are too small

are harder because I feel like there is less engagement that goes on." Agreement was echoed by Ross, who shared that "interactive environments are easier in smaller classes, and I am more comfortable asking questions in smaller environments, but not too small." Small class size allowed the student to "more easily hear," "focus more on the teacher and no other people," and "get less distracted."

***Starting Class***

The chime of the bell signaled the start of whole new learning experiences with little time to transition as they moved from one class to the next. Joe expressed that it was difficult to transition and "get in the mindset" when moving to a new class. Students felt that teachers were simply expecting them to jump in when, instead, they needed a way to "kind of make the transition," "rest for a second so (they) can be more focused for the rest of class," and "wind down from the last class." Instead, students referenced "slowly warming up to start, "easing into the lesson to get settled," and allowing time to get ready to "zone in."

The best way for transition to occur was inconsistent across students, with several suggestions ranging from a "summary of what was on the homework," "chatting, chatting, chatting," or "doing a review problem from the class," as long as you can "knock it out in a few seconds." Overall, the trend was the same; there needed to be some transition into class, with the main suggestion being to take time to get to know students better and share an interest in their day. Carol shared, "Like you could make some conversation and stuff. I think that makes it easy to just talk about anything later in the lesson because it sets the trend." Others, such as Kevin, felt that time should be spent "doing a review problem from the last class" but ensuring time was left for discussions, helping students to not feel rushed, as it set a negative trend for the class.

Students shared that they were the most engaged when “you spend five minutes just like talking about, you know how life is kind of like lowers your guard.” Tammy believed to some extent, chatter at the beginning of class “lowers your guard” so you are ready to listen to what comes after and puts you in a better mood so you can pay more attention. Sam shared the same sentiment, saying he wanted the beginning of class to feel like “a nice dinner party kind of thing.” Five students believed that a bell ringer, or review problems of some type, helped get them in the zone for the current class and allowed necessary review simultaneously. Tammy felt, "It kind of helps when I walk into a class, and there is work from the last class that I can use to remember what we are doing.” Dallas believed introduction could be done by “working them out on a whiteboard when we get there” but something interactive, as “it’s engaging to do this instead of simply sitting and watching others do work.” Dallas suggested that practice could be completed through “homework quizzes in the beginning that are only two or three questions,” or Katie similarly suggested, “review problems like at the beginning can be by myself so I remember what we did last class and get ready to go.” Ultimately participants all agreed; however, some means of introduction is necessary to avoid “immediately pounding students” as they walked in the door, causing students to shut down before the lesson began and could no longer engage in subject matter taught later in class.

**Varied Structure**

Classes often include a variety of techniques for disseminating information, from standard notes, group work, individual work, review games, and assessments. James shared, “I cannot handle classes where I come in daily, and it is the same pattern. I just can’t do it. There has to be some variety.” Students felt variety was needed because “repetition isn’t even engaging.” Students preferred lessons planned in such a way that they were not doing the same type of

problems too often. The students shared the belief that “too much or too little because then it is not engaging.” Students needed time to “practice problems and stuff” and learn the content, “like it can’t be just fun and games, especially for math.” Grace suggested ideal classes contain “like a quiet, you know, learn this, and then off days, we can do solo or group work, like practice problems and stuff.” Active learning was the most heavily discussed component in terms of themes, as students spent much time discussing finding “a good balance” and what methods “allowed students to learn and practice on their own while still having engaging and academically meaningful work.” The significant categories by discussion broke down into notes, group and individual work, practice type, and review. The frequency and example quotes can be found in Appendices BB and CC.

***Notes***

The sub-theme notes refer to the active practice of student note-taking in class, typically while a teacher provides instruction. Joe shared that nothing was less engaging than “when you’re reading it up on the board, you take away the writing it up on the board aspect, and there’s nothing happening.” While note taking might be beneficial for many students, Tammy shared, “worst days, but I feel like if I didn’t have those (notes days) that I most definitely would not have learned as much.” The concepts during notes cannot just be “a jumble of concepts” or just “thrown out and stuff.” Notes are necessary for “initially introducing a topic, but after that, active learning should be used so that the students can actually engage.” Ross shared

> This means that before a student can go off on their own and teach themselves, they need a solid background in teacher-centered learning, where the information is given in a straightforward fashion. Especially when the class is math. There is always a way to solve

a math problem, and there is always a right answer. Because of this, one of the best ways for it to be taught is by teaching it straightforwardly.

When students take class notes, the practice shows them how "to walk through the steps" and "give knowledge, as it is kind of hard to be knowledgeable without a lack of knowledge." Class can become engaging by "consistent explanations," "providing information," and "outlining the steps." Without initial teacher guidance, students shared that "they learn the wrong material" and then felt overwhelmed and gave up instead of pushing through the content.

While sharing notes, students felt teachers should have focused on "trying to understand and explain every step," so students could begin practicing independently. According to Jack, one way to engage the students during times of lectures was to "pinpoint main concepts that are really important for success." He explained that specification pulls students back who are beginning to lose focus. Dixie shared that hearing a teacher say, "Make sure you write this down in your notes," is cliché but makes a substantial difference in her attention. Additionally, even when taking notes, students should be encouraged to ask questions: "If it's just like a lot of talking with no questions, I zone out." Students need time to ask questions and ensure that the lecture is not just "go, go, go" because it does not give time to understand the content but instead to regurgitate. Taking time for questions allows students to discuss and avoid being "monotone and just the same every day."

***Group Work***

Students shared a variety of thoughts on group work, with John sharing, "group work is fun, but I don't learn the best," with others sharing that the benefit "depends on the topic." Grace even shared that she had never "done that (played games) in a class like math before but thinks it could help." Overall, group work was the second most discussed topic within the theme of

methods of varying class structure, being referenced in some way by every participant and discussed in every focus group. Overall, participants agreed it was more helpful after initial notes "to see it (content) more clearly because sometimes it's not something I could do by myself, but it is just easier that way sometimes." Participants believed that it should not be how processes are introduced but instead used "once we get down processes pretty well" because implementing too early or too late can be problematic, as shared by Joe:

> Implementing independent work too early, however, can pose too strong of a challenge for certain students and can be discouraging. Maintaining group work too late, however, can stop the student from being able to work independently and prevent them from seeing the gaps in their knowledge or areas.

Ross referenced that practice only bred more confusion if student.s "work problems they've never seen before." Instead, Carol suggested it is a chance to "feed off of other's ideas, but make sure that you really solidify what you know and that you are ready to work on your own." Students felt placemen of practice towards the beginning of the unit assisted in gaining understanding "as you're learning it" and "figuring it out together, so it's a lot more beneficial than getting stuck alone."

Students perceived that group work provided several major positive attributes centered around discussion, increasing motivation, hearing new perspectives, filling small gaps, and gaining understanding from their explanations. Carol shared that group work allowed students to "get more work done because my brain is working through problems I would normally give up on." During group work, Kevin expressed that he was motivated to "work harder so that people will want me in their group" and "be excited to have me, making me feel much more engaged." Class discussions were also a chance to find gaps that needed to be filled, as students

"compare myself to others and how well I have learned the materials." Tammy explained, "You learn something by explaining it to others." Dixie postulated, "as you teach someone else something, you retain it yourself." Explanation also allowed students to hear other perspectives that "may have been skimmed over the first time," and allowed group work to "push me to look at a problem from the lens of another student rather than the teacher." Alex explained that explanation can be "good for reinforcing" components you already know and "helps clarify small areas of confusion."

Jack shared that even though hearing others' perspectives can assist in understanding, it is "also easy to piggyback off of others" and "allow them to do most of the work for you." He explained that students should continue "measuring yourself and being critical" and use it as an experience to learn what to do further on their own. Instead, Joe suggested, " it should be used to fill small gaps and solidify thinking as you start working your way around something new and learn the nuances." Alex expressed that sometimes group work can be engaging as "you race not to fall behind your group members instead of trying to learn the material" but that while he is forced to pay attention, he does not gain as much since he is instead frantically working. John's thoughts were similar as he felt he was often unsure of where he was "lacking because others just do it for me," so he struggled to understand what he did not know and "will continue to not know that for the test."

To encourage engagement, students think it is important to realize that they "get more distracted in the same group every day," but working in small groups helps them "learn it in a better way." Sam stated that variety also helps ensure that group members do not rely on others too much, as he often felt that he "was the only one in the class who needed" help. Additionally, Dixie explained group dynamics impact learning, as she shared that "if (I) have a group that like

doesn't care or isn't motivate(d), I'm not going to be motivated. But then, like, we're like, okay, like this is done. Very beneficial." Carol explained that having "small, varied groups" corrects many issues, however, and allows you to get to know many others."

### *Individual Work*

Jack shared that while group work is important, the "individual has its own value in comparison." The main reason students value group work centers around finding "holes in your own knowledge." Group work provides an opportunity to "work on my own," "really understand stuff," and "ensure they can accomplish the test on their own." Students believe it encourages engagement if they understand the concepts, as group work allows for individualized learning, as shared below by Ross.

> I am someone who prefers independent work, especially in a class like math. I prefer this way because I often find other people holding me back either via distraction (socializing rather than working) or a difference in the level of understanding.

The main discussion point centered around ensuring preparation for the test, as students "learn what they get stuck on" and how to move through these issues on their own similar to what would be done on a test. Increased engagement occurs because it forces students "to do their own work without reliance on others" and "because the tests are independent."

### *Practice*

Taking the time to practice problems allows students the opportunity to understand concepts taught in class, providing time to fully familiarize themselves with the content. Ross shared the following about homework concepts: "Don't stick the first time, and I know you are supposed to fail sometimes. That's why you do homework. But sometimes, I do wish that I understood." Many participants shared the importance of problem-solving during class, "in-

between steps, especially when it is long and complicated." Katie shared that sometimes she got so overwhelmed that she simply "close[s] my book and be like 'nah,' and upon getting to review the day, I am still like 'nah'." Kevin shared that the learning process goes much smoother when "I am moving around in class to review before I feel engaged and will retain the material." Grace preferred to work them out and then "have the teacher jump in and question why we think the way we do or suggest something else to get me on the right track." In-class practice reviewing notes to solidify understanding before "going over the homework alone." Alex shared that the best classes concluded with time to "start our homework … because if I have a question, I could ask them to see how the lesson meets the problem."

In-class practice allows students to work on concepts "that never stick the first time" and allows practice before students "go and work on their own" to understand fully. Students can also review during review days before assessments, allowing students to "go and do different work on your own." According to students, Those days were engaging because "it tells me exactly what I need to know," which can be done with games or practice. Angel shared, "structure(d) review dates make it engaging but also like, I think for days, we're learning a new lesson… and communicate with what's difficult." Jack shared, "I would much prefer to review by playing a game in a group and working with paper and pencil. This keeps me engaged and keeps me from getting distracted." Alex noted similar thoughts, stating that reviewing before tests and quizzes is always something he "enjoys and finds helpful." Reviewing is a chance to "reinforce the information, you know, and makes you feel more confident about what you know, especially if you have a test coming up." Part of engagement stems from "panic because I'm really behind, and I'm way more engaged than I normally would be."

Stress stemming from grades creates a need for methods of encouragement that are both grade-based and non-grade-based for practice assignments (Papanikolaou et al., 2003). Jack even suggested that teachers answer questions during quizzes to encourage engagement and understanding, stating, “If you ask them, I feel like they should be able to say oh, you messed up here. Let’s go back and work on it. I feel like quizzes should be a little more open than tests.” Kevin agreed by saying it would be “helpful because they can like to explain stuff to me that I don’t get, but I feel like that help shouldn’t be graded.”

Ultimately, students are “motivated by grades,” so any time points that can be gained caused an increase in engagement. Joe shared that a “reward system is really helpful for me to feel very engaged and then also helps me pay attention to the notes because I know that there’s going to be something that comes up next.” Jack similarly found activities engaging that have “a reward if I do well on it, but it is not going to hurt me if I do poorly because that really just takes away the pressure.” Pressure can build and cause students to give up and become unengaged after doing poorly on an assignment, as they feel there is no hope of recovery “because like you can bomb one test and it tanks your grade and confidence.” Carol shared that a grade “doesn’t mean you’re not good enough” but that it is easy to be “not very motivated” when it feels like you failed and others are getting it quickly and “no one is doing anything really to help you.” Jack postulated that an easy way to overcome these feelings is to provide “extra credit opportunities as support and an incentive” to continue pushing yourself.

**Instructional Style.** Students felt that they “make every attempt to focus” but that, in many cases, they need help to get “dialed in.” A component of instructional styles was discussed previously in the classroom structure subtheme by adding a variety of methods to disseminating information. The other half of instructional styles is how information is shared. Students centered

their focus around interactive lessons, chances for inquiry (from both students and teachers), competition, opportunities for problem-solving, and application of real-world concepts.

***Interactive.*** Kevin believed he "makes every attempt to pay attention as much as possible, but at the end of the day, I'm catching myself falling asleep because we are doing the same things repeatedly." Jack shared that he can "tune in" when a class is interactive, and he is "moving around, asking questions, or interacting with others." Carol thought "games also help" because "it doesn't feel weird to ask questions because you aren't thinking about that part." She indicated that students are so focused on their surroundings and accomplishing the task that they overlook the components that could become awkward when you "don't quite understand what you're doing, and I can't go up and ask that in front of the whole class." Joe speculated that

> It is easy for a student to lose focus when the teacher is not attempting to keep the student's mind active. This may involve taking small breaks, asking students to answer questions, or giving them a chance to practice problems on their own. Some students pay attention while teachers simply write notes on the board, but it is less engaging and far more difficult for the majority of the students to focus without active learning.

Students felt that they needed to be able to "interact and listen" to fully grasp the concepts that are being presented. In addition to movement and games increasing interaction, students suggested a large focus on question style in terms of both the teacher and them. Questions could even include a sidebar conversation because "you can keep talking about someone or something you're teaching like you get a little bored, but we are like, dude, a little sidebar would help so much," as discussed by Carol. Kevin suggested inquiry could also be accomplished through hands-on activities, as it helps students jog their memories about different components of math because they remember activities even if they struggle with the concept, "I don't remember that topic in

the slightest for AP Stat, but I do remember counting pennies for two hours." Instead, students need to "participate so they don't just zone out" as they all are fully aware that "participation affects focus," "if I don't participate, I kind of zone out," "participating in class definitely affects my focus," and that being "involved in the learning process".

***Inquiry.*** The most frequently referenced method of increasing interactions and focus centered around "asking questions and thinking about what to ask" in terms of being motivated. Students felt they were "more motivated and everything and then also keeping at a pace where I have time to ask questions helps me learn." The ability to understand and keep pace with the class allows for further participation. Kevin believed participation occurs more easily when he speaks up.

> I participate in the class, just the more I generally learn and the easier it is for me to focus. I mean, that's always been the case for me. If I don't speak up in class and I don't participate, I just cannot be engaged. I just won't be there. My mind will go somewhere else. And quite frankly, I just kind of get bored, but to keep things kind of interesting for myself, I have to stay engaged I have to ask questions.

Joe shared that students' ability to focus is also affected by "holding questions." Ross shared that holding back questions when things "never really clicked with me, and I am afraid to ask sometimes."

