

The Effects of Motivational Factors on Student Achievement in STEM

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Abstract

This study examines motivational factors and how they affect student achievement, as well as teacher and student perceptions of these factors in a STEM school. The focus of this research is to determine if there is an association between overall reported motivation and student achievement as measured by End of Course performance and Grade Point Average (GPA) in a STEM school. This study utilizes mixed-methods research and examines the MUSIC® Model of Motivation which educators use to assess motivation and study students' perceptions of their classes (Jones, 2017). This research investigates the factors in the MUSIC® Model of Motivation and the effect of motivational factors on student achievement and learning. The research suggests a correlation between the success factor and achievement as measured through state-mandated End of Course assessments (Ohio Department of Education, 2018). The results suggest the strongest correlation between motivation and achievement (End of Course) in American History. The research examines student and educator perceptions of motivational factors. Both educators and students perceive the caring factor to be the highest. Interest is the lowest scoring factor for students while empowerment is the lowest scoring factor for teachers. Educators summarize through interviews the role of the educator as a facilitator of learning and a motivator that combines the factors to engage students. Educators in this study strongly emphasize the importance of the caring factor in a school setting. They argue that this factor is crucial in the STEM school, which is a public school of choice. The research implements reflective practices through qualitative research questions based on the quantitative results.

Keywords: motivation, caring, achievement, success, STEM

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Chapter 1

Social research practitioners argue there are various approaches to engage students in their learning, and the effects of these approaches on student achievement is an area that interests educators. Hattie (2012) argued the importance of the educator knowing and understanding the impact of teaching methodologies and adjusting accordingly. Additionally, student-teacher interactions can be an impactful influence to students' motivation to learn if the educator pays attention through effective dialogue. Student motivation may affect achievement and the factors that contribute to motivation can vary (Elliot, Dweck, & Yeager, 2017). Educators can examine the factors independently or as an aggregate in various combinations. Internal and/or external factors or a combination of both can motivate students (Conti, 2008). Student interest is one factor that motivates students to learn (Chen, Darst, & Pangrazi, 2000). Students' situational interest can lead to students' motivation increasing and learning improvements (Mazer, 2013). Engagement and hands-on, inquiry-based learning can generate student interest when activities are properly guided (Chen et al.). Researchers study various inquiry-based teaching methodologies such as problem-based learning, project-based learning, and problem-solving teaching and how they affect student motivation and achievement. Some researchers argue that these teaching methodologies can increase engagement and student learning when properly executed. Hattie (2012) discusses teaching methodologies and states that they can only be truly impactful when the implications are examined in terms of effect on learning, rather than the focus on teaching style. Some studies focus on student and teacher perception of these varying methodologies and motivation, while others are outcome-based focusing on the effects of these methods on student achievement (Chen et al.).

This study examines motivational factors and how they affect student achievement, as well as teacher and student perceptions of these factors in a STEM school. The research explores the effects of teachers utilizing various problem-solving techniques, as well as the student perceptions of these techniques compared to teacher perceptions. Most importantly, the study is intended to provide tools for educators to use in examining the impact of these factors on learning and how they can become expert teachers through the careful and thoughtful examination of teaching pedagogy on the impact of student learning. These results are examined in terms of the effect on student achievement outcomes as determined by the Ohio End of Course Exams (Ohio Department of Education [ODE], 2018) in a Science, Technology, Engineering, and Math (STEM) School. STEM-designated schools in Ohio are considered public schools and are open-enrollment schools of choice.

This study utilizes the MUSIC® Model of Motivation, which is a framework of strategies used to support teachers in increasing student motivation and studies students' perceptions of their classes compared to teacher perceptions (Jones, 2017). The MUSIC® model is an acronym that represents five principles, “eMpowerment, Usefulness, Success, Interest, and Caring” (Jones, 2017, p. 1). The MUSIC® model is based on five key principles, implying students are motivated when they:

- Are empowered and have ownership;
- find the content useful;
- feel that there is a chance of finding success through the activities;
- are interested in the lesson; and
- feel that the teacher cares about them

These factors are examined in terms of student versus teacher perceptions to compare how they view each of the factors. The research examines how the factors affect student achievement in terms of End of Course exams and GPA. The factors can be examined in isolation or as an aggregate. The research is mixed-methods, utilizing quantitative components to assign numerical values to each factor in terms of teacher and student perception of each of the five factors. Qualitative questions center around the quantitative results to promote teacher reflection.

Problem Statement

Educators face a great deal of challenges in teaching students. They must balance accountability with building relationships and establishing a climate of high achievement and trust. Educators in teacher preparation programs are trained in teaching methods, as well as to become synthesizers of information pertaining to the analysis of student learning and subsequent adjustments made to instruction (Hattie, 2012). According to Hattie (2012), once they become full time teachers, they often lack the support to put this training into practice and are unsure about how to measure impact of instructional practices. In order to properly plan lessons that engage students and prepare them for rigorous tasks, educators must find what motivates students then capitalize on these factors to maximize student achievement, consistently measuring effect along the way (Conti, 2008). Teachers must examine effects in terms of learning outcomes as a result of these factors and adjust instruction based on the evaluation of these outcomes (Hattie, 2012).

Statement of Purpose

The intent of the study is to reveal motivational factors and student and teacher perceptions of these factors. The effect of these factors are analyzed in terms of student achievement. The purpose is to determine how these factors influence achievement and which

ones are the most powerful. The results could be used to inform teachers in effective instructional design, therefore potentially maximizing student motivation in hopes of increasing achievement. The study is intended to provide tools to educators to analyze the effects of instruction on student learning and capitalize on the motivational factors to fully maximize learning.

Research Questions

This research examines motivational factors and their impact on achievement and growth in a STEM school. Achievement for the purpose of this study refers to End of Course Exam results and GPA. The researcher determines how factors associated with motivation affect student achievement in these terms. The factors are examined both as individual constructs as well as their combined effect and impact with various combinations. The research explores the potential moderators of impact found through the study. The focus of this investigation is to determine if there is an association between overall reported motivation and student achievement as measured by End-of-Course performance and GPA in a STEM school. More specifically:

1. What is the association between each motivational sub-factor (eMpowerment, Usefulness, Success, Interest, and Caring[MUSIC®]) and student achievement in a STEM school?
2. What is the relationship between educators' responses regarding their courses' motivation sub-factors and how students respond regarding the same course?
3. What do educators report about their perception of the student and teacher results?
4. What do educators view is their responsibility in the educational process and outcomes of their students?

Overview of Methodology

This study is a mixed-methods research, and examines the MUSIC® Model of Motivation, which educators use to assess motivation and study students' perceptions of their classes (Jones, 2017). This is an investigation into the factors in the MUSIC® Model of Motivation, and the effect of motivational factors on student achievement and learning. The investigation focuses on the teacher and student perceptions in the MUSIC® Model and compares the teacher perceptions to student perceptions of these factors. The study analyzes the effects of these factors on student achievement as defined in the study. Qualitative interview questions guide teachers into reflective practice based on quantitative results.

Rationale, Significance, and Assumptions

This study is significant in that understanding the factors that motivate students and the effect on student achievement in terms of End of Course data and GPA. The research can potentially provide guidance to educators on how to develop effective lessons and programming based on analysis of these factors. By understanding the motivational factors that affect student achievement, educators can use this information to purposefully plan and deliver effective instruction. Educators must be fluent in actively engaging with students and adjusting instruction based on feedback before, during, and after the lesson (Hattie, 2012). Educators in training sometimes express knowledge of formative instructional practices in theory, but fall short in their comfort level in practical application when they become teachers (Hattie, 2012). The study intends to measure the effects of the factors on achievement and student learning outcomes and the results can drive future instructional practice in order to maximize outcomes. The results can also provide a guide for future practice in leading educators through the process of determining the effects of educational practice on student outcomes. Underlying researcher beliefs include:

students who are motivated want to learn, students who feel a sense of belonging and care from teachers will outperform students who do not perceive the teacher as caring, teachers are not fluent in analyzing the effects of their instruction; any student has the ability to grow as a learner, and engaged students are more likely to be motivated to learn and achieve.

Definition of Key Terms

Academic Core Classes- The six End of Course tested contents in 9th and 10th grades are English, English 2, American History, Geometry, Algebra, and Biology (Ohio Department of Education 2018)

Achievement-For the purpose of the research, achievement refers to the End of Course results and student grade point average (GPA)

Constructivist Approach- people build their own knowledge based on experiences and self-reflection (TeachThought, 2017)

Extrinsic Motivation- external factors such as social recognition or rewards motivate an individual (Conti, 2008)

Formative Assessment- The process of the teacher evaluating process towards lesson goals and adjusting as needed (Hattie, 2012)

Intrinsic Motivation- internal factors such as the need to feel successful and connected that motivate an individual (Conti, 2008)

MUSIC® Inventory- an acronym that represents five principles, “eMpowerment, Usefulness, Success, Interest, and Caring” used to study student and teacher perceptions of motivational factors (Jones, 2017, p. 1)

Problem-based Learning- problems used to generate learning experiences, often with the use of an authentic audience (TeachThought, 2017)

Problem-solving Teaching-a teaching style that focuses on problem-solving, promoting higher-order thinking skills and reasoning (Bailey & Taylor, 2015)

Project-based Learning- uses the constructivist approach to education, with a focus on projects in the curriculum and meaningful task completion (Tamim & Grant, 2013)

Self-determination Theory- compares internal and external motivational factors (Conti, 2008)

Situational Interest- how activities appeal to students; it is dependent upon student perceptions of the activity as it occurs (Chen et al., 2000)

Social Justice- an awareness of bias and experience leading to fair and equitable treatment of all (Tatum, 2017)

Tripod's 7Cs™ Framework- lays out elements of effective teaching. This method uses surveys to solicit student responses as they pertain to these elements (Ferguson & Danielson, 2014; TripodEd, 2019)

Universal Design for Learning (UDL)-flexible learning framework that eliminates barriers to learning (Novak, 2016)

Visible Learning- the teacher is tasked with observing learning through the eyes of every student (Hattie, 2012)

Theoretical Framework

Social research practitioners have studied various approaches to engage students and the effects of these approaches on student achievement and learning. Student interest is one factor that motivates students to learn (Chen et al., 2000). Students' situational interests can lead to increased motivation and improved learning (Mazer, 2013). Researchers study the effect of teacher behaviors such as communication on student learning outcomes such as achievement, but

there is an ongoing need to determine how this directly affects learning (Frymier, Glodman, & Claus, 2019).

Students who feel as if they can be successful may have increased motivation to learn. Motivation can be driven by the feeling of success, which varies with age groups. Often young children's views on success are overly inflated and optimistic (Elliot, Dweck, & Yaeger, 2017). According to Elliot et al., younger children demonstrate more optimism, but it is not blind. They proceeded to say that environment can heavily influence this optimism since early years are spent in educational environments where children have much control of the learning process. They are more open to a growth mindset and willing to learn through failure. In young children performance is not measured like it is in older children. According to Elliot et al., if younger children are more open to challenge and multiple trials through failure, then something must happen as they grow older to drive them toward a fixed mindset or a growth mindset. Although humans have genetic predispositions to traits inherited by parents, a person's environment and experiences impact how they demonstrate competence (Elliot et al.). According to Elliott et al., this is crucial for educators to keep in mind because the environment created can either encourage efficacy or discourage growth.

Theorists have different views about what determines behavior and motivation level. Some argue it comes from an internal locus, known as intrinsic motivation. Others argue that motivation is enhanced through extrinsic factors, including rewards, recognition, or fear of punitive measures (Conti, 2015). Praise is a way that competency may be communicated and

would be considered an extrinsic factor (Elliot et al., 2017). Conti (2015) argued that intrinsic motivation is more powerful because it hinges on three basic needs: the need to feel successful, the need to feel connected, and the need to have autonomy.

The Self-Determination Theory (2018) is effective in comparing internal and external motivational factors. According to Frymier (1993), there are various types of extrinsic motivation. Students who avoid guilt and pursue external rewards possess external and interjected motivation. Identified and integrated extrinsic motivation means associating value with an activity. Intrinsic motivation comes from within and motivates a student regardless of external rewards. This study examines five factors of motivation, which are a combination of extrinsic and intrinsic sources and their impact on student achievement. The Self-Determination Theory (2018) has practical implications in education; educators must know and understand what motivates students in achieving difficult tasks in order to plan and prepare appropriate lessons (Conti, 2015). In order to determine what is considered appropriate, an educator must possess the skills of evaluating effects of instruction.

Hattie (2012) theorized the concept of Visible Learning, where the teacher is tasked with observing learning through the eyes of every student. He argued that the most important role for teachers is that of change agents and evaluators of progress toward learning consistently.

Additionally, Hattie (2012) stated that achievement and learning are not mutually exclusive, but rather the attainment of one can lead to the other. Formative assessment and feedback through dialogue, especially when tasks are challenging, aid in student learning. Charlotte Danielson's

(2013) framework was also present in Hattie's (2012) theories and the motivational factors Jones (2017) studied in the MUSIC® inventory, including discussions about formative instructional practices. Danielson (2013) lists four domains, including planning and preparation, classroom environment, instruction, and professional responsibilities. Danielson (2013) discussed effective instruction, and formative assessment appears multiple times in the rubric as a large part of effective teaching as well as in Hattie's (2012) work.

Tripod's 7Cs™ framework lays out more elements of effective teaching and has consistent themes with Hattie (2012) and Jones (2017). Like the MUSIC® model, Tripod's 7Cs™ framework uses surveys to solicit student responses as they pertain to these elements (Ferguson & Danielson, 2014). The framework has three conceptual categories consisting of multiple factors that contribute to effective teaching. The categories are "personal support (care and confer), curricular support (captivate, clarify consolidate), and academic press (challenge and classroom management) (Tripod™, p. 1). Motivating students to want to learn can be challenging and involves a complicated combination of factors, and the educator is tasked with the process of realizing what motivates each individual student. This research examines factors as sources of motivation and their effect on student achievement in terms of End of Course results and GPA in a STEM School, as well as teacher and student perceptions of these factors.

Summary

Measuring motivational effects is complicated and can be difficult to quantify. Theories in existing research discuss motivational factors such as the Self-Determination Theory. In this

study the research explores the five motivational factors in the MUSIC® model. These factors are analyzed in terms of student achievement in a STEM school and the teacher and student perceptions of these factors in academic core classes.

Chapter 2 provides an in-depth examination of the five motivational factors of the MUSIC® model as well as other research-based contributing factors to what can motivate students to learn.

Chapter 2

Review of Literature

Hattie's Theory of Visible Learning

John Hattie (2012) discussed the concept of visible learning as the process of making student learning visible to teachers, and advocates for the teacher to actively and consistently evaluate the impact of their teaching on student learning. Hattie (2012) argued that the educator must seek to find the true impact on learning. The teacher should focus on the individual student rather than focus on the teaching methodology and adjust instructional practice as impact is measured and evaluated. Hattie (2012) discussed eight specific mind frames that an effective educator must adopt when becoming a change agent toward this practice.

Hattie (2012) stated the importance of teachers understanding that their primary role as an educator is to consistently evaluate the impact their teaching has on how students learn and their achievement. Hattie (2012) claimed that the traditional approach to lesson planning is not the optimal way to approach teaching. He argued that teachers who are able to adjust throughout the lesson by making changes based on feedback throughout the activity are more effective in reaching students. The students and teacher interactions, and the recognition that the teacher must adjust instruction based on these interactions defines excellent teaching. Rubie-Davies (2007) stated that teachers with high expectations of students provided more regular feedback to students than lower-expectation teachers, and this feedback provided insight as to what tasks have been achieved and what outstanding goals exist for students. In many teacher preparation programs, teachers trained on how to properly evaluate the lesson before, during, and after to adjust accordingly, but lack leadership in how to continue to improve this process when they become teachers (Hattie, 2012).

Hattie (2012) also discussed teacher mindset as an important factor related to student success, and the willingness of teachers to facilitate the change process of student learning. Mindset, even in adults, can change over time (Dweck, 2007). Mindset is either described as fixed or growth, or somewhere in between. According to Elliot et al. (2017), if younger children are more open to challenge and multiple trials through failure, then something must happen as they grow older to drive them toward a fixed mindset, or a growth mindset. Although humans have genetic predispositions to traits inherited by parents, a person's environment and experiences impact how they demonstrate competence (Elliot et al.). This is crucial for educators to keep in mind, in that the environment created can either encourage efficacy, or discourage growth. Effective teachers must realize there is a spectrum of mindsets, from fixed to growth, and that they are change agents for student learning (Dweck, 2007). Every educator must know and understand his/her own mindset, and also invest the time and energy to appreciate that others will have various combinations of mindsets. This will allow for empathy when planning and delivering lessons, knowing the perspective of the student and the lens through which they see. The teacher should work to coach students with different mindsets, maximizing opportunities for students to find success through ownership of activities. Hattie (2012) argued that teachers need to embrace student learning through scaffolded tasks with clear expectations and direction. Garza, Alejandro, Blythe, and Fite (2014) explained caring as a combination of empathy, listening, scaffolding, and providing what students need academically.

When individuals are in school to become educators, they take classes primarily about content and very few about best practices when teaching. Teacher preparation programs do not prepare them to examine the effectiveness of teaching strategies, and how to adjust throughout the duration of a lesson. When they become teachers, the professional development provided by

building leaders often targets best practices for teaching rather than how students learn (Hattie, 2012). When teachers understand and evaluate how students learn they can see through the students' viewpoints. They are then able to evaluate the degree to which the students are learning. This concept has connections to Jones' (2017) caring factor, since it is essential for a teacher to take time to know students on a personal level. Osterman (2010) indicated that positive teacher-student relationships make students feel more connected. This connection can manifest itself in the interactions that Hattie (2012) emphasized as being crucial in the process of teachers leading change and consistently evaluating progress toward learning.

Assessment is a term that educators often only associate with testing and accountability. Although this is certainly true sometimes, Hattie (2012) argued it is much larger than that. He stated that the terminology should be transformed from the "assessment of" to the "assessment for" and indicate in what ways the formative assessment provides information to the educator as to how the lesson progressed (p. 185). Hattie (2012) argued that feedback is the most crucial component of student success, and if used effectively can maximize student learning. He listed critical questions that teachers should ask about lessons, then adjust accordingly (p. 185):

- Who did you teach well and who not so well?
- What did you teach well and what not so well?
- Where are the gaps, where are the strengths, what was achieved, and what has to still be achieved?
- How do we develop a common conception of progress with the students and with all of the teachers in our school?

Effective instruction occurs when student learning is maximized. This can only occur when teachers engage in two-way communication rather than simply talking at the students in

the form of a monologue (Hattie, 2012). Part of dialogue means that the teacher needs to listen, and that includes questions, struggles, and ideas. When teachers utilize lecture only, the higher-achieving students can make sense of the information better than struggling students since their repertoire for learning tools and strategies exceeds those of struggling students. The type of dialogue matters, and according to Hattie (2012) requires more future research. Hattie (2012) argued that when students are able to converse in the language of the content they exhibit a greater understanding and retention. Listening means that the teacher must strive to understand what the student is saying and make necessary adjustments when using the dialogue as interaction-driven formative instruction. Hattie (2012) stated that the more difficult the activity, the more essential it becomes to engage in this dialogue and two-way feedback process.

In addition to two-way communication, Davidson (1999) discussed other ways that teachers can show they care about their students. One way is to learn about students' lives outside of school, and the other way is to monitor their academics and provide them what they need. By knowing students and understanding their needs, teachers increase student engagement. Hattie (2012) discussed passion in education, and how impactful it can be for students when a teacher is passionate about their work. That passion includes the excitement of teaching and observing the learning process, as well as the frustrations that come with trial and error. According to Hattie (2012), passion is contagious, and can stimulate positive student behavior when the teacher models through instructional practice.

Teaching is a challenging profession, and in order to maximize student learning the teacher must enjoy the challenge and embrace it as an opportunity (Hattie, 2012). Part of the challenge is recognizing that each student has different strengths and weaknesses and adjusting the lesson accordingly. More importantly, the teacher must evaluate the effect of the instruction

on student learning, which means analyzing this information for each individual. To determine effectiveness, a teacher must establish what a successful lesson execution looks like and how to evaluate. Hattie (2012) argued the importance of success criteria and clear expectations and communicating these to the students consistently. In addition to clear communication, the teacher must plan activities that are meaningful and worth the effort when working toward the intended outcomes (Brophy & Good, 1986). High-expectation teachers have a tendency to establish learning goals as opposed to procedural plans and communicate them clearly (Rubie-Davies, 2007). Rubie-Davies (2007) determined high-expectation teachers provide a framework for learning and for clear and concise instructions. This allows students to understand the meaning and purpose in the challenges, which is vital in making connections that lead to student learning.

Making clear connections is one way teachers can demonstrate care (Hattie, 2012). The perceptions of the teacher's view of caring are analyzed in relationship to the students' views of caring (Jones 2017). Banerjee (2016) argued that student perceptions of teacher attitude toward them can lead to better academic performance. This is tied to the concept of caring and what this may look like according to student perceptions. These perceptions are key to whether or not a student feels safe enough to learn through trial and error, and if the educational climate is not only indicative of interpersonal relationships, but more specifically empathy, fairness, and trust (Hattie, 2012). Hattie (2012) argued that students must feel safe and willing to fail during the learning process. He argued that leaders must create this similar culture for teachers as they learn to evaluate their impact on teaching.

In order to properly educate a child, educators are responsible for not only teaching students, but also communicating the language of education to families (Hattie, 2012). One way

this can occur is through student-led conferencing, which allows students to speak the educational language in terms of his/her own progress toward mastery. This type of conferencing allows the parents to hear through the viewpoint of the student, which may be less intimidating. Often parents are willing to be partners in the education of their child, but they are ill-equipped to assist due to the educational language barrier. Hattie (2012) argued that it is crucial for schools to implement a complete wrap-around approach to educating children. The teacher must be willing to have these conversations with parents, so they are ready to engage in the learning process beyond a superficial level. This leads to an overall understanding of the impact on learning, and a team approach to adjusting in order to maximize learning impact.

Hattie's (2012) mind frames led to the concept of visible learning and can lead to maximizing student learning and achievement. Hattie (2012) argued there is not one program, teaching methodology, or resource that can improve student learning. Hattie and Donoghue (2015) stated that "learning and achievement are not dichotomous; through growth in learning in specific domains comes achievement and from achievement there can be much learning" (p. 1). Educators must take the approach to consistently analyze the impact of teaching and make appropriate adjustments. This study design provides the opportunity to analyze the factors that contribute to student motivation and achievement and provide suggestions for future practice for educators to evaluate and analyze the impact of instructional practices on student learning.

The concept of visible learning overlaps with some components of the Tripod's 7Cs™ framework, which lays out elements of effective teaching. This method uses surveys to solicit student responses as they pertain to these elements (Ferguson & Danielson, 2014). The framework has three conceptual categories, consisting of multiple factors that contribute to effective teaching. The categories are, "personal support (care and confer), curricular support

(captivate, clarify consolidate), and academic press (challenge and classroom management) (Tripod™, p. 1). This framework also manifests itself in Danielson's (2013) work, in which she identified teaching responsibilities that enhance student learning. The framework is research-based and has multiple domains that encompass responsibilities in the classroom, planning instruction, and other professional responsibilities that combine for effective teaching.

Factors in Student Motivation

Motivation is what drives human behavior to attain a goal (Wang, 1993). In a school context, student motivation can impact student achievement and have implications on instructional practice. Student motivation to learn is connected to activities that are meaningful and worth the effort when working toward the intended outcomes (Brophy & Good, 1986). Hattie (2012) discussed the concept of Visible Learning, which is a set of mind frames that teachers can utilize in order to maximize student learning. Research suggests a correlation between student motivation and achievement (Wang, 1993). As stated earlier, factors that motivate students can be intrinsic, extrinsic, or a combination of both (Conti, 2015). Educators must be aware of what motivates students and be able to monitor learning progress and outcomes to make necessary adjustments that improve student learning. Motivational factors can be examined in isolation, or as interconnected components of a system (Chittum, 2015). Jones (2017) explained the MUSIC® model as an acronym that represents five principles, “eMpowerment, Usefulness, Success, Interest, and Caring” (p. 1). These factors in motivation may affect student achievement; teacher perceptions of these factors in an educational setting may differ from student perceptions of these same factors (Jones, 2009). Social research practitioners study various approaches to engage students in their learning, and the effects of these approaches on student achievement. Wigfield and Eccles (2000) discussed motivation in

terms of the value in task completion, and the performance expectations of the assigned tasks. Student interest is one factor that motivates students to learn (Chen et al., 2001). Students' situational interest can lead to increased motivation and improved learning, and interest may be influenced by other factors (Mazer, 2013).

In terms of engagement, researchers study methods such as problem-based learning, project-based learning, and problem-solving teaching and how they affect student motivation and achievement. Some studies focus on student and teacher perception of these varying methodologies and motivation, while others are outcome-based and focus on the effects of these methods on student achievement. This study examines student engagement and their perceptions when teachers utilize various problem-solving techniques compared to teacher perceptions of the same techniques. These results will be examined in terms of the effect on student achievement outcomes, as determined by the Ohio End-of-course Exams and student Grade Point Average (ODE, 2019). This study utilizes the MUSIC® Model of Motivation, which educators use to motivate learners and study students' perceptions of their classes (Jones, 2017). A known gap in the research is a study comparing and contrasting these methods and how they impact student achievement when used in combination to increase relevance and engagement.

Empowerment

The empowerment factor in the MUSIC® model refers to educational strategies and planning that foster student autonomy through freedom and choice (Jones, 2017). Student empowerment leads to autonomy, which promotes intrinsic motivation (Deci & Ryan, 2012). Teachers who allow for students to share ideas and include students' input promote autonomy and ownership (Tripod™, 2014). Ferguson and Danielson (2014) referred to this concept as conferring, and it implies that teachers demonstrate the idea that they welcome ideas and

feedback. Novak (2016) argued that when students are provided a choice in assignments prior to planning instruction, this can increase engagement and allow students to have self-directed activities that promote creativity. Martin and Calabrese (2010) discovered that empowering students can also improve behavioral engagement. Carroll and Gordon (2013) argued that setting individual goals can improve empowerment, especially for at-risk students. When students have input in lesson design such as pace or topic selection, they exhibit a sense of increased ownership and empowerment (Jones, 2009). Hattie (2012) cautioned by stating that choice and autonomy can be productive, but the teacher still must provide direction and monitoring to prevent confusion. Additionally, expectations and goals must be clear, so that students are aware of what the teacher expects.

Choice means that students perceive that they provide input into decisions pertaining to lessons (Wang & Eccles, 2013). This can include students providing insight into classroom operations and activities (Ferguson & Danielson, 2014). Choice can lead to increased motivation toward a task, since students have input into the lesson design and implementation. Another way to provide choice is to allow students to choose how they demonstrate mastery. Jones (2009) further discussed this by stating the importance of teachers explaining rationale for instructions provided to students. Offering choice of activities, or different ways to express mastery, promotes student autonomy and ownership of the task (Su & Reeve, 2011). Teachers can modify their lessons to further support autonomy but cannot force students to embrace this. To further promote autonomy in a classroom setting, Schwartz (2017) stated that student-led conferences at school is yet another way teachers empower students toward ownership since they are an active part of goal setting and progress monitoring.

Teachers can have a part of the instruction while serving a primary role as facilitator. Part of facilitation is allowing students to collaborate to work in groups, sharing diverse ideas. When students have the opportunity to work together and contribute to the conversation and the teacher shows he/she is listening, students feel empowered since they can feel ownership of components of the lesson (Ferguson & Danielson, 2014). Sample strategies to promote empowerment include whole group and small group discussions, student perspectives on classroom issues and current events, and peer-feedback towards the lesson goals.

Usefulness

Jones (2009) referred to usefulness as the perceived value of a lesson, and how the lesson impacts students' lives directly. Kauffman and Husman (2004) argued that student motivation increases when they feel the content is beneficial for the future. Conversely, if a student feels the assignment is irrelevant, they are less likely to complete it with fidelity. Not only should students be equipped to see the connections to their lives within the lesson, the teacher should make connections to previously learned facts and cross-curriculum associations (Ferguson & Danielson, 2014). Ferguson and Danielson (2014) referred to this as consolidation, meaning the teacher gives the message that they will work to find connections and review and summarize information. In a study performed by Simons, Vansteenkiste, Lens, and Lacante (2004), students performed better in classes that were directly related to their major in college due to perceived usefulness to their career aspirations. Teachers should take this into consideration when planning and eliminate assignments that students perceive as useless (Garcia, 2019). Garcia (2019) also discussed the importance of making connections to the real world and life outside of school within lesson design. Students become more autonomous when the teacher clearly communicates the rationale behind the task and makes clear connections. Student motivation to learn is

connected to activities that are meaningful and worth the effort when working toward the intended outcomes (Brophy & Good, 1986). Reeve (2009) stated that lessons become more meaningful when the teacher considers the individuality of the students. Teachers should acknowledge when there is discontent toward the task through the individual's negative perspective (Deci et al., 1994). Jones (2009) suggested the following to foster students' perceptions of usefulness: (a) provide clear explanations regarding connections, (b) provide students with diverse opportunities to make connections and demonstrate learning, and (c) promote its application to the real world.