Students often worry that their questions "negatively impact the class and waste time." Teachers need to continuously remind students to ask questions by "reassuring them that you know it's a safe space to ask these questions." Reminders are especially true as students are often not "bold enough to say so" without encouragement. Students also shared that, depending on their level of confusion, it was difficult to engage and to know what questions to ask. Dixie shared, "if

it seems like the rest of the class is understanding it, and I'm like not, I may not say anything." Grace echoed, saying, "sometimes I don't even know what question to ask, so I don't know how to even think about it." Circling back to questions, though, other students can also lose interest. Kevin purported that he struggled to focus when others spoke up, sharing that when "somebody else in the class asked a question and I've just given the answer or something, so I am less engaged" or "I feel like it is a break to me" even going as far as saying "it's kind of the perfect time to tune out."

Students suggested that to ensure questions are helpful and being asked appropriately, they should explain answers in a manner that is not going to "leave anything up to interpretation," be "comprehensive, he just knew what we meant'' and ensure that, if it is unclear "make sure we understand it before moving on." When these things do not occur, students felt instead that their questions are a "burden on the class" or not worth "paying attention to because it was already said." Students suggested "figuring out what the questions meant before answering" and being sure to "slow down to answer instead of rushing through."

During the lesson, when teachers are lecturing, students suggested ensuring that a time for inquiry still occurs to help them remain engaged. Specifically, asking questions ensures that students know it "is important and ok to ask questions" but that cannot be accomplished simply by" stopping and saying, "Do you have questions?" or "Everyone gets this, yeah?" because then they feel as if they are expected to understand already and will check out. Instead, focus on asking questions, such as "waiting and having others try," "asking a question but when the student answers back, and it is not a good answer" to build on the question instead of simply saying it is wrong, and ensuring students have the chance "to explain it better as people try." Several students commented on the benefits of asking a teacher a certain number of questions before moving on

instead of simply asking if students understand. Kevin shared that in AP Statistics, Mr. Hustle often would say, “I need two more questions before moving on,” and that more than two occur because the people holding back on their questions now know that it helps others to ask them. So instead of simply “waiting for the class to answer while they just go silent for five minutes,” he morphed it into a time where everyone must engage to move on to the next lesson component.

**Competition.** Numerous students brought up competition in terms of increasing their engagement by asking questions, completing more problems, and working harder with their peers. Kevin explained that “it just fit his competitive nature,” while Randy shared that it simply made it “more interesting” and kept his attention longer. Ross followed by sharing that he did not think anything was as engaging or more fun than games. Joe shared that he does not “zone in and out in games;” instead, “you always have to be up there because you know everyone else is constantly working too.” Carol shared that the pressure is a fun kind that “makes you want to do more” and is especially helpful “if you are already kind of checked out for the day,” as it brings your focus back into the classroom. Randy shared, "some people I know they’re just like not feeling it that day, but they still normally try to play.” Alex and Caroline believed, though they thought that games become unengaging if you give up, stating, “If I know I am going to lose, I don’t try as hard and don’t get as much out of it” and “like if you know you are going to lose you are going to stop paying.”

Overall, the games take the pressure off, allowing you to “just do one problem without expectations, and you can ask questions” because if “you do poorly on it, it doesn’t hurt you.” Joe stated that games “takes the pressure off and instead helps you learn and stay focused.” Carol expressed that pressure does begin to build if you “feel like you need to like to catch up to everyone else, but kind of better… when you’re going to have points no matter what.” End goals

came up in terms of both motivation and engagement across seven different participants. Alex voiced that it is most effective to have competition when there is a "reward or end goal so everyone knows they can achieve something." Ryan suggested that rewards encourages people to "keep going for all the points" instead of simply quitting.

**The Challenge of Problem-Solving.** For students to remain engaged in the content, they must find it hard enough "to be really ready" because no one wants to do "busy work where you don't have to pay attention." Students want to be presented with a "puzzle to understand," but that stays within their "mental capacity." Jack said, "When it is too hard, I am less engaged because I have to focus on what questions to ask, so I can't pay attention." Conversely, Dixie stated, "When it's just boring stuff that I finish too quickly, I always feel so done." Carol sees both sides saying:

> I kind of get it, but there's, like, a clarifying detail, like, there's something I'm not sure of, then I feel like, I'm a lot more, like, comfortable asking, but if I'm like, just completely lost. I have no idea what we're doing. I'm probably not going to ask the class I might like to go back later.

The perfect level made it "more enjoyable to participate," students will be "more willing to ask questions," and not be able to just "get by with my own smarts where I don't pay attention." Instead, a student with the perfect amount of challenge will need help with "clarifying details, like something I am not sure of" but not "really confused, because I won't speak up."

Students explained that material that is too challenging could become stressful because, in addition to wanting to understand the concept, there is "extra motivation because it's just like fun" when you can figure the material out. Jack explained, "It is really rewarding, and that personally just gets me more excited about the topic." Ross described the most engaging time,

> And so like, sometimes I get really excited, like if the teachers like going through a lesson, and then they like to say something, but like, I figured it out in my head before as they said it. I'm like, I find that like really rewarding, and that personally just gets me more excited about the topic. than I would have been like if I hadn't put that together. Yeah, obviously, you can't do that for every problem. Because then that would be the point of going to school if you figure it out before you learn everything.

Ability to work slightly ahead allows students to "get really excited," find "motivation to do better," and work like it is "crunch time during problem-solving" transition to active learning "is a good way to keep students engaged and sometimes even excited about what they are learning because they get to figure it out themselves."

***Real World.*** Students have mixed feelings about the application of mathematics to their everyday lives and to the use of real-world problems in their classes with general themes ranging from Ross stating, "rather than just like reading straight from the book, or like, doing boring problems like I think bringing in real-world applications" to Carol sharing "like doesn't really apply to my life like I don't really see like a need to be learning calculus besides for college and then after that, I will not use it never because but because like again like I can just like do that like on my phone or on a calculator." Overall though, as shared by Randy, students "focus when you actually care about the subject or, like, you care about the teacher, and you can do really well. If you are interested, it feels easier."

Using real-world problems can create automatic engagement through building on previously learned material, "inherently better at it and more interested …remember more of the old stuff," attaching to their "web of knowledge," or connecting to "something visual." Many teachers make connection to other classes, such as physics. According to students, connections

can bring up positive feelings, such as those shared by John, “I love when it relates to physics. It can connect to something I previously learned and makes it so much easier,” while the opposite can be true. Kevin verbalized

> that math is one of those things you have to take. It’s always going to have numbers. So, like you can’t, like don’t try and be another class. You know, be your own. Class, like a math teacher, shouldn’t be like, well, you know, this actually kind of has to do with like chemistry that blows. I’m not in here for chemistry. I hate chemistry.

Additionally, when these real-world connections can be made outside of the classroom, students still focus on variability as they “apply the math to real-world scenarios.” They do not want to see the same scenarios replicated and instead want “straightforwardness that sounds really cool.” Randy expressed,

> Yeah, but for what it’s been mainly, it’s like this happened is it realistic that this was due to random chance, right or not? It’s always a sport or people that skiing or people lean to the right way. I guess. It’s like, just stuff that I don’t find interesting.

Ultimately, overall connections were seen as positive if they could relate to previous math classes with students saying, “I can tie that back,” or “I want to be able to connect with what I previously learned,” but that focus should be maintained on making connections that are relevant to students.

**Emotional Engagement**

The second theme that emerged from the data regarding students’ engagement in their high school mathematics career was the role of emotions in their engagement inside the classroom. Emotional engagement centers around the foundational idea that students must be comfortable, confident, and experience passion to engage in learning. Students shared thoughts,

such as “It’s always been the hardest, and it’s never really been my favorite,” “My ability affects how much I enjoy the class,” and “I can’t do well because some things just don’t click.” These emotional impacts affected how students engage in the classes and their level of motivation to succeed. Additionally, they must receive emotional support in the form of a positive response from their teacher to continue engaging in the material; as shared by Kathy, “If I’m not comfortable with the material, I’m not going to speak up about it, and be wrong.” The general theme development is shown below in Table 5 and Appendices DD and EE.

**Table 5**

*Theme Development: Significant Statements in The Role of Emotions in Engagement*

| Subtheme | Significant Statements |
|---|---|
| Confidence | “Easy to kind of miss something really small, especially in the earlier stages of math” (John) |
| | “Dreaded like going every day because I didn’t know” (Randy) |
| Positive Responses | “Not receptive to like the question when they get like frustrated” (Grace) |
| | “When the teacher is open to helping, they seem welcoming” (Dallas) |
| Comfortable | “It has that more like relaxed feel. It’s much easier to talk and ask questions” (Joe) |
| | “Not super, like stressed out the whole time about it” (Grace) |
| Passionate | “Makes it way more fun, and like me way more willing to want to try because, like, I know my teacher wants to be there and I know my teacher wants me to do well.” (Carol) |
| | “More engaging to listen to a teacher who is interested in what they teach” (Katie) |

### *Confidence*

Students expressed that they are drastically impacted in the classroom by their level of confidence. Confidence in their current year of mathematics or one that has continued to grow as “there are certain things that just don’t click” until math turns into something “just kind of a thorn

in my side." These negative feelings can lead to struggles not only in the mathematics classroom but also "more of an effect on my overall school day life and attitude." Students shared that the building nature of mathematics makes it difficult to remain engaged once falling behind because "now you are thinking about it and you go on to the second class, without knowing the answer, and then by the time we get to that part I have forgotten the rest of the stuff." Building leaves "holes in your knowledge" from year to year that can end up causing a constant decrease in engagement. Dallas articulated,

> And I think a lot of times if you come in and you don't understand the topic and my class just is rolling, it's like, well, I just missed that. That's what it was to try and go back and figure it out. Or it's one of those to try and get it when I'm not going to get it on my own kind of thing, which just leads me to be less engaged.

As students feel constant stress, they cannot actively engage. Instead, they begin to check out, as topics "come up again and again and again." Dallas shared that she did not want to say stress makes her "shut off necessarily but kind of tune out" as she continued to be overwhelmed by the material. Kevin stated a similar sentiment about Honors Calculus: He "was really scared to take this class because [he] didn't feel confident," but as he began to understand and gain his confidence back, he felt more engaged. Dallas expressed that "before, I was not super great at math," and that has "held me back some," but that she felt confident when she was "taking everything" over with others. Ultimately, the consensus among students was, "if you're kind of confused," it can lead to asking questions or zoning out, and the confusion was all based upon the level of confidence. If a student is somewhat confused, they are likely to seek help, but unfortunately, the more confused they become, the lesser level of engagement, which creates a feeling of "just like move on" because "I'm never going to get it and I am going to fail anyway."

Students will struggle with inquiry, moving forward, and remaining engaged until they can shift their mindset.

**Positive Response.** How teachers answer questions directly impacts interactions with students and levels of understanding as students work to become engaged. How teachers respond to students' questions hugely impacts students' engagement in several ways. Angel shared that "classes where the teacher is kind of, I don't know, responsive and open to questions, you're also able to think, I don't know, because if I'm, like, reluctant to ask a question theme as it impacts, I can't participate." Response from the teacher can center around "clarifying the question," "slowing down to student needs and doing like one simple problem," or "spreading it out" to ensure students can get support. Randy stated that the questions must be answered "fairly enough where the class understands what's going on," or it will decrease the student's ability to focus and engage.

Attitude is also affected by the approachability of the teacher as they respond to questions, as they must ensure that students will "come to them for help." Avoiding things as obvious as the following scenarios shared by students: "laughing at me," "getting frustrated," "yelling at me," or even saying, "I feel bad about asking her questions because she responds in a way that makes me feel stupid." In these cases, a student actively attempted to engage, but how the response was given negatively impacted them emotionally, inhibiting their ability to move forward instead of "creating, like, an environment where questions are welcome."

Students felt the most shut down when they felt they were "a bad student" because there is no room for growth as they move through the material, stating that some teachers even "seem annoyed when you don't understand things and are condescending about it." Students suggested that these roadblocks can be removed by being "open as possible to questions and receptive to

them no matter how stupid they may seem," "monitoring facial expressions," and continuing to reiterate "that asking questions is a good thing." John suggested that the more significant issue centered around the following:

> So, a lot of times like if a teacher [has] taught something and a student, it didn't sink in for the student. They might go up to the teacher and ask them about later, and that will be like, well, I already taught you talking about you're not paying attention or like, you know, I don't want to say get upset, but judge your student off of that. Like that happens a lot, especially in upper-level classes as well. And I think that's like; I think that makes it makes it really hard for the students to learn them because they clearly didn't get the concept the first time for whatever reason, I don't think there isn't really matters. What does matter is that they're attempting to now they're putting to collaborate, figure it out, and solve it instead of putting into solving it instead of just letting it be something that they don't understand. So I think it's essential for a teacher to not judge their student base, rather than based on whether they're willing to figure things out and understand or learn new things slowly.

Many of John's peers echoed his thought that students should be commended for asking questions, especially the ones they feel are dumb, as it showed they are taking the initiative to understand instead of saying, "I don't know if he can redeem himself from this one." Ross articulated that inquiry is the most essential part of engagement because "they're confused, they have a right to be informed on the truth" instead of being judged. These are the students who are actively "trying to do [their] best" but are struggling, and if the "teacher treats you like you are dumb," then a student may disengage and no longer learn in the environment.

***Comfortable***

As discussed previously, students found inquiry hugely influential in their learning, and they shared that ability to ask question was strongly related to their comfort level. Angel postulated that "students just aren't bold enough to say" their questions out loud in many cases. The idea of importance of asking questions was shared by nine of her peers. Jack said he would only ask questions if he was "comfortable speaking aloud." Joe shared that "certain classes where I feel comfortable to speak up a lot because I feel more relaxed, in a good way." Dixie explained that relaxation can come in a variety of ways, such as "variety between challenging questions and easier questions," "teachers seeming very encouraging," and "not like strict notes all the time." Randy stated he was the most comfortable in class if "every time I ask a question, like she always seems very engaged, encouraged." The "laid back and not like strict" style also carries over to the content.

Grace voiced that she performed the best when she was "connected or comfortable with the content. Not super stressed out the whole time." John explained that he thought engagement happens best when

> there's like a middle section where you understand some of it but not all you have holes in your knowledge, and you're aware that there are holes, and you are close to understanding the concept with a few puzzle pieces missing in your understanding. So I feel like that's where you're most engaged as you can start there to understand a subject or a topic, but you're just not quite there. So that's like the middle of your understanding. Then the very other far end for you to understand nothing is in the classrooms moving on or like your teacher does another problem with the subject matter that you were very on and didn't understand.

Working just slightly outside of a student's comfort zone applies just the right amount of pressure while still allowing the student to feel capable and engage in their learning.

### *Passionate*

Teachers have the job of instructing students; the easiest way to draw students in is with their passion. Grace explained that her most engaging classes happened when teachers "actually care about their jobs," and it was "very clear when teachers are passionate about what they teach, and that affects students' passion and engagement." Ross gave the common sentiment that if a teacher cares, it "makes me care about a class a little bit more" and "enjoy being in class." Sam shared the same sentiment by saying,

> this passion rubs off on the students. Moreover, it makes the students more engaged in what the class has to offer and allows the students to be able to learn more as a result.

Passion "makes it much easier to do well and learn," according to Dixie. Joe explained the same thoughts as well

> If a teacher is passionate about a subject, it is contagious. It is also evident when a teacher does not want to teach the subject that you teach. Simply having a teacher that enjoys the subject matter they are teaching and also maintains a good attitude helps to keep a student engaged.

A teacher's attitude can "make or break whether or not I am going to pay attention/be engaged," shared Joe.

### Community

Students are impacted by the community in which they learn. As quoted previously, if they are "comfortable or uncomfortable affects what I can do," but a significant component of comfort is built by who is around them. Students discussed relationships with their teachers,

relationships with their peers, and if they felt supported by their community. Joe said “a teacher’s attitude and the relationships with a teacher can make or break a class” because “having good relationships with the students makes them more engaged in class and makes the class more enjoyable for everyone.” As stated previously by students, they need to discuss, participate, and inquire about being engaged truly, and is affected by “your peers around you” as students do not “want to be judged.” Ultimately, a feeling of support from students and teachers is necessary for students to succeed. Tammy shared, “Teacher attitude and student relationships make me comfortable asking questions.” Similarly, Dallas was quoted as saying, “Teacher’s attitudes and relationships with students impact how comfortable I am in the classroom. If they are able to joke around, I will be more engaged.” Sense of community in a “casual setting where I can ask questions, and the teacher can respond to me in a way where, like, I am comfortable with a teacher” is necessary for others to be engaged. Table 6 shows the number of times a given subtheme was referenced, while Appendix FF shows several example quotes.

**Table 6**

*Theme Development: Classroom Structure Categories*

| Subject Matter | Interview Frequency | Focus Group Frequency | Journal Entry Frequency | Totals |
|---|---|---|---|---|
| Peers | 24 | 11 | 5 | 40 |
| Teaching Relationship | 24 | 19 | 11 | 54 |
| Support | 34 | 10 | 5 | 49 |

**Peers.** Students are firmly affected by their peers regarding what they are willing to share, how motivated they become, and how hard they are willing to work in a class. John wanted to be in an environment that is

> understanding and a classroom environment where I can feel like I can speak up without it being like every little thing that I say is going to be wiped, scrutinized or he you know, judged or thought over a lot, I guess.

Students were impacted by how their peers interacted with them and how they felt. Alex shared, "I think if I'm closer with a teacher, but I don't really know anybody, I'd still be quieter." They wanted to "sound knowledgeable to peers" and not have students "glare" at them or "judge them when asking a question. Kevin postulated that embarrassment is more acute if "others don't have the same problem as me." Jack, similarly, was concerned initially because he wanted to ensure he had "the same kinds of questions" so people do not "think I am stupid." Conversation and discussion only happen when students feel "comfortable with the people around them," but students suggested that there are ways to "help build the relationships between the students in the class if someone isn't comfortable with their peers" as, until connections occurs, they will be "unlikely to participate in class." Students reported that teachers can assist in building the community by "more group activities, because you kind of become friends." Students felt communication helps because by using smaller, varied groups, students are able to "get closer to different people," hinder "getting sidetracked with smaller people," and it "can bring the class together."

Students feed off each other because if "everyone's participating, you don't feel like everyone's bored, and that kind of goes with, like, engaging with people." Having a "similar experience" allows for connections to form, as students no longer feel like "they have to catch up

to everyone" and instead can actively participate without worry of judgment. Instead, the focus can begin to shift to thoughts such as, "I know I can help others," "well, if I need help, I know they can help me," and you can "learn better because everyone is trying." Focus on effort and high expectations for the community assists students, as they feel they are having "a positive impact on fellow students to put forth an effort as well." Sam explained that often as classes become connected, you "learn better because everyone is putting in equal or more effort." Conversely, if students "don't care or isn't motivated, I'm not going to be motivated."

***Teacher Relationship***

Just as students are affected by relationships with their peers, the same is true for the teacher. Relationships can come in terms of motivation, as shown by Alex, "If I do love the teacher, then it's like, I want to make them proud. I want to work for them" or simply a feeling of joy when they realize that class is next. As Kevin expressed, "I have a reason to be excited because I'm like, man, Mr. Hustle is gonna teach me today, you know, like, that's gonna be so fun." Students expressed that they try harder in class when they have a relationship with a teacher. Carol shared

> that if you like to respect them as a person and like because they like to treat you as a person do then like you're not gonna lie, like disappoint them almost like you're gonna want to try in their class like you don't want to just be like making their life harder and be like slick pulling a dead weight, you know?

Grace echoed, saying: "When a teacher and I have a good relationship, I will do everything in my power to make them proud of my accomplishments in their class." When a teacher shows a "genuine interest in student's success, not only on the subject level but a real life, it creates an eagerness to learn and succeed in the class." Positive attitude from the teacher leads to a statement

from Alexander, “I like the teacher more and tend to try harder.” Angel also gave a similar sentiment, “Push for an A or to do well in the class and make the teacher feel proud,” and for the student to find “confidence or ask questions or help when needed.”

Teachers that stood out to students as engaging tended to have common characteristics. Many referenced that if a teacher is “not receptive to, like they question and they get frustrated, you know, I am going to quit trying.” They also found that a “casual setting where I can kind of ask questions and the teacher responds to me in a way where I am comfortable” encourages further questions instead of simply disengaging. Ultimately, a single statement to a student, such as “That’s a dumb question,” will likely lead to disengagement, not only on that day but continued issues as time progresses. Students feel the same way when a teacher “calls them out” or says a question can be further explained “outside of the classroom,” as it makes it seem that their thoughts are not valued, or they are “stupid for not understanding” already.

Students, such as Katie, did, however, recognize that creation of a relationship is a two-way process, stating things such as “obviously respect goes both ways,” “I don’t do well getting yelled at like, I don’t know, like I feel like I want someone to like to talk to me like I’m a grown-up,” and “have respect for me as I have for them.” A sense of understanding between a teacher and student allowed a relationship to flourish, offering students success. Graces shared

> that understanding a student’s needs is something that many teachers need to grasp. If a student is falling behind, it is the student’s responsibility to speak up to the teacher to receive this aid. In a student-centered classroom, a student can receive this help much easier compared to a classroom in which a teacher teaches at their own pace and not the student’s pace.

As students were more comfortable in a classroom, they explained that they were more "encouraged to ask questions" and get help. Also, it allowed teachers to understand what was being asked of them by students, ensuring that students were "motivated to do well" and to "put forth the effort to be engaged."

Understanding also encompasses the idea of the teacher connection and support being affected by the humanization of the teacher. The connection can be formed by having "actual conversations," not having teachers "sit there and read off the book," and who you "can joke with." If a teacher is personable, students are "more likely to be engaged," as personality is more of a teacher thing. Tammy said even conversations that are "off-topic, but somehow it, like, relates" can help because it gives a nice pause and helps you remember that "your teachers are real." The reality of teachers makes a difference in students' feelings when they come in and make them more approachable, and Sam shared that conversely, if a teacher has a negative attitude

> makes it seem like they hate being there; it gives the students all the more reason not to want to be there as well. Thus, if the teacher cracks jokes, makes small talk, and seems generally happy to be there, it positively affects the students within the classroom.

Carol shared similar thoughts, saying,

> I feel like when teachers like to do that, when they talk to you and have conversations with you, like apart from schoolwork, like it makes you like feel like they care about you as a person. It makes you like almost care about them more, and like I feel like that like definitely influences wanting to learn.

Alexander believed that teachers should never underestimate the value of "casual conversations with the teacher, which makes me also more likely to engage with them as I will not feel bored when I strictly learn content."

**Support.** For success and engagement to truly occur, students agreed that all sides needed an underlying level of support. Many students referenced that support needs to be offered inside the classroom and by attempting to understand students' everyday lives. Grace explained that sharing that teachers need to understand their students but "not just surface level, just being engaged with the student, what goes on outside of the classroom." Joe explained by sharing,

> I check out if I don't feel supported then because it's like, well, this is an overall school activity. I'm not just trying to succeed in AP environmental science. I'm trying to succeed in school in general right now. And, so it really helps when a teacher understands when I say, well, I had a performance last night, and I got home at 10:30, and thus I was not able to complete homework; that helps me when a teacher is like, okay, you know, I'm gonna give you an extra day because I know that you typically don't do that or you know that you're pretty consistent with your homework.

Support for students' mental health and emotional well-being let them know that a teacher was behind them in "understanding my extracurriculars" and puts "less pressure allowing me to do better on tests and quizzes" as they can perform their best. Support allowed students to realize that they "have a teacher behind me when I mess up" and that support ocurred so they can safely "ask questions, get help, or express confusion."

A prominent support component was for teachers to "just be available," even if a student chose not to come and get help. A teacher simply "taking the time" allows students to feel

comfortable and supported because they know their teacher wants them to do their best. Grace explained that support comes in the form of willingness to explain concepts,

> get into a problem with you in class. Like when I'm talking to you. It's just like, I don't understand what to do here. You're just like, you go through it, and you do it, and sometimes you're like, and you have to do it like with me. So it's just not like super easy. So I feel like I'm supported whenever the teacher just like has to go through the same process with me it makes me not feel stupid.

Understanding allowed for assistance at the time without the student feeling like they are a nuisance, ensuring they can continue engaging through the remainder of the lesson. A final aspect of support discussed by students was the continued support while failing and understanding that "it is ok to fail and that you will be there to help." Carol shared about a time when she began showing improvement and sought advice from her teacher on what she should continue doing. In the case of improvement, the teacher-responded, "You've been doing better, so just keep doing what you are doing." Carol felt there was no room for improvement and that he was not supporting her to continue improving. Students suggested that they will work harder if there is a chance that they are almost at the level of breaking through and a simple "even if you don't have it now, you've almost got it" could make a huge difference in their attitude.

**Outlier Data and Findings**

Several unexpected trends were discovered during data analysis that did not align with the research questions that guide the study or the themes that emerged from data analysis. While participants sought to be engaged in the lesson overall, the trend that students in standard-level classes described more clearly than those at higher levels. Consistency was found, however, across thoughts on computer science by all students, no matter their level. These findings were

inconsistent with current research, as all 15 students indicated that computer usage decreased engagement.

### *Differences Across Levels*

During the interview process, students were asked to respond to the prompt: Give me three words to describe your favorite class (Question 10), and word by word, explain why you chose those three words (Question 11). These questions were included to gauge what students deemed important in the classroom, as well as to hear descriptions of why they chose the given topics. Sam explained it is very situational "on the people within the classroom and the individual student's motivation." As shown in Appendix GG, students in standard-level classes focused heavily on engagement (4), comfort (3), and level of difficulty (3). As students moved to higher-level classes, the focus shifted to the level of difficulty (4) and interest in the topic (4) with no focus on comfort or teacher support.

The students' descriptions also followed the same pattern with a heavy focus on the relationships instead of the content, expressing statements such as, "way to increase student's engagement is by having engaging, exciting, and friendly teachers," "I always think that with any class math or not the teacher attitude and relationship is what makes me actually care about learning," and "it's definitely, the people. It's not the set-up." Students in the lower level classes further discussed the need for teacher support likely due to lack of confidence, as answers centered around "constant encouragement," being "very, very laid back," and their willingness to engage was based heavily on "how comfortable I am in the class."

Students in higher-level math courses focused more extensively on challenging problems, the inquisitive nature of problem-solving, and the desire to learn independently. As opposed to their counterparts, they looked at group work more unfavorably, sharing thoughts such as, "I need

to practice independent work before the independent test," I work faster, and usually better," "working on my own helps me understand," and "in my personal opinion independent work allows for more growth because it comes from the student themselves." Questions are not based on a need for comfort but instead heavier focus on in-depth understanding. Kevin explained, "I am literally willing to do anything" when it comes to understanding the content. Students focus shifted from what their peers thought to a true desire to understand the content, but overall the consensus was that questions only got asked if "I actually have no clue what's going on." Students instead shared statements, such as "I love the idea of rolling the boulder up the mountain" during a problem, "really delve into the like the topic at hand and almost solve it like it's a puzzle," and even "being scared helps me do better because I just need to work harder." Students were more comfortable with the idea of productive struggles as they worked through the material, leading to a shift in their needs. Ross shared, "concepts never stick the first time. I know you're supposed to fail. That is why you do homework and practice." Understanding showed a substantial shift from counterparts who focused on the idea of "just show me how to do it" instead of wanting to work through challenging concepts. Kevin shared he believed that the difference centers around the idea that "it's expected for [me] to do better; I feel like I'm willing to go that extra mile to try and do better."

Lastly, there was a substantial difference between students' opinions regarding real-world experiences and applications. Katie, for instance, shared

> it doesn't apply to my life. Like I never got, and like I just don't like, I have my phone, but like when the students talking about something like that can happen in the real world like she sees me, and I see something that relates like outside of class.

Carol echoed, sharing the disconnect between real-world application and mathematics

> like doesn't really apply to my life like I don't really see like a need to be learning calculus besides for college, and then after that, I will not use it never because but because like again like I can just like do that like on my phone or on a calculator.

Instead, students in higher level classes actively sought to not only find connections but took classes with that goal in mind. Grace, for instance, shared, "I really lik research; I found out after science seminar that I like figuring things out." Ross similarly referenced science seminar and was "interested to see how it could connect to my research. Overall, they felt like what is "taught in class is something you're going to be able to like, actually do out and do on your own and use." They even worked to find connections to non-STEM classes, with Joe sharing, "you know, maybe my gen ed classes will just kind of help me in the math brain for my actual music classes."

**Computer Usage.** In the case of computer usage, a component of classrooms shown in the literature to increase engagement, data showed that students' opinions were contrary. Overall, all students ranked computer usage as the least effective way to garner engagement. Alexander, Grace, and Angel felt that technology "isn't valued in my learning experience," "isn't an effective way for me to learn," and "feels like a chore." When asked during interviews and focus groups to discuss components of courses that had been engaging, there were no comments about computer or technology usage. On their own accord, no student-felt that computer usage was worth mentioning. During journal entries, however, students were given the four most common ideas found in literature leading to opinions on computer usage. Every student (14 participants, as one did not submit the journal) ranked computer usage as least engaging in their mathematics class, shown in Table 7, and individualized details are in Appendix HH.

**Table 7**

*Overall Ranking by Student from Journal Entries*

| Student Participant | First Choice | Second Choice | Third Choice | Fourth Choice |
|---|---|---|---|---|
| Group work vs. Independent Work | 2 | 8 | 4 | 0 |
| Teacher Attitude and Relationship | 10 | 4 | 0 | 0 |
| Computer and Technology Usage | 0 | 0 | 0 | 14 |
| Active Learning (Student vs. Teacher-Centered) | 2 | 2 | 10 | 0 |

During journal entries, all students shared predominately negative thoughts about computers. Most entries' centered around the inability to focus or lack of additional time to enter information. Angel shared, "Computer and technology use is definitely not a bad method, but I think it is the least engaging because of the distractions that come with it." Thoughts were echoed by peers, with some referencing that while working, "there are many other things going on, on my device at once," "texts or emails may pop up making me lose focus," causing "procrastination and distraction." Kevin even went as far as saying, "If I have a computer in front of me. I will not do any work. End of discussion." Sam expressed that no matter how hard you are working, a computer is "more of a hindrance … because there is so much temptation to do something else."

The secondary concern is dealing with the entry of answers, as students shared, "just typing in the correct answer if it is a complicated fraction that you have to plug in. It makes me enjoy math less than the other options." Several students shared thought by saying, "Doing math is easier for me on paper," and "It's also frustrating when I get the right answer but plug it into the computer wrong, so I don't get any credit for my work." Dixie even blatantly said, "I would rather do any traditional pencil and paper homework over the technology one."