Brantlinger (2013) described critical agency as the sense students get when they feel they can make a difference in the world. Brantlinger (2013) went on to say that students need to understand themselves and their potential contributions to the world and discover opportunities to connect subject matter to their lives outside of school. A simple strategy a teacher can employ to make the lesson relevant is to ask students to reflect upon the lesson content, and how it can relate to them personally (Ferguson & Danielson, 2014). Teachers can also connect the content to current events and other ways students can transfer the knowledge to other applications.

Success

Students' perception of how well they will perform if they exert time and energy to the assigned task is success (Garcia, 2019). Jones (2009) indicated the importance of proper balancing of the level of difficulty; the tasks should be challenging yet manageable in order for students to be motivated to complete them. If a student is not feeling confident about their ability to complete an assignment, they are likely to be less motivated to work toward the task (Jones, 2009). Teachers should consider this when planning, and utilize formative instructional practices to gauge student abilities, then adjust accordingly. When students have a positive self-concept,

this may correlate to higher levels of achievement, especially when students are able to complete challenging tasks with success (Gregory & Huang, 2013). There must be a balance between high standards that promote engagement and unrealistic expectations (Montgomery & Hirth, 2011). Effective differentiation can provide students at all levels with an opportunity to feel as if they have the ability to complete the task and feel success. Teachers must provide a variety of ways so that students will have the opportunity to demonstrate competency toward the assigned task (Emmer & Stough, 2001). Jones (2009) stated the importance of clear expectations through the use of rubrics so students understand the goals clearly defining what success means in terms of the activity. Additionally, Jones (2009) argued that activities should be challenging, and teachers must be available to help. Students should have the opportunity to reattempt assignments to demonstrate mastery. Students who feel successful are more likely to be motivated in the task completion. Their success toward a task can be supported through consistent and timely feedback.

Feedback

Teachers provide feedback to students in a variety of ways, whether it is formal or informal, summative, and/or formative. When a teacher clarifies for a student, they help in student understanding the content of the lesson and intercept confusion. This is more effective when checking for understanding frequently and providing specific feedback (Ferguson & Danielson, 2014). The means of teachers' delivery of feedback can vary from written to oral and include nonverbal communication. Quaglia (2016) argued that listening as a form of engagement can lead to more effective, purposeful feedback. Rubie-Davies (2007) stated that teachers with high expectations of students provided more regular feedback to students than lower-expectation

teachers, and this feedback provided insight as to what tasks have been achieved, and what outstanding goals exist for students.

Hattie (2012) argued that feedback has the most impact on learning, and that effective feedback can help narrow the achievement gap and promote growth. Hattie (2012) continued to argue that in order to provide feedback that has a purpose, teachers must have a sound understanding of where a student starts, and where they are intended to go, relative to the outcomes. When teachers understand this, they are able to provide meaning to the task, provide insight toward how to successfully complete the task, help with student misunderstandings, and promote motivation as students invest more energy toward successful task completion. Sharratt and Fullan (2016) discussed the need for descriptive feedback, since it provides direction to students for what is needed in order to meet the learning goals. They stated that the teacher or other students can provide this descriptive feedback, and it is impactful when it (p. 72):

- is timely;
- identifies strengths and weaknesses;
- points to areas needing improvement;
- shows students how they can take steps to close the gap;
- chunks feedback so students can handle and absorb;
- models the type of thinking in which students will engage when they self-assess;
- allows teachers to take immediate action in a daily effort to improve student work;
- offers information to students about their work, product, or performance relative to simply stated learning goals; and

- avoids marks, grades, or comments that judge the level of achievement

According to Hattie (2012), there are many ways that teachers can provide feedback: through affective processes, increased effort, motivation, or engagement; by providing students with different cognitive processes, restructuring understandings, confirming to the student that he or she is correct or incorrect, indicating that more information is available or needed, pointing to directions that the students might pursue, and indicating strategies with which to understand particular information. (p. 129)

Teachers must frequently check for understanding and adjust instruction before, during, and after the lesson. They can task students with self-evaluation against the rubric and goals set for the lesson. As teachers adjust their instruction, they are providing specific feedback that supports problem-solving and critical thinking (Ferguson & Danielson, 2014). Part of learning is trial and error, and students must feel safe to make errors and learn through this process while making adjustments toward improvement. Students must learn to embrace obstacles and tackle them enthusiastically. Hattie stated the three questions that should guide teachers during the lesson are: (a) Where am I going?, (b) How am I going to get there?, and (c) Where to next? (p. 130).

Hattie's (2012) first question, "*Where am I going?*" indicates that teachers need to know the lesson goals, why they are choosing these goals, and most importantly, how to communicate these goals to students (p. 131). He argued that establishing and communicating goals are usually task-driven, and not focused on mastery toward the standards. Jones (2009) stated the importance of clear expectations through the use of rubrics so students understand the goals clearly, defining

what success means in terms of the activity. Ferguson and Danielson (2014) argued that rubrics can provide clarity towards the expectations. From the expectations, a student can create goals, and have a clear path towards learning. Goals and feedback are related because students know where they are, and where they need to go; teachers who are equipped with this information can then provide guidance toward the end goal. Once students meet the goals, they can then set appropriate future goals and the conditions needed to attain these goals. Feedback is meaningless if the established goals are not challenging because students already know how to master the easier content (Hattie, 2012).

Part of mastering the standards related to the content is answering the second question, “*How am I going there?*” (Hattie, 2012, p. 132). Progress feedback as it is related to the starting and end point defines this question. This part of instruction is the most effective when providing feedback that is in relation to the end goal, rather than comparison to other students’ progress. This can consist of the following strategies: clear learning expectations and definition of success, providing effective discussions and tasks, providing meaningful, targeted feedback that moves students ahead, promoting student ownership of learning, and using students as resources to assist each other.

Strategies related to effective feedback are also included in the final question as to where to go next with the lesson (Hattie, 2012). This can help educators decide what the next activity is and can promote autonomy in the process of learning. Novak (2016) argued that when students are provided a choice in assignments prior to planning instruction, this can increase engagement and allow students to have self-directed activities that promote creativity. The intent of this is to promote students to seek out their answer to questions and define and empower them in their own learning process.

Hattie (2012) researched the effect of feedback on student achievement and suggested its importance in raising student achievement. He argued that feedback is the most crucial component of student success and, if used effectively, can maximize student learning. When the teacher provides effective feedback there can be increased interest in the lesson. According to Ferguson and Danielson (2014), some strategies that can promote effective feedback that clarify misconceptions, include (p. 10):

- explaining concepts using multimedia, including text, images, audio, and video;
- using rubrics to articulate criteria for success and describe a range of performance levels;
- using exit slips at the end of the lesson to check student understanding and using responses to plan subsequent lessons, clarifying as needed; and
- writing comments on student work describing specifically what has been achieved and where more work is needed.

Interest

When students are interested in an assigned task or project, they are more likely to be motivated (Garcia, 2019). In order to promote interest, students must see connections to life outside of school, which varies based on the students. Teachers who make lessons relevant can captivate students through inquiry (Tripod TM, 2014). Bowers and Flinders (1991) argued that cultural responsiveness is a key factor in attracting student interest. Teachers must take this into consideration when planning. Cordero (2008) argued that programs preparing students for cultural competency “rely on the principle that cultural identity and differences are positive” and

not a hindrance (p. 165). Cordero (2008) continued by explaining that a cross-cultural teaching model can extend beyond the classroom setting to include experiential learning. Cordero (2008) discussed how cultural competency for Latinos can be increased by (p. 177):

- (a) sensitizing students to Latino worldviews and cultural values;
- (b) increasing their knowledge about Latino oppression experiences and strengths;
- (c) deepening ethnographic interviewing skills and increasing cross-cultural community encounters; and
- (d) enhancing their understanding and commitment to cross-cultural learning as an ongoing process

Also relevant in cultural competency, two-way dialogue and relationships are crucial. Dornoo (2015) stated “in the mathematics classroom, when teacher-student relationships are fluid and equitable, students learn to collaborate, share tasks, accept criticism, and alternate opinions, respect the decisions of others, construct their own knowledge, and become responsible for each other” (p. 85). Jones (2009) stated that in order to foster student interest, activities must take into consideration student background and experiences. In order for teachers to learn this, supervisors must be prepared to engage in difficult conversations with staff in order to ensure this is occurring. According to Ryan (2006), supervisors can facilitate the critical conversations needed to establish a high standard for cultural competence, and provide feedback on teaching that (p. 124):

- is detailed and specific;
- expresses caring, interest, and support;
- is non-judgmental;

- provides praise;
- establishes a problem-solving orientation;
- responds to concerns regarding student behavior; and
- discusses teacher-student interaction

In addition to ensuring cultural competency, the use of hands-on activities is one strategy that can increase interest, leading to higher motivation. Additionally, student engagement in assigned tasks can be motivating (Jones, 2009). When students have sustained involvement in tasks and experience positive emotions toward the task engagement occurs. According to Skinner and Belmont (1993), part of engagement may involve planning activities that allow for social interaction that can be powerful in leading to higher levels of interest in the classroom. Student and teacher perceptions of their learning environment whether it is project-based, problem-based or problem-solving can vary. In the three models discussed, there are commonalities in mentioning the concept of applying real-world skills to solve authentic problems.

Student disengagement in high school is common, especially students who do not find the content relevant (Gregory, Allen, Mikami, Hafen, & Planta 2014). There is often a lack of appropriate professional development for teachers on how to effectively engage students (Gregory et al.). When teachers have positive interactions with students that are appropriate for their age group and that acknowledge social-emotional needs, students have a tendency to function better in the classroom. Gregory and Weinstein (2004) concurred that this type of teacher engagement with the student promotes positive student outcomes and can increase student engagement significantly. Fredericks, Blumenfield, and Paris (2004) described behavioral engagement as the level of involvement a student has in school and can be examined

through school attendance and task completion. Spielhofer, White, O'Donnell, and Sims (2005) discussed engagement in terms of at-risk students. Strategies that can assist with these students include: (a) providing activities that students perceive as meaningful, (b) promoting student participation, (c) creating learning environments that are different than traditional settings, (d) providing individual assistance and attention to students, and (e) assisting students in preparing and planning for the next phase of their lives. Some research suggests incorporating more lab activities in classes such as science, to improve engagement and learning (Hofstein & Lunette, 2004).

Teacher efficacy regarding teaching strategies is associated with student outcomes. Teachers with high efficacy can demonstrate a positive effect on student achievement (Lee, Cawthon, & Dawson, 2013). High student achievement is linked in many studies to student engagement, and that it is a fundamental component to student success (Pianta, Hamre, & Allen (2012). Engagement has several definitions and can include a variety of activities that directly involve students in their own learning as well as clear expectations (Taylor & Parsons, 2011). Promoting student engagement is complex, and teachers sometimes struggle with how to implement engaging teaching practices and deciding which ones are appropriate to use. Klem and Connell (2004) argued that students who are highly engaged feel their teachers are well structured, caring, and convey high expectations. In addition to these classroom and teacher characteristics, there are several teaching methodologies that teachers can use in order to increase student engagement.

Bailey and Taylor (2015) discussed problem-solving teaching emphasizing “practice-based teacher education” (p. 111). They argued that problem-solving teaching is a higher-level method of educating students. Additionally, this style of teaching leads to more developed

students with higher-order thinking skills, reasoning, as well as those who are more adept at problem-solving (Bailey & Taylor, 2015). Carson (2007) discussed problem solving as the ability to use prior knowledge to navigate new and unfamiliar situations. Bailey and Taylor (2015) studied the effect of new teachers using problem-solving techniques in math, and how those techniques support teaching math at a higher level. The researchers discovered that prior to the study, many of these teachers had not previously been exposed to this style of teaching, and problem-solving was received positively overall. Syahputra and Surya (2017) studied problem-solving techniques and determined that they can lead to improved, higher-order thinking skills and solving mathematical problems. Using problem-solving to teach conceptually has strengths and challenges for both teachers and students according to Docktor, Strand, Mestre, and Ross (2015). Carson (2007) opposed this view, stating that in order to truly teach problem-solving, a knowledge base still has to be established. He goes on to say that failing to establish a knowledge base results in overlooking an essential part of problem-solving.

Project-based learning (PBL) uses the constructivist approach to education, with a focus on projects in the curriculum (Tamim & Grant, 2013). Part of the outcome of project-based learning is educating through a project and completing meaningful tasks. Project-based learning is more than just project completion (TeachThought, 2017). Tamim and Grant (2013) discussed the key components of PBL as projects that are designed to “push students to struggle..., are student-driven, and realistic”, but are more than just a project as a culmination (p. 73). They proceeded to say that PBL can lead to increased intrinsic motivation and an outlet for students to showcase what they know in a variety of ways. Tamim and Grant (2013) argued that PBL leads to higher interest, increased critical thinking skills, and improved oral and written skills. The fundamental concept in PBL is to have students solve real-world problems and apply new

knowledge to solve problems (David, 2008). Projects are used in this method as the primary instructional tool. But the definition of project widely varies (David, 2008). He argued that there are not many studies examining the effects of PBL on student achievement, but that some research indicates that the importance of supporting teachers and proper professional development are crucial in successful implementation.

Similar in some ways to project-based learning and problem teaching is the problem-based learning pedagogy. These teaching styles are sometimes named interchangeably in error, but there are some subtle differences along with some overlapping concepts. Problem-based learning is defined as problems used to generate learning experiences often with the use of an authentic audience (TeachThought, 2017). This type of teaching is a shift from the teacher disseminating the information, to serving as a facilitator (Joseph, Jain, & Kotian, 2016). Students tend to prefer exploring problems that have relevance which are connected to real-life (Mundilarto, 2017). The concept behind problem-based learning is to allow students to apply prior knowledge through solving authentic problems (Mundilarto, 2017). Mundilarto (2017) argued that applying problem-based learning methodology leads to increased student achievement. Similar to researchers' findings with problem-based learning Downing (2013) argued that project-based learning has yielded positive outcomes and involves active learning in real-world settings. She continued that it is engaging, keeps students interested, and can be adapted to many subject areas. Joseph et al. argued that overall instructors perceived PBL favorably. The structure of PBL provides ample opportunities for increased student-teacher interactions, which promotes a culture of caring through feedback via dialogue. When the teacher promotes discussion and methods such as cooperative learning and peer feedback students are more engaged (Ferguson and Danielson, 2014). The strategy of utilizing effective

feedback can translate into multiple types of pedagogy and is a common recurring theme of best practice.