Only two positive statements were shared in the fourteen journals in regard to computer usage. Both students discussed positives when dealing with practice. Angel shared, “The only thing that I would recommend using with technology would be a website-based program that we would have practice problems on.” Sam’s view was quite similar sharing, “not effective in my opinion. Sure, the usage of technology for homework with IXL really helps me understand the material, but IXL is not generally completed within the classroom, and it is also dependent on the student’s motivation to learn.” Overall, both students were suggesting that technology provides an additional resource that can be valuable for practice, but that it should not be used in the classroom, and students should work on material outside of the classroom. Joe echoed, though, saying, “It doesn’t matter what or how much tech is used in the class. It simply is not valued in my learning.”

## Research Question Responses

The purpose of this transcendental phenomenological study was to describe the engagement in mathematics of high school seniors during their high school careers. The study’s research questions focused on what components of mathematics classrooms are engaging and if students deemed engagement important to their learning. Additionally, participants discussed commonalities and differences between engaging tasks in different subjects. Participants gave a detailed account through individual interviews, semi-structured focus groups, and a journal entry. Responses to those questions are detailed below.

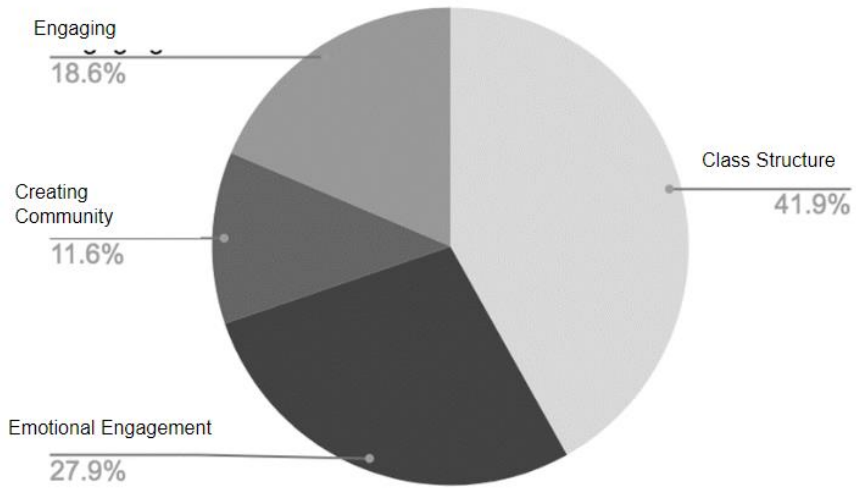
### Central Research Question

How meaningful is engagement to seniors in mathematics classrooms? The student participants shared their opinions about their current and previous classes regarding the positive and negative components of their learning environments. There was variability in details across

mathematics levels, and the same three general themes emerged. These themes consisted of (a) classroom structure, (b) emotional support, and (c) a sense of community. During their interview, students were asked to select three terms that came to mind for their favorite math (or any other) classes throughout their high school career (Interview Question 10). These words all fell into themes found in the interview, focus group, and journal entry data centered around the community (11.6%), classroom structure (41.9%), and emotional engagement (27.9%). Figure 2 below shows the percentage breakdown for how many words matched each category and how many students chose *engagement* as their word. Additionally, engagement itself was stated by a large number of participants (18.6%). Specific word choice by each participant is shown in Appendix II. Overall, even if students did not select *engagement* as one of the components of their favorite class, engagement is impacted by something they did choose, showing the importance to their learning.

**Figure 2**

*Three Words by Theme*



**Sub-Question One**

What are the experiences that senior mathematics students describe as engaging? The goal of the question aimed to learn opinions on what methods students find helpful. Analyzing students' data led to the development of three themes, each playing a role in students' engagement in the classroom. Students described the classroom structure (dissemination method and variety of strategies), emotional support, and community building.

The most discussed components of engagement centered around the structure of the mathematics classroom. Ross suggested that for a classroom to be truly successful, it must first be "interactive so he is comfortable asking questions." Sam suggested that a component of comfort is the size of the classroom, indicating that it is "easier to teach each student individually to each person's needs." To be truly interactive and comfortable, students proposed "switching things up." The first step in comfort and variety is engaging students as they walk in the door. The manner in which class starts varies from allowing students to "rest for a second" or doing review problems, but either way, there needs to be some transition to get students in the right mindset as the lesson begins.

Carol shared that while notes are necessary at the beginning, it is "hard to focus sometimes because she would stand up at the board and just like write stuff." Students shared that while seeing how to do a problem is helpful; however, the teacher should not just "do the problem yourself on the board" but instead "ask everyone to do it with you" while asking questions and sharing thoughts. Students also suggested varying classes to keep them engaged by using "notes one day and the like, play a game or do practice" because students determined they are the "least engaged … when we're just taking the notes for the fifth time on slightly different problems." Practice by working in groups and mixing independent work was the most favorable to students.

Group work allows students to be more engaged because “you can learn how other students may see the same problem,” stronger students can “solidify understanding in the topic by explaining it to others,” and allows time to fully engage as you “talk through problems or answers with other people.” Even though group work is engaging, students still want time to work independently so they “know what to work on” and can continue to study independently. As students review in groups or on their own, they share they are the most engaged when “there is a reward are the end or a goal the students are solving problems to achieve.” Ultimately, these goals and shifts of class structure allow students to try various methods, but it is necessary to also have an environment that allows for students to be engaged.

When structuring a classroom to be engaging, students suggested methods of building confidence, encouraging inquiry, constant support, and using students’ competitive nature to draw them into the lesson. Sam expressed that the most important component of an engaging class is that “a student has the confidence or ability to ask questions for help when needed.” Kevin verbalized that the ability to ask questions was “pretty engaging” and allowed students to connect with the lesson. During times of questions and confusion, students need teachers to continue showing support so students know that their teacher “wants them to do good.” Joe expressed that students need to “feel comfortable, asking questions in class and have the opportunity to fail in class without judgement.”

No matter the set-up, if students do not feel emotionally supported, they cannot be successful, as they will struggle to engage and ask questions. Kevin shared, “when a teacher supports me, I feel motivated to like, do better.” Teachers should be “encouraging students to ask questions” as all participants indicated that they are the most engaged when they are inquisitive. According to Jack, if students do not feel safe and supported asking these questions, they may

find it confusing that they grow to dread. A need to feel success, or the opportunity to achieve success, was echoed by Katie, who expressed that if a teacher simply “moves on” when a student is still confused they automatically have the thought, “Oh well. I’m just never going to get it, and I will keep failing,” and that motivation to keep trying can be lost. Additionally, Grace shared that it is “much more engaging to listen to a teacher who is interested in what they teach. If the teacher is not interested then the students will not be either.” Ultimately, according to Ross, “If a teacher is excited about their topic and expresses that through their attitude, then I am more inclined to pay attention.” Students’ ability to focus is also affected by the community in which they are a part.

Carol explained that community and participation “depend on relationships with the teacher and people in the class.” Angel shared that one of the largest impacts on her feelings about a class revolves around the teacher: "For me, the teachers make me either love the class or just plainly hate the class. I have had years where I love math because of my teacher, and I have had years where I hated math because of my teacher.”

Grace expressed that, at times, she is “more peer-driven, but I think if you don’t feel comfortable with the teacher, you’re not going to ask questions, and you will second guess yourself.” Carol shared similar thoughts, saying, “I think the people in the class can definitely have an impact” on what a student is willing to share or how well that student participates. Ultimately, as teachers and peers develop a community in class, students will be more willing to engage and work harder as they “become more invested.” The teacher should work to have a relaxed environment where people are “willing to talk” because their engagement will increase as they participate. A sense of community is ultimately developed by having a “supportive and understanding teacher” that can lead by example and bring interest to the topic.

**Sub-Question Two**

Why are specific methods beneficial in some disciplines and less effective in others? While a variety of methods (active learning, student-centered, group work, and technology usage) have been found to be effective in education, they are generally tested in humanities-based classrooms or schools in general. The question aimed to understand better if students felt all methods worked equally across different disciplines. It is worth noting, however, that students at Mun High School use the Harkness method for their humanities courses. Soutter and Clark (2021) explain that Harkness is a student-centered and discussion-based method, allowing the administrator to be an evaluator while students lead the classroom. As students compare their humanities to mathematics, the learning style of Harkness should be kept in mind, as their comparison will be off of style.

Mathematics is simply a different style class than others as "like you're solving a problem rather than discussing the past a little different(ly)." The need for the different subjects also varies as, "English is very opinion based and history is more memorized. I'm more comfortable with having a teacher specifically guide (me) in the right way." Instruction leads to the main difference as problems have one correct solution, even if there are multiple approaches, as opposed to English and History, which are often based on opinions, having multiple answers. Carol shared, "there could be multiple ways to get the answer, but like there is an answer," which automatically leads to more pressure.

The need to arrive at one answer and understand the reasoning makes math "much more cutthroat than other classes," according to Jack. He goes on to explain,

> When I go into like another class, such as psychology, for example, there's no real pressure, and they feel the need to succeed. Yeah, I do better in my class. In the math,

> because when you go into math, it's like, if I don't grasp this problem, then that really screws up the rest of this unit because that's a building block for the rest of the unit.

Alex explained that math needs more explanation because "if something doesn't click, it's hard because you still have to work it out," so each problem builds upon "things you have been learning for a very long time." John echoed, saying, "Holes in your knowledge from a year ago, two years ago, a week ago, they're going to come up in whatever you are learning. So, I think the fact that it's a class is similar to Spanish where everything is built upon its base like layers." Constant building makes it more engaging on purpose, but it also means if "you kind of space out, you know, a few minutes you miss even like a word your teacher says about a problem, then you miss a step. You're now really falling behind." Problems in class keeps a constant stress on math but also increases the need for time to practice in class and to have strong explanations from teachers as opposed to other classes. These notes and lectures are more necessary in math because "there are certain nuanced aspects of math you still just need to ask about," and teachers must find ways to explain it and hold students accountable for engaging.

Ross shared that the most important thing for math is "really just going over the homework and practice … English and History might say something different." Dixie articulated that time "working out problems and using small groups" helps a student figure out how to do problems and gain understanding by "solving a problem rather than discussing the past like History or a reading like English where it is more sharing opinions." Alex suggested that games are more useful in math because it is a way to complete practice problems with less pressure, as opposed to using technology, which is "engaging in classes like English and History for writing and research where the answers are more rhetorical."

Overall, students struggle to understand the connection to everyday life. Lack of connection for many students creates a struggle to find enjoyment. Kevin shared a comparison to his marine biology class, where he was able to connect with the content leading too more joy,

> it's kind of hard to, like, learn math, like outside. Like, like for English, like, you lose inventory. I was like, Yeah, this math equation makes me really happy. Oh, man, me too. Let's go outside. The like, like for science. So, think about, like, this fish reading underwater. This slice of it just like makes you like, I can't wait to learn something else about this fish. Like, I can't wait to, like, talk about how I felt about this. There's just like, you could just do your math and be like, Wow, this equation, I'm gonna I can't wait to learn more about it.

Many students felt English and History discussions allowed for connections to be made as it "relates to outside of class." Students felt that creating a connection was harder for math, and many connections felt forced, unlike other courses.

The struggle with connections crosses the barrier of just content, as humanities courses favor discussion-based learning and sharing of opinions. That means that the teachers in these courses are able to connect with students easier by sharing personal experiences and reading in many cases, about the student's thoughts. Ross shared,

> Books have like deeper meaning and, like, philosophical questions and stuff like that, like that's the only thing you talk about, and all you do is talk about it. Like it's really easy to, like, make a connection with your teacher, because you're all just sitting there and talking about life and like, you know, and math that's harder by just like being like a nice person and being engaging and like really loved your subject. Isn't the easiest way for like a math teacher to like, be engaging.

Carol suggested in math that the best way to engage with the teacher is instead "just walk in and like ask your question or like talk to you" to develop a relationship in an attempt to keep students engaged.

## Summary

Chapter Four provided an overview of each participant, describing the analysis results of their responses. A transcendental phenomenological study was used, and data were collected through student interviews, semi-structured focus groups, and a response to a single journal prompt. All 15 students completed the individual interviews and the focus group, but one student did not submit the journal entry due to lack of time. After analyzing the data, meaningful themes were found in both interviews and focus groups. Journal entries were used to corroborate the data, as students were given more time to think independently (due within 72 hours of their focus group). Three major themes emerged (a) classroom structure, (b) emotional engagement, and (c) community. These three themes were further subdivided into subthemes and described in terms of student quotes and conversations.

The data collected answered the central research question and two sub research questions. Students shared their experiences learning mathematics throughout high school, specifically discussing different activities and interactions that had been engaging during their high school years. Learners spoke about the benefits of notes, group and individual work, review games, and using a variety of methods in class to disseminate information. The participants also heavily focused on the need for students to be confident and comfortable with increasing inquiry, as they felt that students could not engage if they were not asking questions. A considerable focus was placed on building community in terms of a relationship with teachers and comfort with peers. Students shared that their relationships with their teachers and the manner in which the teacher

responded to questions was one of the most important aspects of remaining engaged in class. Ultimately, students felt the most engaged in small, inquisitive classes where they were able to ask questions and have the opportunity to succeed.

# CHAPTER FIVE: CONCLUSION

## Overview

The purpose of this transcendental phenomenological study was to describe students' lived experiences throughout high school mathematics in terms of engagement. The data came from student interviews, semi-structured focus groups, and a journal entry. Chapter Five will discuss the results and the relationships between the findings and the relevant literature presented in Chapter Two, as well as provide additional information to inform educators about the benefits of engagement and methods that students find engaging. The study's contribution to the literature on engagement and methods in math that students find beneficial has been included. The chapter concludes with a discussion of the study's theoretical and empirical implications, limitations and delimitations, and recommendations for further research.

## Discussion

Examination of the experiences of 15 high school students in a variety of mathematics levels ranging from Mathematics of Finance (the lowest class offered for seniors) to AP Calculus BC (college-level mathematics). Data were obtained using interviews, semi-structured focus groups, and journal entries. The research was guided by Kahn's (1990) engagement theory stating students can only truly learn content by being engaged in the presented material. The data was reviewed, grouped, and coded to create a description of the participant's experiences and thoughts within each case. Three common themes emerged that described students' thoughts when learning mathematics through engagement: (a) classroom structure, (b) emotions, and (c) creation of community.

## Interpretation of Findings

While analyzing the data, a number of themes emerged, but the themes overall related to the same general concepts. Students feel most engaged in classes where they are able to practice inquiry. The ability to theorize and discuss their thoughts keeps them engaged in the learning content and solidifies their understanding to build their confidence. Without confidence and a support system, students do not seek help, and instead, their confusion can cause them to spiral into further levels of doubt and failure. Inquiry is encouraged by teaching in a variety of methods instead of students simply expecting the same information disseminated in the same manner every day. Lastly, students benefit from a learning community where their teachers and peers feel supported.

### *Summary of Thematic Findings*

The transcendental phenomenological study was driven by a single research question and two sub-questions. The results suggested that there are several things teachers should consider to make their mathematics classrooms more engaging. Through a review of literature, analysis, and data collection, three themes were developed regarding what senior mathematics students have found engaging during their high school career and stumbling blocks that can negatively impact engagement. Additionally, suggestions were provided for differences between mathematics and other courses and manners in which these differences can be addressed and overcome.

Students feel that there must be a variety of methods to share information used in the classroom to provide information while remaining as active and open to questions as possible. There can be no overall gain from a class if students do not feel emotionally supported, as they will begin to give up and lose interest in what has been taught. Lastly, students felt more comfortable asking questions and participating in an area where they feel safe with their peers and

teachers, creating a community of support and understanding. The results included theoretical, empirical, and practical implications for classroom teachers, administrators, and students.

**Importance.**The central research question asked if engagement was essential to high school mathematics students. Overall, the answer was a resounding *yes* from all fifteen students who participated. They explained that while there are days that they actively check out during class, there are many instances where they instead try to pay attention but simply cannot remain focused. Several students expressed that they could overcome and focus no matter their surroundings, but were not deemed as important for the majority. Instead, most students explained that it is hard to focus on the content of the class remains unengaging, and they will miss steps. In many cases, these missed steps or problems created a vicious cycle because if students fell behind and missed steps, they either needed to ask a question to catch back up to their peers in the classroom or simply wait and hope that they figured it out later.

Many expressed that waiting caused them to lose further interest in the problems taught for the remainder of the lesson because they knew they would be confused nonetheless, which could lead to whole classes where they gained no usable information. Conversely, if they asked questions, some teachers would respond negatively, sometimes even defensively, which meant that not only did they not get the answer to their question, but it also created a chasm in the relationship with that teacher, decreasing their comfort in asking clarifying questions in the future. Questions also led to further confusion and lack of interest for students unless their teacher responds positively and answers their questions to ensure that they understand the content.

In mathematics, as the topics build on each other from year to year, students explained that missed content in one year often affects the next. Spiraling could negatively impact student's ability to engage in learning in the following unit or even in future levels. An AP Calculus

student, for instance, explained that when his class began working on volumes of solids of revolution, he recalled no formulas from Geometry and, upon speaking with his mom, realized that he "was sick and missed almost a month of that grade." At the time, due to illness, he was medically exempt from learning that information. Still, three years later, it came back, and he was missing a foundational component that everyone else in the class had. Lack of foundational understanding caused him to be unable to focus on the material at the current level of his peers and instead have to revert to Geometry content on his own because he was too scared to ask in class based on previous interactions with his teacher. She was known to make statements such as, "If you don't know that, you shouldn't be in this class," leading students to feel uncomfortable asking clarifying questions and instead continuously losing points on foundational material. His story provides a perfect example of the lasting effect of engagement, as missed content caused stumbling blocks later, which caused even more incredible frustration and lack of engagement, as the student basically felt he could not be successful in the given unit and would simply wait until the next one. Students expressed that, for all classes, being able to pay attention and having a teacher that shows interest and a desire for their students to perform well will lead to tremendous success as they work harder, pay more attention, and ask questions in class.

**Student Needs.** Sub-question one focused on what students needed to occur in the classroom to be actively engaged. The information was then organized and evaluated to determine what could be done in a classroom to be most engaging. Overall, small and varied classes are most engaging for students. They saw many benefits to notes, and surprisingly all discussed notes being necessary at some point during their interview, even though it is the component of units that they complain about the most. However, it is essential to note that lessons should be as interactive as possible, with the teacher constantly communicating with the students about how to solve

problems and common pitfalls of students, positively answering questions. As students became confident with the material, they benefited from shifting into group work, both so they can explain to peers and fill their gaps in understanding. Group work was only seen as beneficial after a necessary foundation was laid, as students shared that if it occurred too early, they often became overwhelmed and learned material wrong, causing more significant confusion, and leading to higher anxiety levels.

Review games and activities, both as groups and individuals, allow students to be engaged in class and work through problems in a low-stress environment, as they become more focused on the competition than the problems that have been put before them. At the point of understanding, the preference is to shift to individual work before examinations so students can focus on what they do not know and ensure they have truly mastered the content. Overall, students shared that they are the most engaged during review time, as there is a goal, or when they actively participate in productive group work.

Overall, emotional well-being continued to be discussed in terms of engagement, with students sharing that, as things became too difficult, they would simply stop attempting the content, with Katie even sharing that she “will close her notebook” and give up for the day. Students expressed that they need to be comfortable around their peers and teachers to learn truly. Comfort is necessary to ask questions that come to mind, no matter how inconsequential they may feel. Many students shared that group work assists greatly, as they often develop relationships with their peers and will begin to realize that similar questions are present in the class. They also can find someone who understands the content well and can discuss and explain material when stumbling blocks occur.

The other significant engagement component centered around the teacher, with several students saying it was the most important. The importance of the educator was obvious during the journal entry analysis, as ten of the fourteen submitted journals indicated that teacher relationships and attitude was the most critical aspect of their engagement. Teachers who supported them and were passionate about the content and students' success received much discussion. Students expressed that not only do they try harder in these classes, but it makes asking for help possible. The ability to inquire and ask for help allowed gaps in current content to be filled and for missing previous knowledge to be obtained as students work through the material. Students also expressed that the most important part of taking notes is asking questions and participating in discussions, which is only possible if they are comfortable with the teacher.

**Across Disciplines.** Sub-question two centered around the idea that what could be engaging in some disciplines (such as humanities or foreign language) might not be true for mathematics. Students quickly eexprssed that many of the same rules applied. They still focused heavily on connection with the teacher, for example, but did express that how a humanities teacher would be able to connect with students is different than what is possible in many mathematics classrooms. The students explained that in math, where the goal was solving problems, students could not share their thoughts and opinions but only their processes. The main interaction with the teacher centered around how they support the student's work and respond to the student's sharing thoughts. A math teacher's attitude was viewed as more important because it sets the tone for the entire learning experience.

Additionally, added stress occurs in mathematics because of the nature of problem-solving and the anxiety that often comes with it. For instance, if a student submits a paper in English but completes the assignment poorly, that student might get a low score. Still, the student will not

receive a zero, whereas, in math, a student could spend a great deal of time practicing problems and even answering them on a test, receiving no credit because of flawed logic. These situations were when a teacher becomes important in continuing to build up confidence in their students so they do not simply feel they cannot accomplish the task.

Lastly, how the class is set up is quite different. At Mun High School, students employ the Harkness method in their humanities classes, focusing on student-led discussions instead of teacher-led lectures. Many students viewed mathematics as more similar to a foreign language course where a good portion of time should be spent practicing while Humanities the majority of time should be spent discussing. Practice allows for greater strength in understanding and confidence building as students move through problems. Students shared that it is imperative that practice time occurs in class and that even when homework is done, it should be discussed. They viewed quite differently from other classes because discussing a paper after it has been turned in would likely not positively affect engagement, but discussing the difficult problems from homework or a review problem would likely elicit a more positive response in math.

## Implications for Policy and Practice

The results have implications for teachers, administrators, and students. Literature has shown that students only continue in classes that they find enjoyable, and a large portion deals with how engaged students are with the content (Mebert et al., 2020). Engagement has often been increased with problem-based learning, scaffolding from one year to the next, or using technology to accompany lessons (Anya, 2021).

### *Implications for Policy*

As education continues to shift to standardized testing, online classes, and computer-assisted practice problems, it is important to consider if the content is provided in a manner that

can engage students and continue their curiosity. Many students viewed math as “a box to check off” on their path to what they truly wanted, and this issue that must be addressed if the goal is to draw more interest in content and student success. Currently, many public and private schools focus on test scores for a portion of their funding, and educators are encouraged to spend time ensuring that students understand concepts that will be on standardized tests. Huang et al. (2022) shared that the importance of discussion and thought processes cannot simply be removed from mathematics by teaching a formula if success is to occur. Policy must be adjusted to ensure that while students are learning content, it is done in a manner that students find engaging. If not, it continues to fulfill a present expectation of simply checking a box off instead of actively learning and seeking to understand. Additionally, school districts can share a reminder that various methodologies should be used in the classroom, and professional development could be provided to assist teachers in learning different styles and options.

### *Implications for Practice*

The major takeaways centered around teachers and interactions in their classrooms. The presented research serves as a reminder that, just as teachers get bored teaching the same thing every day that in many cases, students do as well and strive for variety. Spending time in class allowing students to practice and varying groups allows them to work through the material, solidify current understanding, working through and discuss content. Interaction and explanation allow students who are struggling at various skill levels to obtain support and those who are finding success to gain further knowledge by explanation or to work at their own pace. Additionally, all students focused on activities during class in terms of asking questions and encouraging inquiry. The need for inquiry is of the utmost importance, as students shared that

they need to interact to learn. Times that notes are being given with a lack of response likely means that students are not engaged in the learning and are not obtaining information.

The importance of confidence and comfort also play a large role for students, so teachers should work to ensure that they support students in the classroom. Support can be positive responses to questions, getting to know students better, and focusing on interactions. The idea of interactions becomes hugely important as students ask questions to obtain help and need to remain confident enough to do so. Additionally, math teachers should provide focused time, especially for those confused students, on answering questions to allow students to gain understanding. In class, it becomes easy to suggest students come back later or state that it is something they should know from a previous class, but in all reality, these are often the questions that take the most confidence to ask, leading to the conlusion that it is foundationally necessary for students to gain understanding to progress through the lesson productively.

## Theoretical and Empirical Implications

The findings in this transcendental phenomenological case study revealed that engagement is important to students, and there are numerous ways in which it can be achieved as per high school seniors at Mun High School after the 2022-2023 school year. The findings provide relevant information for policy or practice and implications for educational theorists, as some of the data supports previous research while also filling a void based on participants.

### *Theoretical Implications*

The framework in this phenomenological case study was Kahn's (1990) engagement theory. The data supported the findings, indicating that engagement is necessary for true learning. Additionally, the data supported the idea that relationships build engagement (Martin & Collie,

2019), group work can be of benefit to students (Poort et al., 2022), and active learning increases interest (Deslauriers et al., 2019).

**Active Learning.** Deslauriers et al. (2019) found that, in many cases, students view active learning less favorably than lecture-based learning in terms of understanding. Even though students enjoyed the process more, they often felt it led to less understanding. I believe similar results were found, as students believed they were more engaged during group work but often struggled with the problems, so they felt that notes first helped. Even in the case of requesting lectures, though, the hope was still that it remained as active as possible in terms of students working through problems, asking questions, and attempting to work ahead of the teacher, with several even commenting that working ahead was their favorite part of notes, feeling rewarded if they could obtain the answer on their own. This study also focused on younger students than Deslauriers et al. (2019), as the aforementioned study focused on college-level students, and shows a secondary source of information from another population.

**Technology.** Oluwajana et al. (2021) was one of many researchers who studied the effectiveness of technology on student engagement and learning. Unlike the Oluwajana et al. (2021) study, the upper school students at Mun High School did not find technology beneficial in their learning and instead found it distracting. Students shared that as assessments are on paper, it felt more logical to continue assessing similarly. IXL Learning (2018) showed that students' confidence and capabilities increase using adaptive technology that allows for personalized instruction. Still, even with personal growth, the students at Mun High School referenced two major issues. The first is that even though it is adaptive, they can still get distracted, and the second is the issue of entering problems, as they received no partial credit even if they were

almost at the correct answer, so it caused undue stress. Quin (2017) expressed that success often parallels engagement but can be negatively impacted by stress, causing students to lose interest.

**Comfort.** Gross et al. (2022) discussed the components of Maslow's Hierarchy of Needs (1943) in online learning and shared the continued need for students to feel supported and understood to achieve success. The current study further supports the idea of Maslow's Hierarchy, as students expressed that they could not ask questions or focus if they were uncomfortable. The engagement was not even something on their minds if they felt unsafe in the classroom because of their peers or the teacher. Safety is especially true for students struggling with content, as they cannot overcome their current mental block, often leading to them not paying attention to the lesson and falling even further behind.

**Challenge.** During the interview portion of data collection, Joe did a phenomenal job of inadvertently describing Vygotsky's Zone of Proximal Development (1978). Joe expressed that he always felt the most engaged in classes when it was something that he did not quite know yet but had the foundational knowledge to learn it. He also discussed challenges in terms of a "web of knowledge," which further expressed his desire to attach things to his foundational understanding as he continued to learn. The idea of desiring to stretch slightly past the current understanding is also supported at the college level in various courses as students seek to connect their understanding to the information (Qin, 2022).

## Limitations and Delimitations

In planning my phenomenological study, I strategically decided which students to include and where to conduct research. There are 2,227 high schools in Florida, of which 742 are private (Florida High Schools, 2022). As a private school employee, limiting my research to one private school met my interest and ensured that there would be access to students for all three phases of

the research study. Mun High School also provided a population of students who were comfortable discussing concepts with teachers and one another, as is the style in which they complete their Humanities classes daily. The students are also accustomed to surveys and data collection methods, as they complete these in their classes throughout their high school careers. Additionally, students must take four years of mathematics classes, allowing for greater conversations and experiences in students' mathematics careers.

The recruitment process is limited to students currently enrolled at Mun High School who are no longer receiving grades from the researcher or are not in her course. By interviewing seniors, I obtained information about their mathematics courses throughout their high school careers. As the focus occurred on a span of high school mathematics courses, the sample pool was narrowed to only students who attended Mun High School for all four years of high school to ensure that a similar experience could be discussed during focus groups. Purposeful sampling created a varied sampling pool regarding mathematics course levels and genders. Only one of the included participants was a minor due to the timing of the study, as most seniors turned 18 during the school year.

Due to time constraints, all data were collected from seniors for interviews and focus groups in a week and a half, leaving journal entries to be completed within 72 hours before graduation. The time constaint did put seniors in a bit of a crunch for the sake of the impending graduation but allowed for the completion of in-person interviews and focus groups of sizes between three and four. By selecting students across all levels of mathematics at Mun High School, a mixed picture of student opinion was gained; however, the students who volunteered had ties to the researcher in some way. One example is students who were exempt from the semester's final at the time of data collection and are finished with their senior mathematics

course (three in Precalculus and four in Honors Calculus), students who had their course previously (two in AP Statistics, two in Honors Calculus with a different teacher, and one in Probability and Statistics), or advisees who knew her personally but had not taken any of her classes (one in AP Calculus and one in Financial Applications).

**Recommendations for Future Research**

While the phenomenological study has provided great insight into high school seniors at Mun High School, additional research is needed to understand engagement across different locations and age ranges. In light of the limitations and delimitations, the researcher suggests further studies work on a greater population of students and take in data from other schools, allowing for a more diverse population. Increasing the sampling pool will provide a greater variety of mathematics courses, opinions, histories, and thoughts, allowing for a more in-depth understanding of students' thoughts. Additionally, broadening the participant pool to other institutions would allow for greater diversity in race and economic status, leading to different insights as the sample becomes more heterogeneous since the current study consisted of all Caucasian students.

Purposively selecting students of varied abilities allowed for viewpoints to be shared by various teachers and confidence levels. Selection gave great depth to interviews and was enlightening during focus groups, as some students said certain activities never occurred in their classes. Purposive sellection also allowed for various teachers to be discussed in terms of styles and methods in the classroom when seeking out the methods the students found the most relatable and successful. As indicated previously, trends became evident, and subthemes began to emerge based upon a level of engagement being more involved for lower-level classes. Those at higher levels saw real-world applications more efficiently and were less reliant on teacher support, as

they had developed more grit (as shown in Appendix JJ). Further studies should be conducted across students at different levels to analyze and compare variability between the different subject pools to ensure the best methods are used for every subset of students.