Although there are several types of formal teaching methodologies that promote inquiry and hands-on learning, educators can stimulate students and keep their attention by implementing a few key practices. First, teachers should consider backgrounds and interests when developing lessons. They must also communicate how the lesson is relevant to students, and how it fits into the scope and sequence of a unit. Student interactions and collaboration can increase engagement, and consistent, specific feedback is essential (Tripod, TM 2014). Strategies teachers can use to promote interest include using current events to teach content, projects that incorporate real-world issues, and make technology a daily tool for allowing students to express knowledge (Ferguson & Danielson, 2014).

Caring

In the MUSIC® model acronym, the caring factor determines if students believe that the instructor and others in the learning environment care about their learning and about them as people. Jones (2009) described caring as the trust and respect that teachers and students demonstrate toward each other. Garza, Alejandro, Blythe, and Fite (2014) explained caring as a combination of empathy, listening, scaffolding, and providing what students need academically. In addition to meeting students' needs through academics, teachers can demonstrate caring by showing support for students academically and emotionally (Ferguson & Danielson, 2014). Teachers can show caring through developing personal relationships, creating a physically and emotionally safe environment, and establishing high standards. Hoffman (2009) argued that it is important for teachers to work toward caring relationships and strive toward continuous improvement of that relationship. Shacklock (1998) argued that caring is an integral

characteristic of teachers and a professional responsibility. Cushman (2006) argued that students felt a teacher cared when the teacher was enthusiastic about what they were teaching and had high expectations while communicating confidence in task completion. Reppy and Larwin (2019) stated the importance of meeting the students' social-emotional needs to show genuine care and this requires dedication from all staff members. When students feel a sense of belongingness, they feel cared for by their teachers, and teachers can control this through their actions (Baumeister & Leary, 1995). Noddings (2012) argued that students will work harder for a teacher who cares about them, and their favorite teachers are the ones for whom the students will work the hardest. McKamey (2004) suggested three theories of caring in a school setting. First, the teacher caring theory implies that caring leads to achievement. The caring community theory acknowledges the importance of schools providing a caring setting, especially in situations where this setting is missing at home. The difference theory argues that caring varies in different cultural settings, and, when schools realize this, they are more inclusive.

The perceptions of the teacher view of caring are analyzed in relationship to the student view of caring (Jones 2017). Banerjee (2016) argued that student perceptions of teacher attitude toward them can lead to better academic performance. This connects to the concept of caring, and what this may look like according to student perceptions. Literature discusses different definitions of caring. In education teachers must balance accountability with creating relationships with students. Creating a caring environment can be challenging for some; many teachers are trained in content and not on creating an emotionally safe classroom. Educational climate is not only indicative of interpersonal relationships, but more specifically empathy, fairness, and trust (Hattie, 2012). There is often a disconnect between the theory of caring and the actual practice of caring (Sinha & Thornburg, 2012). Sinha and Thornburg (2012) continued

to say that in order for teachers to “cultivate caring relations with their students, the focus needs to shift from educators doing something to their students to educators doing something to themselves” (p. 24).

Cooper and Miness (2014) discussed caring in terms of understanding, and whether understanding is necessary for care. They argued that students who perceive that their teachers understand them find they have a better relationship with these teachers. This has practical implications and can aide educators in providing strategies that promote strong teacher-student relationships. Teachers’ own perceptions of the definition of care can dictate how a teacher acts, depending on if they feel they are demonstrating that they care (Garza et al., 2014). Osterman (2010) indicated that positive teacher-student relationships make students feel more connected. Osterman’s (2010) research suggested examining high school structures to allow for increased personalization and argued that existing structures do not promote this. Additionally, increased accountability may be a reason for teachers to claim they need to show caring through increased test scores and data analysis (Garza et al.). Sinha and Thornburg (2012) stated that most educators want to have a caring relationship with their students but are not sure how to cultivate this relationship. Additionally, teachers, at times, assume that caring means counseling, and argue that they are not qualified for this.

Davidson (1999) discussed the two ways that teachers can show they care about their students. One way is to learn about students’ lives outside of school, and the other way is to monitor their academics and provide them what they need. Schussler (2009) continued this argument by saying that by knowing students, teachers increase student engagement. Chittum (2015) reported that teachers can project caring through high standards and attentiveness toward students meeting their academic goals. Antrop-Gonzales and De Jesus (2006) stated there is a

continuum of caring, and teachers can show they care through quality interpersonal relationships and maintaining high standards for students. Garza et al. (2014) identified four themes when studying perceived teacher behavior in terms of caring: (a) an overall feeling of belonging, (b) knowing students on a personal level, (c) helping students be successful academically, and (d) attending to social-emotional needs. Sancacore (2002) argued that all students benefit from a teacher demonstrating they care. Conversely, students may perceive teachers as not caring when they keep a distance from students personally (Shacklock, 1998). Furthermore, Shacklock (1998) suggested that if a teacher is consistently unavailable students may feel this is due to a lack of caring.

In order for students to feel a sense of belonging, teachers must emit a feeling of community and demonstrate the value that each student brings to the classroom environment (Garza et al., 2014). Nonverbal communication such as making eye contact and maintaining a friendly demeanor can lead students to perceive the teacher cares (Brooks, 2000). Antrop-Gonzales and De Jesus (2006) argued that caring can be both formal, such as curriculum and informal relationships. Brooks (2000) argued that a positive environment is the most conducive for student learning. Garza et al. argued that knowing students on a personal level, including background and experiences, shows students that teachers care about them as people, not just students. When teachers have high expectations for students, they demonstrate that they care about a student's academic progress. Additionally, factoring in their interests such as extracurriculars shows students that the teacher views them as individuals, which projects care. When teachers tend to students' social-emotional needs, this shows the teacher cares about the students' wellbeing (Garza et al.).

Student motivation is multifaceted and pinpointing the underlying motivation in students is complex (Chittum & Jones, 2017). Teacher-student relationships and authentic caring are factors in student achievement and success (Sinha & Thornburg, 2012). Teachers often perceive themselves as caring, but the students have an opposing view of teacher caring in an authentic manner. Noddings (2005) argued that teachers who demonstrate care respond in a different manner when responding to students' needs. Teachers are uncomfortable when real-life issues are brought into the classroom, and they feel as though it is not part of their job to counsel students in this manner (Sinha & Thornburg, 2012). Caring varies "in the way and time invested in caring for others" (Garza et al., 2014, p. 5). Through interviews, observation, and reflecting, teachers can identify key components in caring and describe what it actually looks like in a classroom (Garza et al.). This reflection can be facilitated through critical conversations by administrators with teachers in order to promote a culture of caring (Ryan, 2006). Regarding teachers in a school, Sinha and Thornburg (2012) quoted a student as saying, "Maybe if they taught something important to us, like what's goin' on in the world.... But it's like they don't know who we are.... I mean they care but not in the right way, you know?" (p. 27). Teacher relationships with students influence the students' perceptions of belonging, which impacts social and emotional experiences in schools.

Teachers have the desire to be caring toward students, but, often, are not sure how to make authentic connections with them (Sinha & Thornburg, 2012). Noddings (2005) discussed two forms of caring, relation, and virtue and states that relational care is more meaningful and impactful in terms of the student-teacher relationship. In relational care, the person demonstrating care takes the other person's perspective into account. Relational care is the most basic type of caring, where one person cares, and the other person cares for the other in a

reciprocal manner. Noddings (1992) stated that the one who cares feels an obligation to show a caring attitude to aid in the development of a reciprocal, caring relationship. The obligation to care leads to actions that demonstrate care, demonstrated by regard for people's affections and emotions.

According to Shacklock (1998), teaching provides opportunities for a caring environment on a daily basis; however, teachers sometimes avoid the opportunity to show care through direct instruction and lecturing. The struggle in a traditional school setting, specifically at the secondary level, is providing the structure for teachers to know their students, and potentially understand them, which can lead to a caring environment (Osterman, 2010). Students have a need for validation through attention, and the period-style format of high schools makes this difficult for educators (Nolbit, 1993). Noddings (1992) argued that increased time does not necessarily mean a positive connection between teacher and students. Teachers can still demonstrate care in a secondary setting through high standards, attentiveness, individual conversations, and parent connections (Shacklock, 1998). Jones (2009) echoed this, stating that teachers can show they care when they stay after hours to assist students with their work.

When students feel attached to a classroom atmosphere, they are more motivated to perform at high levels (Ryan & Deci, 2000). Teachers have considerable influence in how students perceive their school experiences, and it is essential that teachers demonstrate relationship-building to promote open communication and respect (Osterman, 2010). Ferguson and Danielson (2014) discussed the ways teachers can indicate they care about students. Indicators of care include relationship building, characterized by teachers being respectful and showing interest in students as individuals. Simple strategies teachers can utilize to show care include greeting students as they enter, individualize conversations and differentiate teaching

techniques, ask students privately what is wrong if they seem sad, and if a student is not trying, exploring possible reasons prior to reacting (Ferguson & Danielson, 2014).

Teacher Expectations

Antrop-Gonzales and De Jesus (2006) determined that caring student-teacher relationships are defined by high expectations. Whether teachers plan to radiate positivity and confidence in a student, or if it is unintentional, this has a direct effect on student outcomes (Gregory & Huang, 2013). According to Ferguson and Danielson (2014), teachers who challenge their students demand understanding rather than low-level memorization, and they hold their students to high standards while monitoring student work. Boser and Rosenthal (2012) contributed that many students feel their coursework is too easy, leading to a lack of engagement. Subsequently, there is a lack of pride in attending and engaging since missing the material is of little consequence. Montgomery and Hirth (2011) were imperative in arguing that maintaining high standards is crucial for schools, while at the same time providing any necessary remediation. They argued this must be done carefully and thoughtfully so students do not become discouraged and, therefore, disengaged. According to Gregory and Huang (2013), positive teacher expectations can have favorable outcomes for students.

Rubie-Davies (2007) contended that learning environments differ among low-, middle-, and high-expectation teachers in both the learning environment and the social-emotional climate. She argued that the high-expectation teachers employed extra higher-order questioning techniques and provided more feedback to students. Pringle, Lyons, and Booker (2010) stated that teacher expectations can impact the achievement of students; their study mentioned African American students specifically. They stated that students equate high expectations with teacher caring and maintained that teachers with high expectations are perceived as caring more than

those with low expectations. High-expectation teachers had a tendency to establish learning goals as opposed to procedural plans providing a framework for learning, and clear and concise instructions (Rubie-Davies, 2007). Hattie and Donoghue (2016) suggested there are three sources of inputs to learning, the “skill”, the “will”, and the “thrill”. The “skill” is the student’s previous knowledge and achievement; the “will” relates to the student’s disposition toward education; and the “thrill” refers to the factors that contribute to student motivation (p. 2). These factors are present in research such as Hattie (2012), and Ferguson and Danielson (2014), and they appear in teacher evaluation systems designed to coach teachers into implementation of best practice.

Ferguson and Danielson (2014) discussed some strategies teachers can use to challenge students and consistently hold high expectations including (p. 13):

- Asking probing questions;
- Requesting that students explain their thinking;
- Encouraging original thought;
- Pushing students to turn in high quality work and demonstrate belief in student ability;
- Requiring students to revise work after teacher provides feedback;
- Teaching differentiation based on skill levels;
- Pushing all students even those who tend to be disengaged; and
- Being honest with students when work is difficult but encourage students to work to success

Best Practices Tied to Teacher Evaluation and Instructional Leadership

The factors that contribute to student motivation are present throughout the Ohio Teacher Evaluation System rubric. As part of the Ohio Teacher Evaluation System (OTES), which is designed to be a coaching model, several standard areas within the rubric are comprised of

indicators that emphasize the need for knowing and understanding students and what is interesting to them. This is based on background and experiences, and in order for a teacher to fall in the accomplished indicator, the evidence must fall in the following areas (ODE, 2019). Hattie's (2012) Visible Learning questioning pertaining to feedback can integrate with the OTES process to allow for more meaningful discussions and planning. The motivational factors in the MUSIC® Model also appear throughout these indicators:

OTES Rubric:

Knowledge of Students-Accomplished Indicator (ODE, 2019) established that:

The teacher demonstrates an understanding of the purpose and value of learning about students' background experiences, demonstrates familiarity with each student's background knowledge and experiences, and describes multiple procedures used to obtain this information; the teacher's analysis of student data (student development, student learning and preferred learning styles and student backgrounds/prior experiences) accurately connects the data to specific instructional strategies and plans; and the teacher plans for and can articulate specific strategies, content, and delivery that will meet the needs of individual students and groups of students.

Resources-Accomplished Indicator (ODE, 2018) mandated that instructional materials and resources are aligned to instructional purposes, are varied and appropriate to ability levels of students, and actively engage them in ownership of their learning.

Assessment of Student Learning-Accomplished Indicator (ODE, 2018) stated that:

The teacher uses assessment data to identify students' strengths and needs, and modifies and differentiates instruction accordingly, as well as examines classroom assessment results to reveal trends and patterns in individual and group progress and to anticipate learning obstacles; and

The teacher provides substantive, specific and timely feedback to students, families and other school personnel while maintaining confidentiality. The teacher provides the opportunity for students to engage in self-assessment and show awareness of their own strengths and weaknesses. The teacher uses student assessment results to reflect on his or her own teaching and to monitor teaching strategies and behaviors in relation to student success (Ohio Department of Education, 2019).

Charlotte Danielson's (2013) framework has some similar components to the OTES and is also present in Hattie's (2012) theories and the motivational factors Jones (2017) studied in the MUSIC® inventory. She listed four domains including planning and preparation, classroom environment, instruction, and professional responsibilities. In the planning and preparation, Danielson (2013) discussed making connections between contents and past and future lessons, emphasizing problem solving and inquiry, and clear explanations. Formative assessments are part of planning and can assist the teacher in monitoring student progress towards the goals. Danielson (2013) discussed the importance of a classroom environment with organized routines that eliminate barriers. The instruction domain emphasizes student-driven instruction and high engagement. This includes consistently high expectations for students, and feedback relative to learning goals throughout the lesson. Teachers must realize their role in adjusting before, during, and after the lesson to ensure students are learning. Lastly, Danielson (2013) discussed the role

of the teacher in the professional responsibilities domain as a crucial leader in demonstrating cultural competence and relevance. Danielson's (2013) work was embedded in Hattie's Theory (2012) and has connections to the motivational factors Jones (2017) discussed. Bridging these concepts into pedagogy is the role of the administrator, leading the teacher to best practice.