Active learning is effective and is preferred by students in many cases. Still, they feel as if they are learning less material, even though many studies, such as quantitative, had the opposite outcome (Prince, 2004). A mixed methods approach would provide additional information, allowing students to perform while quantitatively giving their opinions. By doing a mixed method study, the analysis could be completed on how students feel about the learning process and the results. Additionally, the analysis could include students' inquisitive nature in the classroom. Inquiry is a component frequently referenced by students as playing a significant role in their understanding of topics and directly impacting engagement, so quantitative analysis could be completed by using Likert scale data on levels of engagement in comparison to the number of questions asked by different students.

## Conclusion

This transcendental phenomenological study focused on engagement in high school mathematics students at a private North Florida high school. The collection of data by interviews, focus groups, and journal entries allowed data triangulation amongst fifteen high school seniors. Data and analysis described high school seniors' engagement in mathematics throughout their high school career, focusing on the importance of engagement, methods that increase engagement, and differences in engagement in different courses. Three general themes were found across the data centered around classroom structure, emotional support, and sense of community. All students found engagement to not only be important, but also necessary for success but it was more frequently described by students in lower level of math. The same was

true about the importance of the teacher as students shared that relationship with their teacher and classmates affected their ability to ask questions. This idea of inquiry was shown to be the most important as students found that an inability to aks questions leads to not only confusion but an inability to continue in current content. This need for inquiry is further supported by positive teacher interactions, sense of confidence, and comfort speaking up in their given scenario. Students believed that group work allowed them to not only practice content and hear different persepctives but also to gain comfort and confidence as they move through a given lesson. The needs did not vary greatly based upon subject, but instead focused on the interactions of teachers no matter what is being taught. Shockingly, computer usage which has been heavily shown to increase engagement, was viewed negatively by all participants. The findings are relevant to teachers as they seek to inspire and educate students in mathematics, and those outside of the classroom, as the number of STEM-interested graduates declines. Overall, participants felt that various class structures that focused on inspiring confidence and inquiry, are the most engaging for students. A sense of community, specifically a relationship with teachers and peers, will allow students to reach their potential in the classroom and become comfortable seeking out their knowledge. Comfort allows students to focus on the content at hand and strive to be successful, often allowing for pushing their boundaries in order to show teachers the level of effort that is being put in. Ultimately, students felt that their teacher's attitude directly impacted their ability to learn in the classroom as well as the ability to focus and comprehend the material provided. As teachers strive to provide the best learning enviorment they can for students, they should first look inward to ensure their own passion is shining through. As they work to build a community of support an inquiry in their classroom, displaying their own passion allows student engagement to blossom.

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## Appendix A: Descriptive Data about Mun

*Mun Senior Class by Race*

| | n | Frequency |
|---|---|---|
| Caucasian (White) | 112 | 73% |
| African Americans | 12 | 8% |
| Two or More Races | 5 | 3% |
| Asian | 4 | 3% |
| Middle Eastern | 4 | 2% |
| Not Reported | 17 | 11% |
| Total | 153 | 100% |

*Mun Senior Class by Gender*

| | n | Frequency |
|---|---|---|
| Male | 77 | 50% |
| Female | 76 | 50% |

*Mun Senior Class by Course*

| | N | Frequency |
|---|---|---|
| Advanced Honors | 5 | 3% |
| AP Statistics | 16 | 10% |
| AP Calculus BC | 6 | 4% |
| AP Calculus AB | 29 | 18% |
| Honors Calculus | 45 | 28% |
| Precalculus | 16 | 10% |
| Probability/Statistics | 13 | 8% |
| Math for Readiness | 8 | 5% |
| Advanced Algebra | 22 | 14% |
| Honors PreCalculus | 1 | 1% |
| Total | 153 | 100% |

*Note.* Eight students take multiple classes and are therefore represented twice in the frequencies.

**Appendix B: Mathematics Course Sequence (Standard Progression)**

| Progression Option | First-year Course | Sophomore Course | Junior Course | Senior Course |
|---|---|---|---|---|
| Retake PreAlgebra (Lowest Option) | Algebra 1 | Geometry | Algebra 2 | Precalculus |
| Algebra 2. Unsuccessful | Algebra 1 | Geometry | Algebra 2 (below 85) | Mathematics of Finance OR Math for College Readiness |
| Precalculus Successful | Geometry | Algebra 2 (over 85) | Precalculus (over 85) | Honors Calculus or AP Statistics |
| Honors Precalculus Unsuccessful | Geometry | Honors Algebra 2 (over 85) | Honors Precalculus (under 85) | Honors Calculus or AP Statistics |
| Honors Precalculus Successful | Honors Geometry | Honors Algebra 2 (over 85) | Honors Precalculus (over 85) | AP Calculus AB/BC or AP Statistics |
| Senior Seminar | Honors Algebra 2 | Honors Precalculus (over 85) | AP Calculus BC | Senior Seminar |

## Appendix C: School Permission

October 24, 2022

[redacted]
Associate Head of School
[redacted]

Dear [redacted],

As a graduate student in the College of Education at Liberty University, I am conducting research as part of the requirements for a Doctor of Philosophy degree. The title of my research project is A Phenomenological Study of the Lived Experiences of Seniors in Mathematics Classrooms Analyzing Methodologies that Increase Engagement, and the purpose of my research is to further understand what students find engaging in mathematics.

I am writing to request your permission to conduct my research with approximately 15 senior level students at [redacted].

Participants will be asked to complete an individual interview, a focus group discussion, and submit a journal entry about engagement in their mathematics classroom. The data will be used to analyze what students find engaging about their own mathematics experiences. Participants will be presented with informed consent information prior to participating and informed assent, depending on their age. It should take approximately two hours to complete the data collection methods listed above. Names and other identifying information requested will remain confidential and all volunatary participants can choose to withdraw at any time.

Thank you for considering my request. If you choose to grant permission, please supply a signed statement on an official letterhead showing your approval. A permission letter document is attached for your convenience.

Sincerely,

Andrea Crews-Brown
US Mathematics

# Appendix D: IRB Approval Letter

LIBERTY UNIVERSITY.
INSTITUTIONAL REVIEW BOARD

May 8, 2023

Andrea Crews-Brown
Sharon Farrell

Re: IRB Approval - IRB-FY22-23-1247 A PHENOMENOLOGICAL STUDY OF THE LIVED EXPERIENCES OF HIGH SCHOOL SENIORS IN MATHEMATICS CLASSROOMS: ANALYZING METHODOLOGIES THAT INCREASE ENGAGEMENT

Dear Andrea Crews-Brown, Sharon Farrell,

We are pleased to inform you that your study has been approved by the Liberty University Institutional Review Board (IRB). This approval is extended to you for one year from the following date: May 8, 2023. If you need to make changes to the methodology as it pertains to human subjects, you must submit a modification to the IRB. Modifications can be completed through your Cayuse IRB account.

Your study falls under the expedited review category (45 CFR 46.110), which is applicable to specific, minimal risk studies and minor changes to approved studies for the following reason(s):

7. Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

Your stamped consent form(s) and final versions of your study documents can be found under the Attachments tab within the Submission Details section of your study on Cayuse IRB. Your stamped consent form(s) should be copied and used to gain the consent of your research participants. If you plan to provide your consent information electronically, the contents of the attached consent document(s) should be made available without alteration.

Thank you for your cooperation with the IRB, and we wish you well with your research project.

Sincerely,

**G. Michele Baker, PhD, CIP**
*Administrative Chair*
**Research Ethics Office**

## Appendix E: Recruitment Letter

Hello,
As a doctoral student at Liberty University in the School of Education, I am conducting research as part of the requirements for a Curriculum and Instruction degree. While teaching for the past decade, I have been interested in making mathematics as engaging as possible. The purpose of my research is to focus on what components of the mathematics classroom high school students find engaging. I am writing to invite eligible participants to join my study.

Participants must be seniors at the [redacted] and must have attended [redacted] for grade levels 9-12. Participants also must not be enrolled in a course taught by Mrs. Crews-Brown. Participants, if willing, will be asked to engage in one interview lasting 30-45 minutes and held in a private setting (e.g., office, library meeting room, etc.) or via Zoom, one focus group for 30-45 minutes with peers that will be held in a private setting (e.g., office, library meeting room, etc.) or via Zoom, and complete a journal submission that will take 5-10 minutes. Journal submissions will be submitted via email or in person. Participants will be provided an opportunity to review and corroborate their statements. To assist with this, both interviews and focus groups will be recorded using audio only and transcribed. Participants will also be asked to agree to the researcher's use of age, gender, and mathematics course information from their school records. Names and other identifying information will be collected as part of this study, but the information will remain confidential.

To participate, please contact me, Andrea Crews-Brown via email at [redacted] for more information or to schedule an interview. When you respond, please provide your contact information and your location for planning purposes. I am seeking to complete interviews during summer of 2023.

A consent document will be sent to you via email after you contact me to schedule an interview. The consent document contains additional information about my research. If you choose to participate, you will need to sign the consent document and return it to me via email before participating in any procedures.

Participants will be provided with lunch if they choose to participate in the interview and focus group in person during their lunch period. The lunch will consist of a Publix sub, chips and drink worth approximately $12.

Regards,
Andrea Crews-Brown

## Appendix F: Reminder Email

Dear Potential Participant,

As a graduate student in the School of Education at Liberty University, I am conducting research as part of the requirements for a Doctorate in Education. Last week an email was sent to you inviting you to participate in a research study. This follow-up email is being sent to remind you to submit your consent and assent if you would like to participate and have not already done so. The deadline for participation is [Date].

Participants, if willing, will be asked to complete an interview (45 minutes), a focus group (45 minutes), and a single journal entry (less than 10 minutes). Names and other identifying information will be requested as part of this study, but the information will remain confidential.

To participate, please sign and return the attached parental consent document to [redacted].

A consent document will be sent home with you. The consent document contains additional information about my research. If you choose to participate, you will need to sign the consent document and return it to to schedule your interview.

Participants will be provided lunch on the day of their interview and focus group participation.

Sincerely,

Andrea Crews-Brown
US Mathematics Teacher

## Appendix G: Consent Form

### CONSENT FORM

**Title of the Project:** A Phenomenological Study of the Lived Experiences of High School Seniors in Mathematics Classrooms: Analyzing Methodologies that Increase Engagement
**Principal Investigator:** Andrea Crews-Brown, Doctoral Candidate, School of Education, Liberty University

**Invitation to be Part of a Research Study**

You are invited to participate in a research study. To participate, you must be a senior at the [redacted]nd must have attended ESJ for grade levels 9-12. Participants also must not be enrolled in a course taught by Mrs. Crews-Brown. Taking part in this research project is voluntary.

Please read this form and ask any questions you may have before agreeing to be in the study.

**What is the study about and why is it being done?**

The purpose of this study is to look at methods of engagement that have been found to be effective in secondary institutions around the world. The focus will be on determining if these methods are found effective by students who have experience mathematics instruction at ESJ.

**What will happen if you take part in this study?**

**Procedures:** If you agree to be in this study, I will ask you to do the following:

- Individual Interview. One 30-45-minute interview during Middle or Upper school lunch where you will answer questions about engagement in class throughout their time in high school. Zoom times will also be available based on necessary time constraints of students' schedules. This will be audio-recorded for transcription.
- Focus Group. One 30-45-minute focus group during Middle or Upper school lunch where they will answer questions about engagement in class throughout their time in high school. Zoom times will also be available based on necessary time constraints of students' schedules. Groups will be made up of 3-5 individuals allowing for discussion about experiences in class. This will be audio-recorded for transcription.
- Journal Entry. Upon the end of the focus group, you will be asked to take 5-10 minutes to share your thoughts on one remaining question in written form and return them in person or via email.
- Agree to the researcher's use of age, gender, and mathematics course information from your school records.

**How could you or others benefit from this study?**

Participants should not expect to receive a direct benefit from taking part in this study.

Benefits to society include additional information about engagement.

**What risks might you experience from being in this study?**

The expected risks from participating in this study are minimal, which means they are equal to the risks you would encounter in everyday life.

I am a mandatory reporter. During this study, if I receive information about child abuse, child neglect, elder abuse, or intent to harm self or others, I will be required to report it to the appropriate authorities.

**How will personal information be protected?**

The records of this study will be kept private. Published reports will not include any information that will make it possible to identify a subject. Research records will be stored securely, and only the researcher will have access to the records. I may share the data I collect from you for use in future research studies or with other researchers; if I share the data that I collect about you, I will remove any information that could identify you, if applicable, before I share the data.

- Participant responses will be kept confidential by replacing names with pseudonyms.
- Interviews will be conducted in a location where others will not easily overhear the conversation or Zoom call.
- Data will be stored on a password-locked computer and may be used in future presentations. After three years, all electronic records will be deleted.
- Interviews will be recorded and transcribed. Recordings will be stored on a password-locked computer for three years and then erased. Only the researcher will have access to these recordings.
- Confidentiality cannot be guaranteed in focus group settings. While discouraged, other members of the focus group may share what was discussed with persons outside of the group.

**How will you be compensated for being part of the study?**

Participants will be provided lunch if they choose to meet during their lunch period for the interview and focus group. The lunch will consist of a Publix sub, chips, and drink worth approximately $12.

**Is the researcher in a position of authority over participants, or does the researcher have a financial conflict of interest?**

The researcher serves as a teacher at [redacted] To limit potential or perceived conflicts, only students that are not being taught by Mrs. Crews-Brown will be allowed to participate. This disclosure is made so that you can decide if this relationship will affect your willingness to participate in this study. No action will be taken against an individual based on his or her decision to participate in this study.

**Is study participation voluntary?**

Participation in this study is voluntary. Your decision on whether or not to participate will not affect your current or future relations with Liberty University or [redacted]. If you decide to participate, you are free to not answer any question or withdraw at any time without affecting those relationships.

**What should you do if you decide to withdraw from the study?**

If you choose to withdraw from the study, please contact the researcher at the email address included in the next paragraph. Should you choose to withdraw, data collected from you, apart from focus group data, will be destroyed immediately and will not be included in this study. Focus group data will not be destroyed, but your contributions to the focus group will not be included in the study if you choose to withdraw.

**Whom do you contact if you have questions or concerns about the study?**

The researcher conducting this study is Andrea Crews-Brown. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact her at [redacted]. You may also contact the researcher's faculty chair, Dr. Sharon Farrell, at [redacted].

**Whom do you contact if you have questions about your rights as a research participant?**

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher, **you are encouraged** to contact the IRB. Our physical address is Institutional Review Board, 1971 University Blvd., Green Hall Ste. 2845, Lynchburg, VA, 24515; our phone number is 434-592-5530, and our email address is irb@liberty.edu.

*Disclaimer: The Institutional Review Board (IRB) is tasked with ensuring that human subjects research will be conducted in an ethical manner as defined and required by federal regulations. The topics covered and viewpoints expressed or alluded to by student and faculty researchers are those of the researchers and do not necessarily reflect the official policies or positions of Liberty University.*

**Your Consent**

By signing this document, you are agreeing to be in this study. Make sure you understand what the study is about before you sign. You will be given a copy of this document for your records. The researcher will keep a copy with the study records. If you have any questions about the study after you sign this document, you can contact the study team using the information provided above.

*I have read and understood the above information. I have asked questions and have received answers. I consent to participate in the study.*

☐ The researcher has my permission to audio-record me as part of my participation in this study.

_____

Printed Subject Name

_____

Signature & Date

## Appendix H: Assent Form

### ASSENT FORM

**Title of the Project:** A Phenomenological Study of the Lived Experiences of High School Seniors in Mathematics Classrooms: Analyzing Methodologies that Increase Engagement
**Principal Investigator:** Andrea Crews-Brown, Doctoral Candidate, School of Education, Liberty University

**Invitation to be Part of a Research Study**

Your child is invited to participate in a research study. To participate, he or she must be a senior at the [redacted] and must have attended [redacted] for grade levels 9-12. Participants also must not be enrolled in a course taught by Mrs. Crews-Brown. Taking part in this research project is voluntary.

Please take time to read this entire form and ask any questions you may have before decided whether to allow your child to take part in this research project.

**What is the study about and why are we doing it?**

The purpose of this study is to look at methods of engagement that have been found to be effective in secondary institutions around the world. The focus will be on determining if these methods are found effective by students who have experience mathematics instruction at ESJ.

**What will participants be asked to do in this study?**

If you agree to allow your child to participate in this study, I will ask them to do the following:

1. Individual Interview. One 30-45-minute interview during Middle or Upper school lunch where they will answer questions about engagement in class throughout their time in high school. Zoom times will also be available based on necessary time constraints of students' schedules. This will be audio-recorded for transcription.
2. Focus Group. One 30-45-minute focus group during Middle or Upper school lunch where they will answer questions about engagement in class throughout their time in high school. Zoom times will also be available based on necessary time constraints of students' schedules. Groups will be made up of 3-5 individuals allowing for discussion about experiences in class. This will be audio-recorded for transcription.
3. Journal Entry. Upon the end of the focus group, they will be asked to take 5-10 minutes to share their thoughts on one remaining question in written form and return them in person or via email.
4. Agree to the researcher's use of age, gender, and mathematics course information from your child's school records.

**How could participants or others benefit from this study?**

Participants should not expect to receive a direct benefit from taking part in this study.

Benefits to society include additional information about engagement.

**What risks might participants experience from being in this study?**

The expected risks from participating in this study are minimal, which means they are equal to the risks your child would encounter in everyday life.

I am a mandatory reporter. During this study, if I receive information about child abuse, child neglect, elder abuse, or intent to harm self or others, I will be required to report it to the appropriate authorities.

**How will personal information be protected?**

The records of this study will be kept private. Published reports will not include any information that will make it possible to identify a subject. Research records will be stored securely, and only the researcher will have access to the records. I may share the data I collect from them for use in future research studies or with other researchers; if I share the data that I collect about your child, I will remove any information that could identify your child, if applicable, before I share the data.

- Participant responses will be kept confidential by replacing names with pseudonyms.
- Interviews will be conducted in a location where others will not easily overhear the conversation or Zoom call.
- Data will be stored on a password-locked computer and may be used in future presentations. After three years, all electronic records will be deleted.
- Interviews will be recorded and transcribed. Recordings will be stored on a password-locked computer for three years and then erased. Only the researcher will have access to these recordings.
- Confidentiality cannot be guaranteed in focus group settings. While discouraged, other members of the focus group may share what was discussed with persons outside of the group.

**How will participants be compensated for being part of the study?**

Participants will be provided lunch if they choose to meet during their lunch period for the interview and focus group. The lunch will consist of a Publix sub, chips, and drink worth approximately $12.

**Is the researcher in a position of authority over participants, or does the researcher have a financial conflict of interest?**

The researcher serves as a teacher at [redacted]. To limit potential or perceived conflicts, only students that are not being taught by Mrs. Crews-Brown will be allowed to participate. This disclosure is made so that you can decide if this relationship will affect your willingness to allow your child to participate in this study. No action will be taken against an individual based on his or her decision to participate in this study.

**Is study participation voluntary?**

Participation in this study is voluntary. Your decision on whether to allow your child to participate will not affect your or his or her current or future relations with Liberty University or [redacted]. If you decide to allow your child to participate, they are free to not answer any question or withdraw at any time without affecting those relationships.

**What should be done if a participant wishes to withdraw from the study?**

If you choose to withdraw your child from the study or your child chooses to withdraw, please contact the researcher at the email address included in the next paragraph. Should you choose to withdraw him or her or should they choose to withdraw, data collected from them, apart from focus group data, will be destroyed immediately and will not be included in this study. Focus group data will not be destroyed, but their contributions to the focus group will not be included in the study if you choose to withdraw them or they choose to withdraw.

**Whom do you contact if you have questions or concerns about the study?**

The researcher conducting this study is Andrea Crews-Brown. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact her at [redacted]. You may also contact the researcher's faculty chair, Dr. Sharon Farrell, at [redacted].

**Whom do you contact if you have questions about rights as a research participant?**

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher, **you are encouraged** to contact the Institutional Review Board, 1971 University Blvd., Green Hall Ste. 2845, Lynchburg, VA 24515 or email at irb@liberty.edu.

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**Your Consent**

By signing this document, you are agreeing to allow your child to be in this study. Make sure you understand what the study is about before you sign. You will be given a copy of this document for your records. The researchers will keep a copy with the study records. If you have any questions about the study after you sign this document, you can contact the study team using the information provided above.

*I have read and understood the above information. I have asked questions and have received answers. I consent to allow my child to participate in the study.*

☐ The researcher has my permission to audio-record my child as part of his/her participation in this study.

_____

Printed Child's/Student's Name

_____

Parent/Guardian's Signature Date

_____

Minor's Signature Date

## Appendix I: Recruitment Verbal Reminder

Script to be read by senior advisors to their advisories three days after the initial email has been sent:

Hi all!
You should have received an email from Mrs. Crews-Brown about her dissertation. You are in no way required to participate, and it is fine to simply delete the email. If you are interested in participating though, please take a moment to quickly email Mrs. Crews-Brown so she can send you the necessary consent forms.

## Appendix J: Screening Questions

1. Are you a current senior?

2. Have you attended [redacted] for all four years of high school?

3. Are you currently enrolled in a class taught by Mrs. Crews-Brown for the remainder of this school year?

## Appendix K: Interview Questions

1. Tell me about your experience in mathematics. Ice Breaker
2. Describe your ideal classroom. CRQ
3. What makes you feel supported in a classroom? SQ1
4. How does that affect class when you come into a classroom and a teacher seems unprepared or rushed? SQ1
5. Describe the first five minutes of your mathematics class. SQ1
6. What is the most engaged you have ever felt in a mathematics classroom? Why? SQ1
7. What affects your willingness to speak up in class? SQ1
8. What could your teacher do to encourage you to ask more questions? SQ1
9. How do you feel that your participation in class affects your focus? SQ1
10. Give me three words to describe your favorite mathematics class. SQ1
11. Word by word, explain why you chose those three words. SQ1
12. How does teacher support affect your engagement in the classroom? SQ1
13. How did you decide what math class to take this year? SQ2
14. Are you planning to continue your mathematics studies in college? Why or why not? S21

## Appendix L: Focus Group Questions

1. After our interview, what thoughts do you wish you had shared about mathematics engagement? RQ1
2. When do you think you are the most engaged in class? SQ1
3. Does your earlier math experience affect what you are planning to do as a career? SQ2
4. Are different things are engaging in your different courses? Why or why not? RQ3
5. What is your favorite class and why? Does this affect your plans to take this type of course in the future? SQ1

## Appendix M: Journal Prompt

Please share thoughts on how the following concepts have influenced your engagement in the classroom:

1. Group work versus independent time
2. Teacher attitudes and relationship
3. Computer or technology usage
4. Active learning (time to work through problems instead of a lecture)

Which of the above methods do you find most engaging and why? Feel free to add items to the list if you feel something is missing.

**Appendix N: Highest Level of Mathematics**

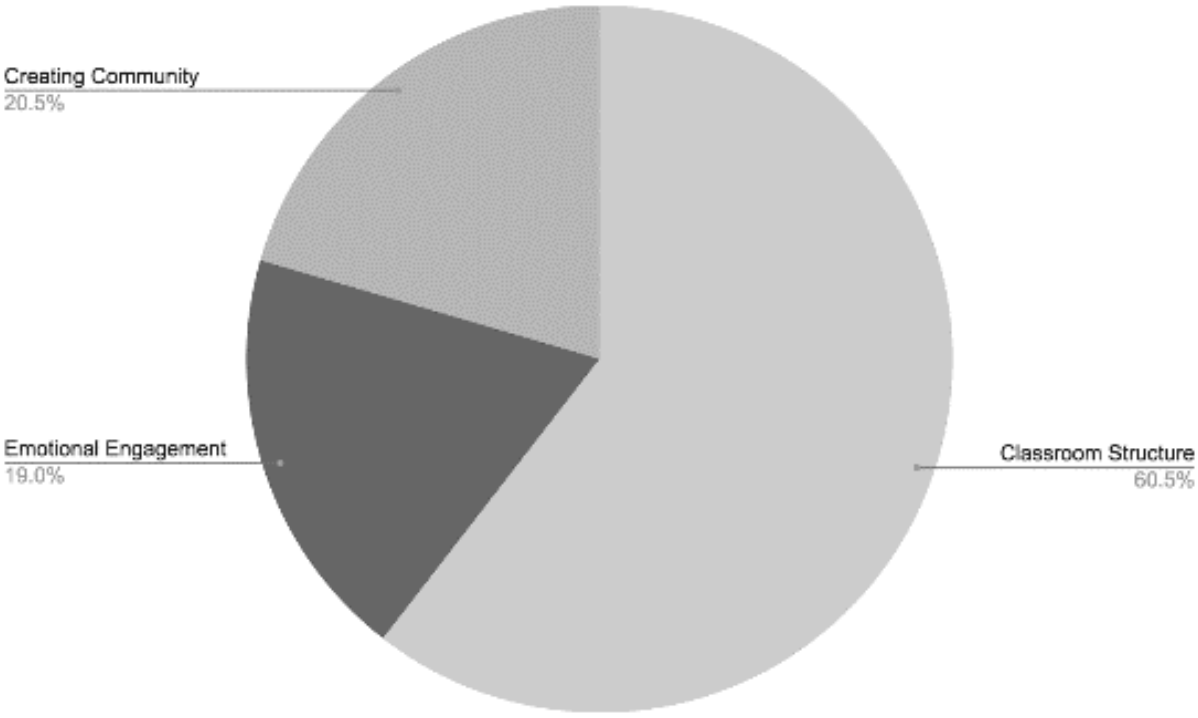
| Senior Course | Number of Paricipants |
|---|---|
| Honors Calculus | 6 |
| Precalculus | 2 |
| Math of Finance | 1 |
| Probability and Statistics | 2 |
| Precalculus | 1 |
| AP Calculus AB (Mrs. Christine) | 2 |
| AP Statistics (Mr. Hustle) | 3 |

Note: Two participants are in two math classes and are therefore represented twice.

## Appendix O: Theme Development for Interviews

| Theme | Subject Matter | Frequency during Interviews |
|---|---|---|
| Classroom Structure | Small Class Size | 6 |
| | Starting Class | 21 |
| | Varied Structure | 94 |
| | Style | 121 |
| Emotional Engagement | Confidence | 21 |
| | Positive Response | 26 |
| | Comfortable | 25 |
| | Passionate | 7 |
| Creating Community | Peers | 24 |
| | Teacher Relationships | 24 |
| | Support | 34 |

## Appendix P: Theme Frequency for Interview Data



**Appendix Q: Theme Development for Focus Groups**

| Theme | Subject Matter | Referenced in Focus Group (4 groups) | Frequency during Focus Groups |
|---|---|---|---|
| Classroom Structure | Small Class Size | 1 | 1 |
| | Starting Class | 2 | 3 |
| | Varied Structure | 4 | 40 |
| | Style | 4 | 17 |
| Emotional Engagement | Confidence | 3 | 10 |
| | Positive Response | 3 | 17 |
| | Comfortable | 4 | 7 |
| | Passionate | 1 | 1 |
| Creating Community | Peers | 4 | 13 |
| | Teacher Relationships | 4 | 19 |
| | Support | 4 | 10 |

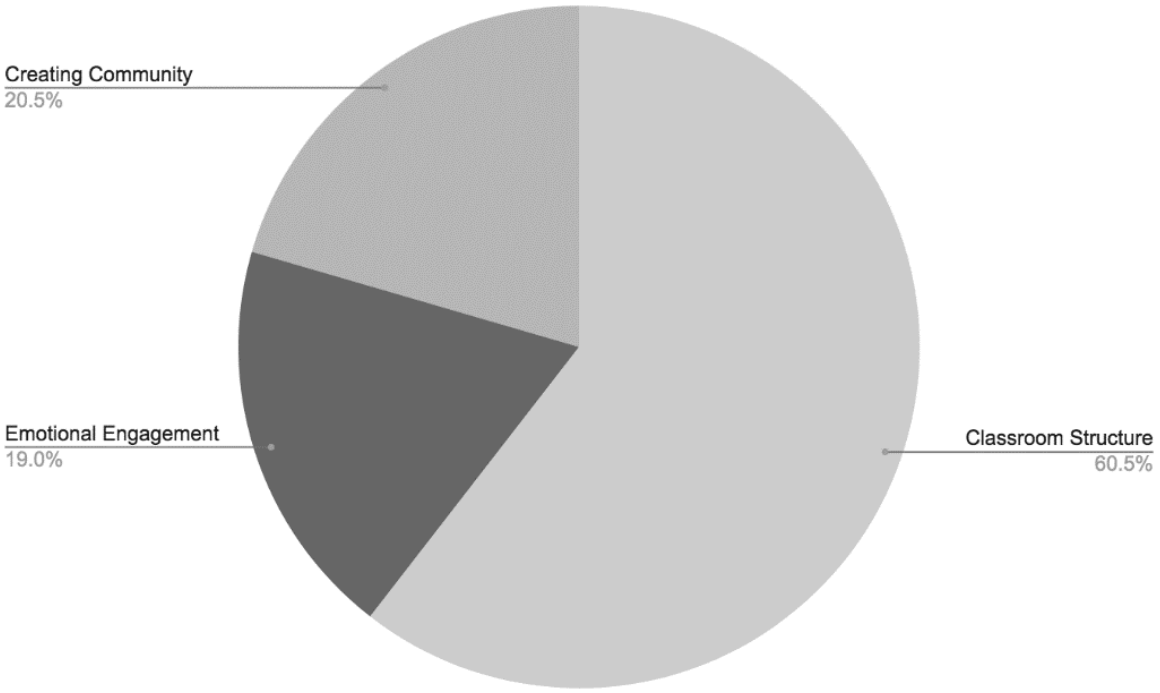
## Appendix R: Theme Development for Journal Entries

| Theme | Subject Matter | Number of Students | Frequency during Journal Entries |
|---|---|---|---|
| Classroom Structure | Small Class Size | 0 | 0 |
| | Starting Class | 1 | 1 |
| | Varied Structure | 10 | 37 |
| | Style | 4 | 6 |
| Emotional Engagement | Confidence | 1 | 1 |
| | Positive Response | 0 | 0 |
| | Comfortable | 0 | 0 |
| | Passionate | 5 | 5 |
| Creating Community | Peers | 1 | 2 |
| | Teacher Relationships | 10 | 17 |
| | Support | 3 | 5 |