The role of an administrator in tying these concepts together will be in the form of instructional leadership, and coaching teachers to effective use of these practices as an intertwined system rather than separate initiatives. The instructional leader will have high expectations in coaching teachers to make learning relevant, useful, and interesting, while at the same time creating a caring, safe environment for all students. While problem-based learning, project-based learning, and problem-solving teaching are all teaching styles designed to maximize student ownership, Universal Design for Learning is a framework that helps to eliminate barriers to learning (Novak, 2017). Ferguson and Danielson (2014) provided examples of this, including organizing the classroom in a way that maximizes efficiency and access. In addition to the physical space, other teaching strategies such as consistent feedback can eliminate barriers before they become insurmountable. Feedback throughout the entire lesson is essential for students to know where they are and where they need to go, relative to the goals (Hattie, 2012). Leaders should also emulate this process, providing consistent and specific feedback to teachers throughout the year, not only during the evaluation cycle. The more frequent the communication and feedback, the more opportunity for the student and teacher to adjust. For barriers to be eliminated, students and teachers must be exposed to inequities and bias, as well as student background and experiences. These concepts applied as tools combined with coaching by the instructional leader toward the accomplished indicators in the OTES rubric bring all of the components together to work toward increased student achievement and improved outcomes

(ODE, 2019). Figure 1 ties all of these factors together through cyclical implementation of components that affect student motivation.

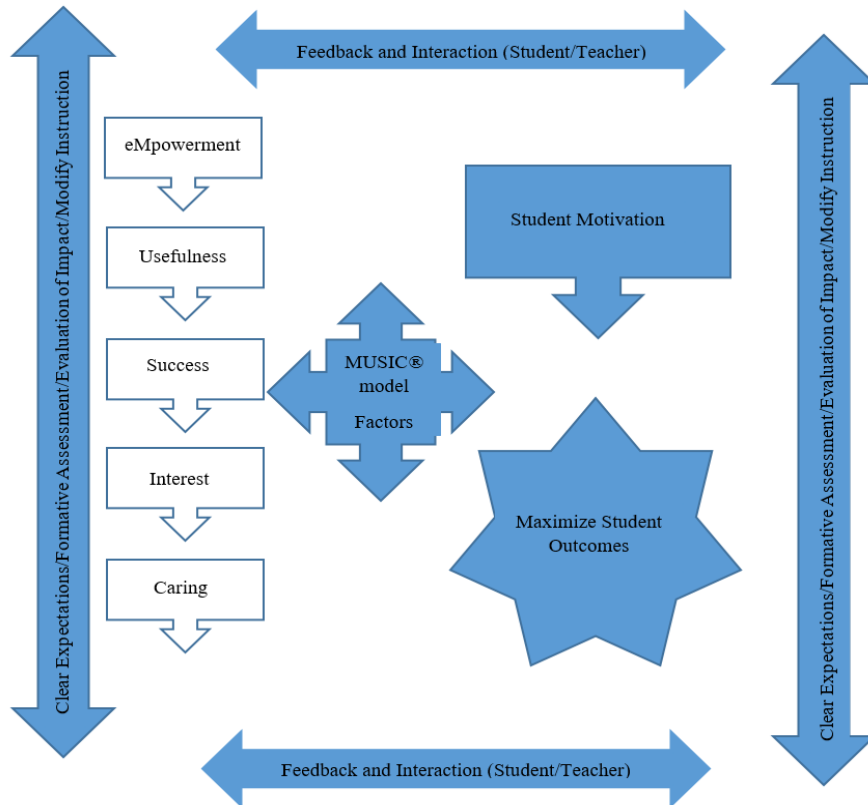


Figure 1. A Model of Motivational Factors, Expectations, Feedback, and Student Outcomes

Researchers can use the MUSIC® model as a source of motivation and effect on student achievement in a STEM school, and the impact on student learning outcomes. Researchers can examine the factors independently, in various combinations, or as an aggregate. Additionally, the researcher can examine the teacher versus student perceptions and determine if a correlation exists. This study utilizes a mixed-methods approach to examine teacher and student perceptions of these motivational factors, feedback, and expectations on student achievement in a STEM school and the effects of these factors on student learning outcomes. Educators can use the results to drive future instructional planning and delivery.

Summary

Contributing factors exist that inform student motivation, which can have an impact on student achievement and learning outcomes. Prior research regarding these factors discuss their effect on student achievement and growth, and ultimately the effect on student learning outcomes. The learning process is fluid and involves consistency with evaluation, feedback, and modification of lesson design based on student-teacher interactions, and evaluation of lesson effectiveness. Teachers must learn to evaluate lessons based on the effect they have on students and focus on student learning in addition to teaching methodologies. Hattie (2012) argued that teachers must monitor the effect of various factors on student learning, and approaches should be fluid and cyclical based on progress. Hattie's (2012) concept of visible learning overlapped with some components of the Tripod's 7Cs™ framework, which lays out elements of effective teaching. This method uses surveys to solicit student responses as they pertain to these elements (Ferguson & Danielson, 2014). The framework has three conceptual categories, consisting of multiple factors that contribute to effective teaching. The categories are, “personal support (care and confer), curricular support (captivate, clarify consolidate), and academic press (challenge and classroom management) (Tripod™, p. 1). This framework is also present in Danielson's (2013) work, where she identified teaching responsibilities that enhance student learning. Teachers should learn which motivational factors are the most impactful with their individual students and use this information to maximize student learning outcomes. Teachers must become research practitioners in their classroom and learn the ways in which they can effectively monitor the effect of teaching on student outcomes.

Chapter 3

Methods

This study was a mixed-methods research study examining the relationship between teachers' and their students' perception of course-related motivational factors on student outcomes. This investigation utilized the MUSIC® Model of Motivation, which educators use to assess motivation and study students' perceptions of their classes (Jones, 2017). Jones (2017) explained the MUSIC® model as an acronym that represents five principles, "eMpowerment, Usefulness, Success, Interest, and Caring" (p. 1). This was an investigation into the factors in the MUSIC® Model of Motivation, and the effect of motivational factors on student achievement and outcomes. The investigation focused on the teacher and student perceptions in the MUSIC® Model and compared two perceptions. The research then examined these factors in terms of achievement and student outcomes. Finally, the study used a guided interview to understand teachers' perceptions of the above findings as a reflective tool that the teachers may use in planning future instruction.

This research examines motivational factors and their impact on achievement and growth in a STEM school. The researcher will determine how factors associated with motivation affect student achievement. The factors will be examined both as individual constructs as well as their combined effect and impact with various combinations. The research explores the potential moderators of impact found through the study. The focus of this investigation is whether there is an association between overall reported motivation and student achievement, as measured by End-of-course performance and assigned course grade in a STEM school. More specifically:

1. What is the association between each motivational sub-factor (MUSIC®) and student achievement in a STEM school?

2. What is the relationship between educators' responses regarding their courses motivation sub-factors and how students respond regarding the same course?
3. What do educators report about their perceptions of the student and teacher results?
4. What do educators view is their responsibility in the educational process and outcomes of their students?

Participants

The participants in the study included 215 9th- and 10th-graders in a STEM school during the 2018-2019 school year. The school is a STEM-designated public school in Ohio, designed for 9th- and 10th-grade students. The school has 20 contributing districts and is open-enrollment statewide. State law prohibits screening of any type for enrollment. If enrollment exceeds capacity, a lottery system must be used; however, at the time of the study, the lottery was not needed and enrollment was first come, first served. At the time of the study, the school was in the third year of operation with students. Table 1 provides a breakdown of the gender distribution of the students.

Table 1

Student Demographics- Females Versus Males

	#	%
Females	95	45
Males	120	55
Total	215	100

As indicated above, the STEM school has more males than females.

Table 2 shows the demographics of the STEM school broken down by race.

Table 2

Student Demographics- Race

	#	%
White, Non-Hispanic	184	86
Black, Non-Hispanic	7	3.26
Hispanic	16	7.41
Multi-Racial	7	3.26
Asian	1	0.47
Total	215	100

Additional student demographics included 125 students (58%) on free/reduced lunch, 42 students with disabilities (19.5%), 23 students on 504 plans (11%), and two students designated as English language learners (ELL) (.9%).

During the study, the STEM school consisted of 10 teachers plus a STEM Coordinator. The study was centered around the content areas of science, social studies, English, and mathematics. There were eight teachers involved in the study; the lab elective teachers were not a part of the study. Four teachers in the study were female, four were male. Six of the eight teachers had been teaching for three years or less, while two of the teachers had been teaching between four and nine years.

Instrumentation

The data were scored using the calculations from the MUSIC® Inventory in Appendix D (Jones, 2017). A score for each scale was calculated: Empowerment, Usefulness, Success, Interest, and Caring (p. 23). Appendix D outlines the items associated with each principle, and provides the equation to determine the overall score (p. 13):

To obtain a score for each scale, average the values for the items in the scales as shown below.

$$\text{Empowerment score} = (\text{item 5} + \text{item 12} + \text{item 16} + \text{item 18}) / 4$$

$$\text{Usefulness score} = (\text{item 1} + \text{item 9} + \text{item 13}) / 3$$

$$\text{Success score} = (\text{item 2} + \text{item 4} + \text{item 7} + \text{item 10}) / 4$$

$$\text{Interest score} = (\text{item 6} + \text{item 8} + \text{item 17}) / 3$$

$$\text{Caring score} = (\text{item 3} + \text{item 11} + \text{item 14} + \text{item 15}) / 4$$

Jones (2017) cautioned not to find the sum or average to determine motivation, and simply taking the average this would be erroneous since certain questions are built upon a specified factor (p. 23).

The teachers took the instructor version of the MUSIC® Inventory (Appendix A) during the same time period and same frequency as the students. Teachers also answered questions using a similar, six-point Likert scale, where they responded on a one to six rating scale:

1 Strongly disagree	2 Disagree	3 Somewhat disagree	4 Somewhat agree	5 Agree	6 Strongly agree
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Figure 2. The MUSIC® Inventory Six-point Likert scale

The responses were scored using calculations explained in Appendix D. A score indicates the level of each of the five principles of the MUSIC® Model. Jones (2017) cautioned not to sum or average the responses but rather to look at the individual scores for each principle to find areas of strength and weakness. The following calculations were used to determine each of the five principles (p. 23):

To obtain a score for each of the five scales, place the item numbers from the prior page onto the corresponding line below. Then, average the values for the items in each scale by adding the numbers and dividing by the total number of items in the scale as shown below.

$$(\text{item 2} + \text{item 8} + \text{item 12} + \text{item 17} + \text{item 26}) / 5$$

$$(\underline{\quad} + \underline{\quad} + \underline{\quad} + \underline{\quad} + \underline{\quad}) / 5 = \underline{\quad} = \text{eMpowerment}$$

$$(\text{item 3} + \text{item 5} + \text{item 19} + \text{item 21} + \text{item 23}) / 5$$

$$(\underline{\quad} + \underline{\quad} + \underline{\quad} + \underline{\quad} + \underline{\quad}) / 5 = \underline{\quad} = \text{Usefulness}$$

$$(\text{item 7} + \text{item 10} + \text{item 14} + \text{item 18}) / 4$$

$$(\underline{\quad} + \underline{\quad} + \underline{\quad} + \underline{\quad}) / 4 = \underline{\quad} = \text{Success}$$

$$(\text{item 1} + \text{item 6} + \text{item 9} + \text{item 11} + \text{item 13} + \text{item 15}) / 6$$

$$(\underline{\quad} + \underline{\quad} + \underline{\quad} + \underline{\quad} + \underline{\quad} + \underline{\quad}) / 6 = \underline{\quad} = \text{Interest}$$

$$(\text{item 4} + \text{item 16} + \text{item 20} + \text{item 22} + \text{item 24} + \text{item 25}) / 6$$

$$(\underline{\quad} + \underline{\quad} + \underline{\quad} + \underline{\quad} + \underline{\quad} + \underline{\quad}) / 6 = \underline{\quad} = \text{Caring}$$

Individual student achievement data analysis included the following sets of data: End-of-course Results for English language arts (ELA) grades nine and ten, biology, algebra, American history, and geometry. The research examined if a correlation existed between the perceptions of the teachers in each of the principles with the student perceptions (Tamin & Grant, 2013). The factor analysis was in terms of student achievement, individually, as well as an aggregate. The research examined teacher and student perceptions to determine if a correlation existed between the results in each factor and as an aggregate. Additionally, if a correlation existed between individual factors such as student engagement, relevance, and student achievement, and assigned

order, then multiple regression analyses were performed using the MUSIC® Inventory (K. H. Larwin, Personal Communication, December 4, 2017).

The qualitative component of the preliminary analysis examined teacher responses to reflection questions. The teachers viewed the aggregate results of student means compared to teacher means for all factors. Once they viewed the results, they answered the following reflection questions individually:

- Did any particular factor (MUSIC®) stand out to you for perceptions of teachers versus students for our group as a whole? Explain.
- What do you think the role(s) of the teacher is (are) in ensuring student success?
- What qualities define a caring student-teacher relationship?
- Which factor (empowerment, usefulness, success, interest, or caring) do you feel is the most important for student learning?
- What does an effective teacher look like?
- Explain how formative assessment is used in your lesson planning.
- Which factor has the lowest student mean? From an instructional standpoint, what can you take away from this?
- Which factor has the lowest teacher mean? From an instructional standpoint, what can you take away from this?
- Which factor has the highest student mean? From an instructional standpoint, what can you take away from this?
- Which factor has the highest teacher mean? From an instructional standpoint, what can you take away from this?

- Have your views on the importance of each factor changed since you viewed the survey results?
- What other takeaways do you have from a learner/teacher perspective based on the results?

Procedures

Part one of the current investigation examined results of the MUSIC® model (Jones, 2017) from the following core content classes for the 2018-2019 school year. The content classes are year-long (two semesters), 47 minutes in length in biology, ELA in grades nine and ten, geometry, algebra, American history, and world history. The study received Youngstown State University (YSU) Institutional Review Board (IRB) approval prior to data collection. Students and teachers took the surveys in late fall, nearly midway through the school year. Students completed the survey during one academic period per day, so the participants did not repeat the study in multiple class periods. The procedure for administering the MUSIC® Inventory began with providing students in each class with the student questionnaire (Jones, 2017). Appendix C provides the general questions. The terms were modified for each content specifically (Jones, 2017). The students in each class had the same instructions and took the test through a Google form. The students answered on a Likert-type scale in which they responded to each question on a one-to-six rating scale (1= strongly disagree; 6= strongly agree) (Jones, 2017). The questions filtered into a spreadsheet where the researcher had a third-party sort and merge all of the data and remove all student and teacher names prior to analysis.