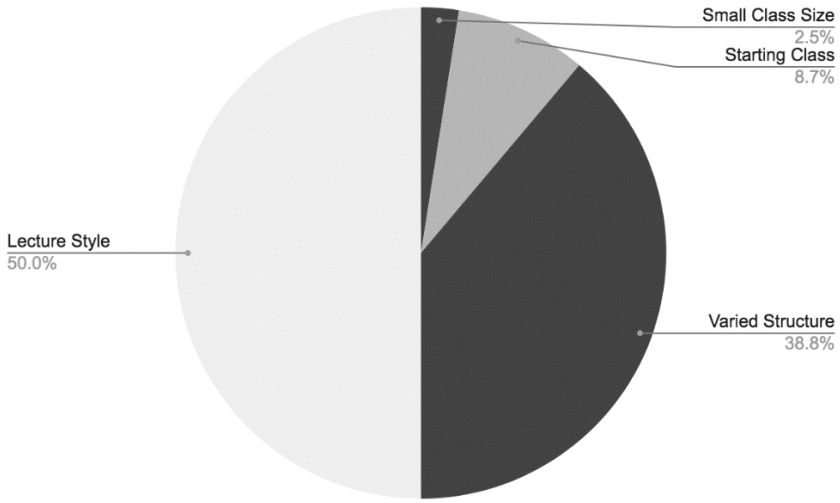
**Appendix S: Theme Development for Journal Entries**

| Theme | Subject Matter | Referenced in Focus Group (4 groups) | Frequency during Focus Groups |
|---|---|---|---|
| Classroom Structure | Small Class Size | 1 | 1 |
| | Starting Class | 2 | 3 |
| | Varied Structure | 4 | 40 |
| | Style | 4 | 17 |
| Emotional Engagement | Confidence | 3 | 10 |
| | Positive Response | 3 | 17 |
| | Comfortable | 4 | 7 |
| | Passionate | 1 | 1 |
| Creating Community | Peers | 4 | 13 |
| | Teacher Relationships | 4 | 19 |
| | Support | 4 | 10 |

## Appendix T: Theme Frequency for Journal Entries



## Appendix U: Subtheme Frequency for Classroom Setting from Interviews



**Appendix V: Theme Development: Subthemes of Classroom Structure**

| Subtheme | Subject Matter | Interview Frequency | Focus Group Frequency | Journal Frequency |
|---|---|---|---|---|
| Foundation | Small Class Size | 6 | 1 | 1 |
| | Starting Class | 21 | 3 | 3 |
| Varied Structure | Notes | 47 | 12 | 12 |
| | Group Work | 19 | 16 | 16 |
| | Solo Work | 5 | 2 | 2 |
| | Practice Type | 4 | 4 | 4 |
| | Review Material | 2 | 3 | 3 |
| | Grades | 4 | 3 | 3 |
| Style | Interactive | 16 | 3 | 3 |
| | Inquiry | 44 | 3 | 3 |
| | Competition | 11 | 4 | 4 |
| | Challenges of Problem-Solving | 25 | 2 | 2 |
| | Real World | 25 | 4 | 4 |

**Appendix W: Theme Development: Subthemes of Classroom Structure from Interviews**

| Subtheme | Subject Matter | Number of Students | Frequency |
|---|---|---|---|
| Foundation | Small Class Size | 5 | 6 |
| | Starting Class | 11 | 21 |
| Varied Structure | Notes | 12 | 47 |
| | Group Work | 12 | 19 |
| | Solo Work | 5 | 5 |
| | Practice Type | 3 | 4 |
| | Review Material | 2 | 2 |
| | Grades | 4 | 4 |
| Style | Interactive | 8 | 16 |
| | Inquiry | 10 | 44 |
| | Competition | 9 | 11 |
| | Challenges of Problem-Solving | 9 | 25 |
| | Real World | 11 | 25 |

**Appendix X: Subthemes of Classroom Structure from Focus Groups**

| Subtheme | Subject Matter | Number of Focus Groups | Frequency |
|---|---|---|---|
| Foundation | Small Class Size | 1 | 1 |
| | Starting Class | 2 | 3 |
| Varied Structure | Notes | 4 | 12 |
| | Group Work | 4 | 16 |
| | Solo Work | 1 | 2 |
| | Practice Type | 3 | 4 |
| | Review Material | 1 | 3 |
| | Grades | 2 | 3 |
| Style | Interactive | 3 | 3 |
| | Inquiry | 2 | 3 |
| | Competition | 1 | 4 |
| | Challenges of Problem-Solving | 1 | 2 |
| | Real World | 2 | 4 |

**Appendix Y: Subthemes of Classroom Structure for Journal Entries**

| Subtheme | Subject Matter | Number of Individuals | Frequency |
|---|---|---|---|
| Foundation | Small Class Size | 0 | 0 |
| | Starting Class | 1 | 1 |
| Varied Structure | Notes | 6 | 9 |
| | Group Work | 11 | 18 |
| | Solo Work | 7 | 7 |
| | Practice Type | 2 | 2 |
| | Review Material | 2 | 2 |
| | Grades | 0 | 0 |
| Style | Interactive | 3 | 6 |
| | Inquiry | 0 | 0 |
| | Competition | 1 | 1 |
| | Challenges of Problem-Solving | 1 | 1 |
| | Real World | 1 | 1 |

## Appendix Z: Theme Development: Classroom Structure Categories

| Subject Matter | Interview Frequency | Focus Group Frequency | Journal Entry Frequency | Totals |
|---|---|---|---|---|
| Notes | 47 | 12 | 12 | 71 |
| Group Work | 19 | 16 | 16 | 51 |
| Solo Work | 5 | 2 | 2 | 9 |
| Practice Type | 4 | 4 | 4 | 12 |
| Review Material | 2 | 3 | 3 | 8 |
| Grades | 4 | 3 | 3 | 10 |

**Appendix AA: Subtheme Development: Classroom Variety of Instructional Styles**

| Subject Matter | Interview Frequency | Focus Group Frequency | Journal Entry Frequency | Totals |
|---|---|---|---|---|
| Interactive | 16 | 3 | 4 | 23 |
| Inquiring | 44 | 3 | 0 | 47 |
| Competition | 11 | 4 | 1 | 16 |
| Problem-Solving | 25 | 2 | 1 | 28 |
| Real World | 25 | 4 | 1 | 30 |

**Appendix BB: Significant Statements by Category by Subtheme for Variety of Instructional Styles**

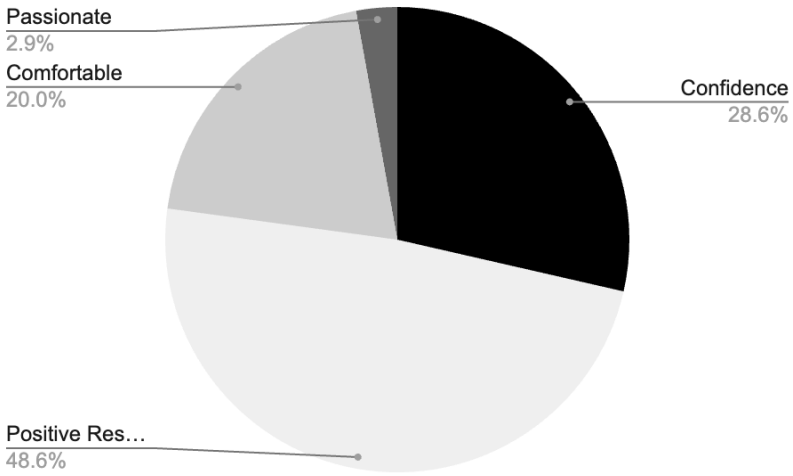
| | Significant Statements |
|---|---|
| Interactive | Active learning is the most beneficial for me as I feel more engaged as it makes me contribute |
| | Whether I'm talking about I can still be like a tentative and focus on what's happening |
| Inquiring | Questions are pretty engaging like asking questions to the class |
| | I think asking questions makes you focus more |
| | Times where the teacher can explain it good enough to where you're like nodding your head when you write |
| Competition | Competition makes it more fun. Like, you have the drive to do it |
| | I'm gonna keep doing all the problems instead of just giving up |
| | Something that I'm going to achieve by doing something |
| Problem-Solving | Figure out how to get it, then I'm like, keep my focus on like what I'm trying to complete each question |
| | Something I'm interested in and I like challenging myself |
| | Depends on the teacher because math can be for me like a really fun subject where it's almost like puzzle solving |
| Real World | Simply teaching the material without meaning is pointless |
| | It's easier to focus when you care about the subject |

**Appendix CC: Significant Statements by Category by Subtheme for Varied Structure**

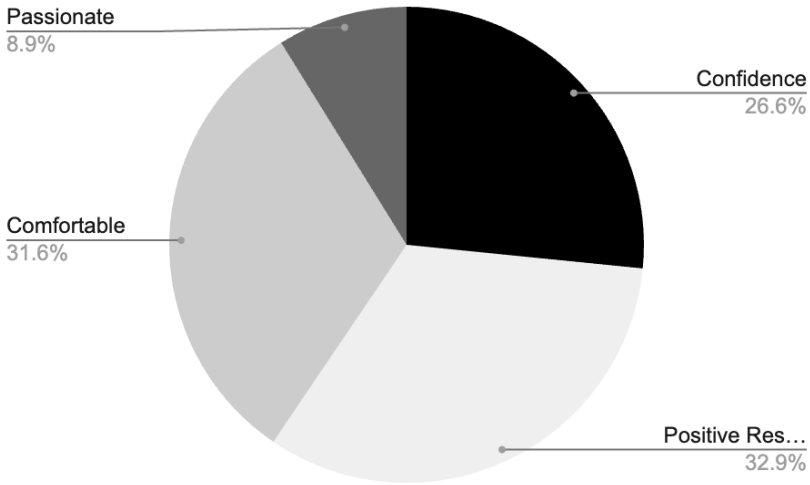
| | Significant Statements |
|---|---|
| Notes | Information straight up exactly how to do it, you write down exactly what to do |
| | Like heavy notes is a lot because I usually just like days off towards the end of it because it's just kind of like hypnotizing |
| | I can reapply that no homework and it becomes a lot easier |
| Group Work | Teaching someone else how to do something is beneficial for mastering understanding |
| | Students to share knowledge and help each other in areas that may have been confusing. |
| Solo Work | Enjoy going at my own pace and being able to ask for help only when I need it |
| | It's just you, which is how a test works |
| Practice Type | If I had a question, I could go ask them see how the lesson |
| | Like learning the lesson and then trying problems and being able to communicate with what's difficult and what's working |

## Appendix DD: Theme Development for Emotional Engagement

Theme Frequency for Emotional Engagement from Focus Group Data




Theme Frequency for Emotional Engagement from Interview Data



**Appendix EE: Theme Development: Subthemes of Emotional Engagement**

| Subject Matter | Interview Frequency | Focus Group Frequency | Journal Frequency | Total |
|---|---|---|---|---|
| Confidence | 21 | 10 | 1 | 32 |
| Positive Responses | 26 | 17 | 0 | 43 |
| Comfortable | 25 | 7 | 0 | 32 |
| Passionate | 7 | 1 | 7 | 15 |

**Appendix FF: Significant Statements by Category by Subtheme for Community**

| | Significant Statements |
|---|---|
| Peers | With your peers around you just being able to feel like what you say and what you're doing. It's okay. |
| | You see someone do something, and then you kind of want to do it |
| | You don't want to look dumb in front of a class |
| Teaching Relationship | This is number one because it can dictate how likely I am to want to succeed |
| | I have reasons to want to do well in each class, and I always held myself to a high standard but it is very nice to know that the teacher also cares |
| Support | I will want to like impress them; we want to do this for them |
| | She makes it like very clear that she wants us to succeed |

**Appendix GG: Three Key-Words for Favorite Class by Mathematics Level**

| | Words Chosen | | |
|---|---|---|---|
| Standard Level (5) | Engaging (4) | Challenging/Easy (3) | Beneficial (1) |
| | | Comfortable (3) | Group Work (1) |
| | | Fun (2) | Encouraging (1) |
| Honors (6) | Focused / Fun (5) | Well Explained (3) | Small (1) |
| | | Community (3) | Interesting (1) |
| | | Engaging (2) | Relaxed (1) |
| AP (4) | Challenging (4) | Engaging (2) | Fun (1) |
| | Interesting (4) | | Small (1) |
| | | | Openness (1) |

Note: Students in two math classes fell into the same category in both cases.

**Appendix HH: Ranking by Student from Journal Entries**

| Student Participant | Group work vs. Independent Work | Teacher Attitude and Relationship | Computer and Technology Usage | Active Learnin (Student vs. Teac Centered) |
|---|---|---|---|---|
| Dallas | 2 | 1 | 4 | 3 |
| Alex | 2 | 1 | 4 | 3 |
| Angel | 2 | 1 | 4 | 3 |
| Carol | 2 | 1 | 4 | 3 |
| Dixie | 3 | 2 | 4 | 1 |
| Grace | 2 | 1 | 4 | 3 |
| Jack | 1 | 2 | 4 | 3 |
| Joe | 3 | 1 | 4 | 2 |
| John | 3 | 1 | 4 | 2 |
| Kevin | 2 | 1 | 4 | 3 |
| Randy | 2 | 1 | 4 | 3 |
| Ross | 2 | 1 | 4 | 3 |
| Sam | 3 | 2 | 4 | 1 |
| Tammy | 1 | 2 | 4 | 3 |

**Appendix II: Three Key-Words for Favorite Class by Student**

| Student Participant | Mathematics Level | Word #1 | Word #2 | Word #3 |
|---|---|---|---|---|
| Kevin | AP Statistics | Fun | Engaging | Knowledge |
| Sam | Honors Calculus | Small | Lead | Tenacious |
| Tammy | Honors Calculus | Well Explained | Not Boring | Comfortable |
| Jack | Probability/Statistics | Encouraging | Easy | Fun |
| Grace | AP Statistics | Challenging | Wordy | Small |
| Dallas | Math of Finance | Explaining | Group Work | Not Boring |
| John | AP Calculus AB | Comprehensive | Ease | Openness |
| Ross | AP Calculus BC & AP Statistics | Interesting | Straight Forward | Complicated |
| Joe | Precalculus | Engaging | High Standard | Comfortable |
| Angel | Precalculus | Engaging | Welcome | Beneficial |
| Dixie | Honors Calculus | Interesting | Involved | Understanding |
| Randy | Precalculus & Probability/Statistics | Engaging | Time | Challenging |
| Alexander | Honors Calculus | Relaxed | Fun | Engaging |
| Katie | Honors Calculus | Community | Fun | Engaging |

**Appendix JJ: Key-Words for Favorite Class by Mathematics Level**

| | Student Participant | Word #1 | Word #2 | Word #3 |
|---|---|---|---|---|
| Standard Level | Angel | Engaging | Welcome | Beneficial |
| | Dallas | Explaining | Group Work | Not Boring |
| | Jack | Encouraging | Easy | Fun |
| | Joe | Engaging | High Standard | Comfortable |
| | Randy | Engaging | Time | Challenging |
| Honors | Alexander | Relaxed | Fun | Engaging |
| | Dixie | Interesting | Involved | Understanding |
| | Sam | Small | Lead | Tenacious |
| | Tammy | Well Explained | Not Boring | Comfortable |
| | Katie | Community | Fun | Engaging |
| AP | Grace | Challenging | Wordy | Small |
| | John | Comprehensive | Ease | Openness |
| | Kevin | Fun | Engaging | Knowledge |
| | Ross | Interesting | Straight Forward | Complicated |

Note: Students in two math classes fell into the same category in both cases.