In part two of this investigation, all of the aggregated data were shared with the teachers, and they were informed that they would be receiving an invitation to participate in a follow-up interview with Dr. Karen H. Larwin. Dr. Larwin individually interviewed each teacher using the

open-ended qualitative questions indicated above. The researcher intended to use the reflective questions as a tool for teachers to develop strategies based on the quantitative results to drive future instructional design. These interviews were recorded, with permission, and transcribed. The transcribed interviews were shared with the researcher for synthesis with the quantitative data.

Research Limitations

Jones (2017) discussed validity in terms of the student questionnaire stating that “confirmatory factor analyses” are used to determine validity (p. 16). He also wrote that the MUSIC® Inventory tool for instructors is intended to for use in reflection and has not been validated for use in research (p. 12). Internal validity for the research is determined if a cause-effect relationship exists between the independent and dependent variables (Trochim & Donnelly, 2008). Additionally, since students only took the test during one period, and they would not have the opportunity, in most cases, to discuss content with one another, the validity of the study was increased (Trochim & Donnelly, 2008).

One threat to internal validity includes mortality/attrition. Examples of this are if students transferred back to their home districts, were expelled, or, for some reason, did not have the opportunity to make up the questionnaire. Another threat exists if a student was absent on one day, creating a condition where the student was able to speak with a peer prior to taking the inventory the following day. If the groups were different to begin with, differential selection is a potential issue, although this was minimized since an entire cross-section of the school is represented in the sample (Trochim & Donnelly, 2008).

Other challenges in this research include bias; for example, a student may not have been honest if they have recently received a poor grade or were unhappy with the class for other

reasons. Another challenge could be students not following directions or rushing through the survey. These challenges are minimized through clear, concise instructions per the MUSIC® Inventory (Jones 2017).

Discussion

The results of the current investigation allowed the researcher to investigate the effects of the five motivational factors on student achievement. Additionally, it provided a baseline structure for comparison to compare and contrast the effects of motivational factors on student achievement individually and as an aggregate. The research analyzed the student and teacher perceptions from the MUSIC® Inventory quantitatively, allowing the researcher to determine if there was a correlation. The study results led to teachers learning the comparison of student versus teacher perceptions, and the impact of the factors on achievement in terms of End-of-course Results and Grade Point Averages (GPAs). Teachers answered interview questions after examining the results of the quantitative component. The qualitative results provided an opportunity for professional reflection that can potentially influence future instructional design. The intent was that the study can replicate in future years, and data can be analyzed longitudinally.

Chapter 4

Results

The current investigation sought to examine motivational factors and their impact on achievement in a STEM school. The research evaluated how factors associated with motivation affect student achievement in terms of End-of-course Results and GPAs. The research examined the factors both as individual constructs as well as their combined effect and impact. The study explored the potential moderators of impact found through the study.

Research question 1:

- *Is there an association between overall reported motivation and student achievement as measured by End-of-course performance and assigned course grade in a STEM school?*

More specifically:

- *What is the association between each motivational sub-factor (MUSIC®) and student achievement in a STEM school?*
- *What is the relationship between educators' responses regarding their courses' motivation sub-factors and how students respond regarding the same course?*
- *What do educators report about their perception of the student and teacher results?*
- *What do educators view as their responsibility in the educational process and outcomes of their students?*

This chapter presents a discussion on the mixed-methods analysis that was conducted based on the research questions guiding the study. Quantitative results examined the comparison of the teachers' and students' perceptions of each of the factors, as well as the association of each factor and student achievement in a STEM school. Qualitative questions provided insight into the teacher reflection based upon the quantitative results.

Descriptive Statistics: Students

A total sample of 168 out of 215 students in the STEM school participated in the survey. Students in eight core content courses answered the survey questions. Eight teachers of the same courses answered the educator version of the questions in the MUSIC® Model Inventory. Lab teachers and students in those corresponding courses were excluded from the survey since these were not tested areas. In the sample, a total of 58% of students received free or reduced lunches. A breakdown of the students by grade level is provided in Table 3.

Table 3

Breakdown of Student Participants

Grade	Frequency	Percent
9	74	44
10	94	56

As indicated above, there are more 10th-graders in the sample.

Table 4 provides a breakdown of students by gender.

Table 4

Breakdown of Students by Gender

Sex	Frequency	Percent
F	77	45.8
M	91	54.2

As indicated above, the number of males in the sample exceeds the number of females by 14.

Table 5 provides a breakdown of students by race.

Table 5

Breakdown of Students by Race

	Frequency	Percent
Asian	1	0.6
Black	6	3.6
Hispanic	13	7.7
Mixed	13	7.7
White	135	80.4

As indicated in the Table 5, the majority of students are classified as White.

Table 6 provides a breakdown of students who are on a 504 plan, or an Individualized Education Plan (IEP), or classified as Gifted.

Table 6

Breakdown of Students on 504 Plan, IEP, or Gifted

	Frequency	Percent
IEP	27	16.1
504 Plan	14	8.3
Gifted	10	5.9

Descriptive Statistics: Teachers

A total of eight teachers participated in the survey; all of these teachers are Caucasian. Four of the teachers (50%) are female, and four of the teachers (50%) are male. The average years teaching at the STEM school is 3.12. Table 7 includes a breakdown of the core area by number of years teaching.

Table 7

Breakdown of Educators by Teaching Years in STEM

Course	Years
Algebra	4
American History	3
Biology	3
Chemistry	3
English - Grade 10	4
English-Grade 9	4
Geometry	2
World History	2

As indicated in Table 7, the greatest number of teaching years in STEM is four years. The school is currently in its fourth-year of operation.

Table 8 provides a breakdown of courses by student survey participants.

Table 8

Breakdown of Student Responses Per Core Content Area

Course	Frequency	Percent
Algebra	9	5.4
American History	18	10.7
Biology	21	12.5
Chemistry	14	8.3
English - Grade 10	23	13.7
English-Grade 9	21	12.5
Geometry	23	13.7
World History	39	23.2

Preliminary Analyses

The data were scored using the calculations from the MUSIC® Inventory (Jones, 2017). A score for each scale was calculated (MUSIC®, p. 23). The inventory assigned specific items associated with each principle and provided the equation to determine the overall score (p. 13):

To obtain a score for each scale, average the values for the items in the scales as shown below.

$$\text{Empowerment score} = (\text{item 5} + \text{item 12} + \text{item 16} + \text{item 18}) / 4$$

$$\text{Usefulness score} = (\text{item 1} + \text{item 9} + \text{item 13}) / 3$$

$$\text{Success score} = (\text{item 2} + \text{item 4} + \text{item 7} + \text{item 10}) / 4$$

$$\text{Interest score} = (\text{item 6} + \text{item 8} + \text{item 17}) / 3$$

$$\text{Caring score} = (\text{item 3} + \text{item 11} + \text{item 14} + \text{item 15}) / 4$$

Jones (2017) cautioned not to find the sum or average to determine motivation, and that this would be erroneous (p. 23).

The teachers took the instructor version of the MUSIC® Inventory during the same time period and same frequency as the students. Teachers also answered questions using a similar, six-point Likert scale where they responded on a one-to-six rating scale:

1 Strongly disagree	2 Disagree	3 Somewhat disagree	4 Somewhat agree	5 Agree	6 Strongly agree
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Figure 3. The MUSIC® Inventory Six-Point Likert scale

The responses were scored using prescribed calculations. A score indicates the level of each of the five principles of the MUSIC® Model. Jones (2017) cautioned not to sum or average the responses but rather to look at the individual scores for each principle to find areas of strength and weakness. The following calculations were used to determine each of the five principles (p. 23):

To obtain a score for each of the five scales, place the item numbers from the prior page onto the corresponding line below. Then, average the values for the items in each scale by adding the numbers and dividing by the total number of items in the scale as shown below.

$$(\text{item 2} + \text{item 8} + \text{item 12} + \text{item 17} + \text{item 26}) / 5$$

$$(\underline{\quad} + \underline{\quad} + \underline{\quad} + \underline{\quad} + \underline{\quad}) / 5 = \underline{\quad} = \text{eMpowerment}$$

$$(\text{item 3} + \text{item 5} + \text{item 19} + \text{item 21} + \text{item 23}) / 5$$

$$(\underline{\quad} + \underline{\quad} + \underline{\quad} + \underline{\quad} + \underline{\quad}) / 5 = \underline{\quad} = \text{Usefulness}$$

$$(\text{item 7} + \text{item 10} + \text{item 14} + \text{item 18}) / 4$$

$$(\underline{\quad} + \underline{\quad} + \underline{\quad} + \underline{\quad}) / 4 = \underline{\quad} = \text{Success}$$

$$(\text{item 1} + \text{item 6} + \text{item 9} + \text{item 11} + \text{item 13} + \text{item 15}) / 6$$

$$(\underline{\quad} + \underline{\quad} + \underline{\quad} + \underline{\quad} + \underline{\quad} + \underline{\quad}) / 6 = \underline{\quad} = \text{Interest}$$

$$(\text{item 4} + \text{item 16} + \text{item 20} + \text{item 22} + \text{item 24} + \text{item 25}) / 6$$

$$(\underline{\quad} + \underline{\quad} + \underline{\quad} + \underline{\quad} + \underline{\quad} + \underline{\quad}) / 6 = \underline{\quad} = \text{Caring}$$

Table 9 provides basic descriptive statistics for each of the factors for the students and the teachers separately.

Table 9

Basic Statistics for Student and Teacher Factors

Motivational Factors	Mean	SD	Skewness	Kurtosis
Student Empowerment	4.25	0.85	-0.64	0.65
Student Usefulness	4.07	1.06	-0.54	0.00
Student Success	4.72	0.93	-0.84	0.70
Student Interest	3.99	1.18	-0.58	-0.05
Student Caring	5.29	0.74	-1.48	2.37
Teacher Empowerment	4.00	0.50	-0.61	-0.93
Teacher Usefulness	4.02	0.51	0.53	-0.37
Teacher Success	4.41	0.40	-0.16	-0.86
Teacher Interest	4.08	0.63	0.08	-1.36
Teacher Caring	5.47	0.53	-0.62	-1.02

As indicated in Table 9, all of the factors demonstrate good levels of skewness and kurtosis ($|2.0|$ and $|5.0|$ as indicated by Field, 2013). The highest teacher and student mean was caring for both. The lowest student mean was interest, and the lowest teacher mean was empowerment.

Table 10 provides reliability estimations for each of the factors.

Table 10

Reliability Estimation for Each Factor

Factor	N	Reliability
Student Empowerment	4	0.8
Student Usefulness	3	0.85
Student Success	4	0.88
Student Interest	3	0.84
Student Caring	4	0.85
Teacher Empowerment	5	0.78
Teacher Usefulness	5	0.85
Teacher Success	4	0.57
Teacher Interest	5	0.92
Teacher Caring	6	0.94

As indicated above, all of the reliability estimates for both teachers and students are within an acceptable level (Field, 2013). The lowest reliability estimate for teacher success is within an acceptable range for the small number of educators completing the inventory.

Research Question 1: *What is the association between each motivational sub-factor (MUSIC®) and student achievement in a STEM school?*

An overall motivation score was computed by summing the student responses to all 18 items. The average response was $M=81.17$ ($SD = 13.09$) across the 168 students. A Pearson's zero-order correlation analysis was conducted in order to understand if a relationship exists between

students' reported motivation and their academic performance, separated by specific course for GPA. This is provided in Table 11.

Table 11

Students' Reported Motivation Per Course

Course	Number of Students	Correlation	sig.
Algebra	9	-0.04	0.926
American History	18	0.35	0.155
Biology	21	0.16	0.508
Chemistry	14	0.50	0.071
English - Grade 10	23	-0.34	0.116
English-Grade 9	21	0.38	0.093
Geometry	23	0.65	0.001
World History	39	0.04	0.802

As indicated in Table 11, two End-of-course sections produced negative associations between GPA and students' average reported motivation scores.

Table 12 provides the correlation between the students' motivation scores across all End-of-course Exams.

Table 12

Students' Motivation Scores Across End of Course Exams

Course	N	r	sig.
Algebra	64	0.09	0.484
American History	92	0.26	0.011
Biology	110	0.15	0.123
ELA 1	73	0.01	0.919
ELA 2	93	0.07	0.492
Geometry	99	0.19	0.064

As indicated in Table 12, the strongest relationship between End of Course exams and students reported motivation score is in American History.

Closer examination by each motivational sub-factor is in Table 13.

Table 13

Closer Examination of Each Student Sub-Factor

Factor	r	sig.
Student Empowerment	0.108	0.164
Student Usefulness	0.078	0.315
Student Success	0.417	0.001
Student Interest	0.118	0.128
Student Caring	0.116	0.135

As indicated in Table 13, the correlation is significant in the student success factor.

Table 14 provides the Pearson's zero-order correlation between End of Course Exams and the students responses to the motivational sub-factors.

Table 14

Correlation Between End-of-Course and Student Motivational Sub-Factors

Student Factors		Alg	Am. History	Bio	ELA 1	ELA 2	Geom
Empowerment	Corr	0.06	0.16	0.02	0.02	0.00	0.00
	Sig.	0.666	0.119	0.804	0.846	0.995	0.977
	N	64	92	110	73	93	99
Usefulness	Corr	0.04	0.05	0.05	-0.03	-0.16	0.10
	Sig.	0.755	0.640	0.610	0.837	0.135	0.339
	N	64	92	110	73	93	99
Success	Corr	0.235	.467	.287	0.066	.327	.409
	Sig.	0.061	0	0.002	0.58	0.001	0
	N	64	92	110	73	93	99
Interest	Corr	0.14	0.15	0.16	0.13	0.03	0.16
	Sig.	0.261	0.145	0.087	0.257	0.781	0.116
	N	64	92	110	73	93	99
Caring	Corr	-0.08	0.12	0.04	-0.14	0.01	-0.01
	Sig.	0.522	0.270	0.689	0.249	0.942	0.934
	N	64	92	110	73	93	99

As indicated above, the sub-factor of success demonstrated significant correlation with four of the six End of Course exam results. The sample size for each End of Course Exams varies during the academic year based on the number of students needing a specific exam.

Research Question 2: *What is the relationship between educators' response regarding their courses' motivation sub-factors and how students respond regarding the same course?*

Table 15 Indicates the correlation between student and teacher perceptions for each sub-factor.

Table 15

Paired Samples' Correlations

	N	Correlation	Sig.
Student & Teacher Empowerment	166	-0.125	0.109
Student & Teacher Usefulness	166	0.042	0.592
Student & Teacher Success	166	0.079	0.313
Student & Teacher Interest	166	0.001	0.986
Student & Teacher Caring	166	-0.224	0.004

Table 15 reflects a lack of relationship between the responses with the exception of the caring factor, which shows an increased divergence between teacher and student responses.

Table 16

Correlation Between Teacher and Student Sub-Factors (Combined)

	Mean	SD	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper	<i>t</i>	df	Sig.
Empowerment	0.25	1.04	0.08	0.09	0.41	3.09	165	0.002
Usefulness	0.05	1.16	0.09	-0.13	0.22	0.53	165	0.599
Success	0.32	0.98	0.08	0.17	0.47	4.14	165	0.000
Interest	-0.09	1.34	0.10	-0.30	0.11	-0.96	165	0.340
Caring	-0.18	1.00	0.08	-0.34	-0.03	-2.37	165	0.019

As indicated in Table 16, there is significant difference between teacher and student responses in three sub-factors: eMpowerment, Success, and Caring. Two of these three that are significant demonstrate a negative correlation (empowerment and caring). Further analysis showed that in the caring sub-factor, in particular, data diverged between teacher and student perceptions.

Qualitative Results

The interviewer was Dr. Karen H. Larwin. She asked one question prior to sharing all of the aggregated data with the teachers. Dr. Larwin individually interviewed each teacher using the open-ended qualitative questions. These interviews were recorded, with permission, and transcribed. The researcher intends to use the reflective questions as a tool for teachers to develop strategies based on the quantitative results to drive future instructional design. The transcribed interviews were shared with the researcher for synthesis with the quantitative data.

Teachers are referred to as Educator one (E1) through Educator eight (E8). Prior to the interviewer sharing the results the teacher would use to answer the questions, they were asked one question:

“When you look at the five factors, what do you think the teacher perceptions are going to be relative to the student perceptions? Which ones are more important?”

Answers to this question varied and were given prior to the teacher having knowledge of the quantitative survey data. E(1) stated that the usefulness factor is important, and engaging interest. E(2) teacher acknowledged that the teacher perceptions of the useful factor may vary from those of the students, since the teacher have an understanding of the big picture and other connections. Two teachers (E3 and E4) stated that the student success factor is the most important, because confidence can yield positive outcomes. Most teachers did not state that caring is the most influential factor until after the quantitative results were presented, then the teachers reconsidered based on those results. E(5) stated the importance of the students feeling as though they can be successful and that this promotes confidence. Caring was a recurring theme; several teachers mentioned that they thought this could be the most important factor, and that they hoped that the student and teacher results were similar regarding this factor. After the teachers answered these questions, the interviewer presented the results and asked corresponding questions reflected in research questions three and four.

Research Question 3: *What do educators report about their perception of the student and teacher results?*

Pertains to Qualitative Interview Questions:

- *Did any particular factor (MUSIC®) stand out to you for perceptions of teachers versus students for our group as a whole? Explain.*
- *Which factor has the lowest student mean? From an instructional standpoint, what can you take away from this?*
- *Which factor has the lowest teacher mean? From an instructional standpoint, what can you take away from this?*
- *Which factor has the highest student mean? From an instructional standpoint, what can you take away from this?*
- *Which factor has the highest teacher mean? From an instructional standpoint, what can you take away from this?*
- *Have your views on the importance of each factor changed since you viewed the survey results?*

The data revealed the lowest student factor as interest, whereas the lowest teacher factor was empowerment. The highest student factor was caring, and the highest teacher factor was also caring. E(1) explained that the lack of time to engage in meaningful discussions could be a reason that empowerment is low. This lack of time, according to the teacher, was due to the pressure to get through the content for the end-of-course tests. This same teacher discussed the highest mean of caring from both students and teachers, and that this was crucial to convey to students. E(6) teacher was happy that the students recognized that the teachers in the school care, and that the mean was relatively high. This teacher stated “we really do care, and we want to see the students succeed. They definitely love it here. I think it is important to be respectful and friendly to students.”

Prior to revealing the data, E(7) identified interest as being the most important. This same teacher expressed disappointment and surprise when he/she saw the results and acknowledged the interconnectedness of the factors. E(8) expressed interest as what the students would perceive as the highest since it is a STEM school and the teachers worked hard to make real-world connections. Several teachers expressed concern over the lowest student mean being interest. They discussed the wording of the questions of being the possible cause of these results. For example, one question that stated, “I enjoy completing the classwork” could have misled a student because they may not enjoy doing work in general, not necessarily the specific content.

All of the teachers properly interpreted the highest and lowest teacher and student means. There were mixed responses regarding the lowest student factor (interest), and the highest student factor (caring). The lowest teacher mean was empowerment, and the highest was caring. The highest factors for students and teachers were the same. The mean for student interest was 3.9, which fell in the middle of the range. One teacher explained the lowest student factor (interest) could be positively influenced by high teacher caring.

Teacher empowerment was the lowest mean, and three-fourths of the teachers referenced time restraints due to end-of-course testing as a possible explanation. E(4) stated,

...I think that one when I did that at least, I thought a lot about standardized testing, because I have a lot of testing as [grade level]. In a sense, we can make freedom and options and give the kids options, but the test sometimes limits what we're able to do as far as empowerment goes. They have control over how they learn the course content.

Several stated that they felt it inhibits them from empowering students in owning the lesson content since they are held to this standard; however, many acknowledged that this particular school does not make the success on these exams a primary goal. One teacher stated, “I do see more engagement when students have a choice, for sure” when discussing possibilities in the way a student expresses knowledge. Regarding the low score of empowerment, E(8) stated,

That doesn't necessarily surprise me a whole lot that the empowerment was lower. And I think it's probably tied back to feeling restraint from having to meet standards or doing test preparation. So, what Ohio requires us to cover, and I know for me that kind of leads me away from doing things that may hold a higher interest level for the students. Like for example, I know that they hate [subject activity], but I have to have them [subject activity], versus maybe showing me that they understand the information in a different way, just because that's part of my standards that I have to shape my course around. So, it's not necessarily super surprising to me.

This theme was recurring, and teachers erroneously felt they have to choose between empowerment and content to prepare for tests. E(6) stated that he/she allowed students to have a lot of choice, which contradicts the results; however, the results were presented to the teachers in aggregate minus identifiers. E(5) stated that the low empowerment rating by the teachers indicated the teachers were not giving themselves enough credit for allowing student ownership in how lessons were taught.

The highest student and teacher means were caring. All teachers demonstrated a positive reaction to the highest student mean, and the value and importance to convey a sense of caring to students. Many acknowledged the sense of caring is elevated in this school, compared to other schools. E(1) discussed the sense of community and family that is emphasized at the STEM school, and since it is a school of choice it is crucial that staff makes students feel comfortable about transitioning to a new environment. One staff member acknowledged that students either chose the school in pursuit of STEM education, an attempt to find a new beginning, or to run away from a previous environment. Teachers reacted favorably to the highest teacher mean (caring), stating this was important for a true awareness in how students are treated. E(2) discussed the emphasis on the importance of caring based on the results as:

Well it reinforces that caring for them and showing them that you care is important to them. And that can sometimes be forgotten as a teacher. When you show them that you care, even though they may not seem like they appreciate it, they do. So, keeping that in the forefront in your mind, is always important, so that reaffirms it.

Research Question 4: *What do educators view as their responsibility in the educational process and outcomes of their students?*

Pertains to Qualitative Interview Questions:

- *What do you think the role(s) of the teacher is(are) in ensuring student success?*
- *What qualities define a caring student-teacher relationship?*
- *Which factor (MUSIC®) do you feel is the most important for student learning?*
- *What does an effective teacher look like?*
- *Explain how formative assessment is used in your lesson planning.*

- *What other takeaways do you have from a learner/teacher perspective based on the results?*

The teachers had varying responses when discussing their thoughts in the role of a teacher in ensuring student success. E(3) stated that the teacher role was a combination of leading and supporting, and that the teacher must establish clear expectations. Once the expectations are set, the teacher must then encourage and support students through their efforts. E(4) stated the importance of the role as facilitator, and as a true partner in each student's education. One teacher stated, "I think the students should want to learn as much as the teacher wants to teach them." Two teachers indicated that students must show they care in order to ensure student success. According to the interview results, connections to real-world are also essential in ensuring success, otherwise the content will not have meaning and students will not retain the information. Regarding students wanting to do work, E(4) stated,

I just think they don't like doing work. I really do. It's a mentality, like a mindset. A lot of them don't like [subject]. I think they think about if this is something I enjoy doing, [subject]? Like no, it's not. I think that's going to impact, but I do give them choice about what they're able to [content activity]. As far as what I'm going to do moving forward to change the class... I always change the class every year based on the students.

E(5) replied the role of the teacher in ensuring success was as follows:

That is a complicated question. I think that our role in student success is high. That we have to set them up to be able to be successful. We have to give them the tools and the instruction and

the support in order for them to be successful. And then there comes a limit, where they have to take accountability and responsibility for themselves as students, and as individuals. Does she want like a ratio? Percentage?

Caring was a theme that appeared most often across questions. E(3) defined a caring teacher-student relationship using several themes. According to participants, the teacher must show respect; however, respect must go both ways. The teacher should convey an interest in students' lives outside of school. The concept of consistent feedback as a way to demonstrate caring surfaced throughout several interviews. E(2) indicated that the students can easily identify if a teacher does not truly care and conceded that students are less likely to want to learn in that setting. The survey results indicated that teachers consistently stated that caring was the most important factor in student learning, and an effective teacher shows the students they care first. (E8) stated that part of showing caring towards a student means developing relationships with them and validating and encouraging success to promote self-efficacy. In order to be effective, one teacher indicated the importance of challenging kids to prevent boredom, and setting challenging expectations was one way to show a student caring. E(5) described a caring student-teacher relationship as:

Giving a student the benefit of the doubt if they are typically a student that turns in every assignment and is late. Pulling them aside and having a one on one conversation with them and finding out what's going on that's causing this. So, building a relationship with students in order to be able to do that, and knowing them to know why all of a sudden is this dropping off when they've been

this type of student all year long. Taking an interest in them as individuals. Taking an interest in their future, in what they're - not only their career path, but them as kids. What do they enjoy doing? Joking with them. Building a relationship in that way. I think calling home also shows interest. The students may not necessarily appreciate it in the moment, but they may later on, that they had a teacher that was caring enough to keep them on the path that they needed to be on and notify people if they were kind of veering. I don't know if they would see it that way.

Participants in the sample (E1-E8) discussed several ways in which they implemented formative instructional practice into lesson design. The answers varied significantly between interviews. E(1) stated,

I use a lot of different strategies. I do a lot of really quick answers to this one question, whether it's like an entrance ticket or an exit ticket. I also just do like walking around and looking at their work, just for my own visual as seeing if they can accomplish that one question. Other formative assessments would be reading an article and then summarizing what they've read or putting together a thesis statement based off what they read or forming their own opinion about what they've read and constructing some sort of argumentative essay or even just an argumentative sentence based off what they read. What other ways do I? Quizzes, tests, actual

projects. They had to model [content], so they had to actually build it, make sure all the [content] were matching up or accurate.

E(2) indicated utilizing quiz results, and real-life scenarios with attached questions that reflected the content previously taught. Informal feedback and conversations as a means to gauge student learning was a consistent theme. Three teachers discussed their usage of success trackers that followed the standards, tracking student progress at varying levels of competency. Educator six (E6) stated, “formative assessment is at least something on a weekly basis, something tangible, something they can turn into me.” He/she also stated the importance of individual conversations, and that a teacher can gain a lot of insight simply from talking with students. Teachers mentioned the usage of entrance and exit tickets, although they did not use specifics when discussing when and how they used the data to drive instruction.

The teachers indicated some additional takeaways from the results. Overall, most indicated gratification from the highest student mean (caring) and began to make connections to the other factors based on how important this was. Authenticity and treating students as individuals was a recurring theme. Several participants evolved their thinking more towards the interconnectedness of the factors as conversations progressed, and admitted it was difficult to tell where the impact of one factor ends and the other begins. Regarding the overlap of the factors, E(3) stated,

Oh yeah, they could probably fall into different things. I really think the 2 biggest things, the 3 of the 5, because I think they all are definitely important. I guess I would say all 5 are important. Because I think to myself, okay, if a student is interested in what they're doing, they're going to be more excited about it. They're

going to want to learn more. But at the same time, if a student feels like they can be successful, they may not be interested, but if they feel like they may be successful, they may say, 'I'm going to do this, because I think I can learn this stuff.' So kind of depending on which way you think about it, if I'm a student and I walk in and it doesn't look like my teacher really cares to be there, I'm probably going to be less motivated to learn.

When referring to how he/she viewed the most important part of the education profession, E(7) stated his/her job was to inspire students, and “my job is to help students define what success means to them and then help guide them along a path that helps them get there.” All teachers expressed interest in viewing the results specific to their own class now that they examined the aggregate, and that will occur after the completion of this research.

Summary

Quantitative results suggest there is a negative correlation between GPA and students' average reported motivation score in Algebra and ELA 10. The strongest relationship between End-of-course exams and reported motivation score is in American History. In closer examination of each student sub-factor, correlation is significant in the student success factor. The success factor demonstrated significant correlation in four of the six exams, including American History, Biology, English Language Arts 2, and Geometry. In terms of teacher and student responses, the caring factor showed increased divergence between student and teacher responses. The research suggests significant differences between student and teacher responses in three factors: eMpowerment, success, and caring. Qualitative questions provided the opportunity for teachers to reflect upon practices based on quantitative results, and themes will

be discussed in the next chapter. These answers were answered in terms of research questions (and affiliated sub-questions) three and four. The teachers reflected upon the responses and their own pedagogy throughout the interviews and indicated that the quantitative result were interesting to them, especially in the caring factor for students and teachers.

Chapter 5

Summary of Findings

Motivating students to want to learn involves a complicated combination of factors, and the educator has the responsibility of attempting to learn what motivates each individual student. The current investigation focuses on motivation and educators' reflections to what students report and how they relate that to their experiences with students. This investigation includes both the quantitative results from the student-administered and educator-administered inventories, as well as qualitative data from follow-up interviews with educators. During these interviews, educators were asked to reflect on the results from the motivation survey. This investigation includes both the quantitative results from the student administered and educator administered inventories, as well as qualitative data from follow-up interviews with educators. During these interviews, educators were asked to reflect on the results from the motivation survey. The intent is for educators to use the results to drive future instructional planning and delivery.

The research question central to this investigation is: *Is there an association between overall reported motivation and student achievement as measured by End-of-course performance and assigned course grade in a STEM school?* More specifically:

1. What is the association between each motivational sub-factor (MUSIC®) and student achievement in a STEM school?
2. What is the relationship between educators' response regarding their courses motivation sub-factors and how students respond regarding the same course?
3. What do educators report about their perception of the student and teacher results?

4. What do educators view is their responsibility in the educational process and outcomes of their students?

The research suggests significant differences between student and teacher responses in three factors: eMpowerment, success, and caring. Quantitative results suggest there is a negative correlation between GPA and students' average reported motivation score in Algebra and ELA 10. The strongest relationship between End-of-course exams and reported motivation score is in American History. In closer examination of each student sub-factor, correlation is significant in the student success factor. The success factor demonstrated significant correlation in four of the six exams, including American History, Biology, English Language Arts 2, and Geometry. In terms of teacher and student responses, the caring factor showed increased divergence between student and teacher responses.

Qualitative questions provided the opportunity for educators to respond to the aggregate results and reflect upon their own practice and experiences in the classroom. These responses were answered in terms of research questions (and affiliated sub-questions) three and four. The educators reflected upon the responses and their own pedagogy throughout the interviews and indicated that the quantitative result were interesting to them, especially in the caring factor for students and teachers. Most educators indicated gratification from the highest student mean (caring) and began to make connections to the interconnectedness of the motivational factors. Authenticity and treating students as individuals was a recurring theme. Several participants' thinking evolved more towards the connection of the factors as conversations progressed, and admitted it is difficult to tell where the impact of one factor ends and the other begins.

Discussion

Research Question 1: *What is the association between each motivational sub-factor (MUSIC®) and student achievement in a STEM school?*

Summary of Findings

An overall motivation score was computed by summing the student responses to all 18 items. A Pearson's zero-order correlation analysis was conducted in order to understand if a relationship exists between students' reported motivation and their academic performance, separated by the specific course for GPA. Two End-of-course sections produced negative associations between GPA and students' average reported motivation scores (Algebra and ELA 10). The strongest relationship, both positive and negative, between End-of-course exams and students reported motivation score is in American History. Students expressed higher motivation in this course and performed better on the exam. The other End-of-course areas did not exhibit strong relationships between motivation and End-of-course results. For most of the measures, the correlation is significant in the student success sub-factor as an aggregate. The sub-factor of success demonstrated significant correlation with four of the six end-of-course exam results.

Interpretation of Findings-Research Question One

Motivation is what drives human behavior to attain a goal (Wang, 1993). For this research question, the study examined if a relationship exists between motivation and GPA, motivation and results on the End-of-course, and the correlation between End-of-course and the motivational sub-factors. In a school context, student motivation can impact student achievement and have implications on instructional practice. Teachers can affect student motivation in many ways, and there are sub-factors that contribute to motivation in a classroom setting. In the results, the sub-factor success produced significant correlation with four of the six

End-of-course exams. Student motivation to learn may be connected to activities that are meaningful and worth the effort when working toward the intended outcomes (Brophy & Good, 1986). Hattie (2012) discussed the concept of Visible Learning, which is a set of mind frames that teachers can utilize in order to maximize student learning. Research suggests a correlation between student motivation and achievement (Wang, 1993). This was evident in the results of the American History End-of-course Exam, where there was a strong relationship. As stated earlier, factors that motivate students can be intrinsic, extrinsic, or a combination of both (Conti, 2015). Educators must be aware of what motivates students and be able to monitor learning progress and outcomes to make necessary adjustments that improve student learning. Hattie (2012) discussed high expectations and clear learning targets. There were two courses with a negative association between GPA and motivation. This may indicate that the students are motivated, but the learning targets are too low and not rigorous enough.

In addition to these specific factors in the MUSIC® Inventory, the research examined other factors through qualitative reflection in research questions three and four. Teachers can attempt to motivate students through student engagement, although this concept is vague and not easily defined. Various approaches to teaching can engage students in their learning, and the effects of these approaches on student achievement. Wigfield and Eccles (2000) discussed motivation in terms of the value in task completion, and the performance expectations of the assigned tasks. This aligns with establishing clear expectations, which is discussed in the qualitative analysis. Student interest is one factor that motivates students to learn (Chen et al., 2001). Students' situational interest can lead to increased motivation and improved learning, and interest may be influenced by other factors (Mazer, 2013).

The research examined the relationship between each of the sub-factors and student achievement measures. The strongest relationship between End-of-course exams and students' reported motivation score is in American History. For four of the six End-of-course exams, the correlation is significant in the student success factor. This means that the more students perceived their success in the course, the better they performed on the exam. Students' perception of how well they will perform if they exert time and energy to the assigned task is success (Garcia, 2019). Jones (2009) indicated the importance of proper balancing of the level of difficulty; the tasks should be challenging yet manageable in order for students to be motivated to complete them. If a student is not feeling confident about their ability to complete an assignment, they are likely to be less motivated to work toward the task (Jones, 2009). Teachers should consider this when planning, and utilize formative instructional practices to gauge student abilities, then adjust accordingly. When students have a positive self-concept, this may correlate to higher levels of achievement, especially when students are able to complete challenging tasks with success (Gregory & Huang, 2013). There must be a balance between high standards that promote engagement and unrealistic expectations (Montgomery & Hirth, 2011). According to this study, when students felt a sense of success they performed better in four of the six content exams. The other two courses may have students feel successful, but the targets are not rigorous enough to adequately prepare the students for the End-of-course.

Context of Findings- Research Question One

The context of these findings must be considered. The school is a STEM-designated school for ninth and tenth graders. The acronym STEM stands for science, technology, engineering, and math. Students from 13 partner school districts attend the school, as it is open

enrollment statewide. In addition to the partner districts, students from a total of 20 districts attend the school.

Students choose to come to the school for several reasons. Some students choose to attend because they are looking for a different culture and experience. Others choose to attend because they prefer more inquiry-based learning that is centered around real-world experiences. Many students have not had good experiences in their prior school and choose to attend as a way of starting with a clean slate. Although the concept of a STEM school is different in the culture and delivery of education, students are still measured in the same way, which is performance on End-of-course exams. In this study, two End-of-course sections produced negative associations between GPA and students' average reported motivation scores (Algebra and ELA 10). This could indicate that students are motivated due to a combination of sub-factors, but the GPA was low. Another explanation could be if the GPA was high, and the motivation was low, possibly due to a combination of sub-factors. In Algebra in particular, the success sub-factor was low, so perhaps the motivation was lower because students did not feel successful. If that is the case, and the GPA was high, the grading may not be accurate in terms of standard-based grading and mastery towards the standards. This result is worthy of future exploration, since math is essential in everyday life, and is integral in STEM education. The strongest relationship between End-of-course exams and students reported motivation score is in American History. Students expressed higher motivation in this course and performed better on the exam, and this is not due to chance alone. This result from research question one, examined in combination with the results in research question two (teacher versus student perceptions) will provide more insight as to what, in particular, stood out in terms of the sub-factors relative to perceptions. The other End-of-course areas did not exhibit strong relationships between motivation and End-of-course results.

For most of the measures, the correlation is significant in the student success factor as an aggregate. This includes American History, where students were the most motivated and performed the highest. The sub-factor of success demonstrated significant correlation with four of the six End-of-course exam results. Two courses did not exhibit a strong correlation between success and End-of-course results (Algebra and ELA 1). This suggests that if students feel successful in this content on a regular basis, they may actually perform better on these exams. Noddings (2012) supported this idea through scaffolding and providing continuous support throughout the duration of the lesson.

Implications of Findings- Research Question One

These results produce implications within this school and the teachers there, as well as generalizations that can provide future research and directions at the adjacent Career and Technical Center which serves students in Grades 11 and 12, in 23 program/career pathways. The results in the sub-factor of success suggest that students perform better when they feel they can be successful. From a leadership perspective, this information is important to further examine, and provide necessary professional development and guidance to staff to find ways to allow students to feel successful, while providing high standards and quality instruction. Education in a STEM environment is intended to be different, focusing on inquiry-based learning and real-world connections. Additionally, the more that the leader emphasizes the concept of cross-content integration, rather than education in silos, can potentially provide students with an overall feeling of success rather than in the content silos. Additionally, a leader should dive deeper into examining why the two contents showed a negative correlation between motivation and GPA. If the reason is learning targets that are not appropriate, the leader must develop measures to work with staff in appropriately aligned learning targets that are rigorous but provide

students with realistic opportunities for feelings of success. This needs to be the culture of an entire building, not just some of the content areas. Noddings (2012) promoted scaffolding and supporting students throughout the lesson to promote high standards and feelings of success. This could be powerful in other areas that are not statewide assessment-based, but other measurements that could be more related to that students are interested. The culture of creating feelings of success for students while establishing high standards of teaching are particularly crucial in a school of choice, since students have already made the determination to leave their home district for one or more reasons.

Research Question 2: *What is the relationship between educators' response regarding their courses' motivation sub-factors and how students respond regarding the same course?*

Summary of Findings

For the purposes of this study, the research examined the motivational factors in terms of GPA and End-of-course results. The research suggests a lack of relationship between the responses with the exception of the caring factor, which shows a growing difference between teacher and student responses. This means that students may have responded high in terms of their perceptions of the teacher demonstrating care, while the teachers reported their perceptions as lower. There is significant difference between teacher and student responses in three sub-factors: eMpowerment, Success, and Caring. Two of these three that are significant demonstrate a negative correlation (empowerment and caring). Further analysis showed that in the caring sub-factor, in particular, there was a gap between teacher and student endorsement of caring.

Interpretation of Findings- Research Question Two

In the MUSIC® model acronym, the caring factor determines if students believe that the instructor and others in the learning environment care about their learning and about them as

people. Jones (2009) described caring as the trust and respect that teachers and students demonstrate toward each other. Garza, Alejandro, Blythe, and Fite (2014) explained caring as a combination of empathy, listening, scaffolding, and providing what students need academically. In addition to meeting students' needs through academics, teachers can demonstrate caring by showing support for students academically and emotionally (Ferguson & Danielson, 2014). The highest mean for both teachers and students was the caring sub-factor, although there was a negative correlation between the teacher and student perceptions of caring. The lowest factor for students was interest in the content, while the lowest response for students was the empowerment factor. This indicates the teachers do not feel strongly that their lessons empower students and allow for them to exhibit ownership. In research question one, the research suggests the success factor was the most influential in four of six End-of-course exams, but that factor did not appear within the context of research question two findings.

Context of Findings- Research Question Two

In the STEM school, which is a school of choice, a culture of caring is essential in making students feel a part of their new school community. Hoffman (2009) argued that it is important for teachers to work toward caring relationships and strive toward continuous improvement of that relationship. Shacklock (1998) argued that caring is an integral characteristic of teachers and a professional responsibility. Cushman (2006) argued that students felt a teacher cared when the teacher was enthusiastic about what they were teaching and had high expectations while communicating confidence in task completion. Reppy and Larwin (2019) stated the importance of meeting the students' social-emotional needs to show genuine care and this requires dedication from all staff members. When students feel a sense of belongingness, they feel cared for by their teachers, and teachers can control this through their

actions (Baumeister & Leary, 1995). Noddings (2012) argued that students will work harder for a teacher who cares about them, and their favorite teachers are the ones for whom the students will work the hardest.

The research suggests that the caring factor demonstrated the highest mean for both the teachers and students. This is crucial for the culture of the STEM school, and it would be problematic if these were low scores. Additionally, the STEM school has a relatively high percentage of students with disabilities, and students on free or reduced lunch. Demonstrating care may serve as the bridge to ensure success for this group of students. The students rated interest as the lowest, which needs further exploration since this is a STEM school, which is designed to integrate real-world issues into each content. The lowest teacher mean was empowerment, meaning, overall, they do not feel that they are empowering their own students. This could lead to part of the explanation of the low score in the interest factor; if students are not empowered they may not have enough student-driven instructional practices embedded into the lessons. This is a statement common among teachers, and is worth further investigation, for it emulates a lack of creativity in lesson design around the standards. The caring factor being the highest is indicative of the positive culture created by the staff and felt by the students. The success factor was not the lowest or the highest for the teachers and students, but it had the highest correlation to End-of-course results, as previously discussed in research question one analysis.

Implications of Findings- Research Question Two

Since this is a STEM school and lessons are intended to reflect real-world connections, it is concerning that interest is the lowest rated sub-factor by students. The caring factor was rated the highest by the teachers and the students. This indicates a culture of caring, which is an

expectation of the administration. Many students who choose to attend do so because they have had negative school experiences up until this point. Students have expressed repeatedly that their home districts do not care about them, so it is especially important that the STEM staff facilitate a caring culture. A low empowerment score means the teachers do not feel they are empowering students, which is a crucial component in student-driven instruction and the focus of STEM education. The teachers reflect in research questions three and four as to the possible reason(s) behind this result. Perhaps it is worth considering the relationship and overlap between the caring and success factors, since it is evident that the school creates a culture of caring. As discussed in research question one analysis, the success sub-factor suggested a correlation in four of six End-of-course exams. If caring can be channeled into making students feel they can have success, maybe this could demonstrate positive outcomes on student achievement. The building leaders must explore this further then provide necessary professional development to staff.

Research Question 3: *What do educators report about their perception of the student and teacher results?*

- *Did any particular factor (MUSIC®) stand out to you for perceptions of teachers versus students for our group as a whole? Explain.*
- *Which factor has the lowest student mean? From an instructional standpoint, what can you take away from this?*
- *Which factor has the lowest teacher mean? From an instructional standpoint, what can you take away from this?*
- *Which factor has the highest student mean? From an instructional standpoint, what can you take away from this?*

- *Which factor has the highest teacher mean? From an instructional standpoint, what can you take away from this?*
- *Have your views on the importance of each factor changed since you viewed the survey results?*

Summary of Findings

Teachers correctly identified the highest teacher mean (caring), highest student mean (caring), lowest teacher mean (empowerment), and lowest student mean (interest). When asked about the possible explanations behind the lowest teacher mean of empowerment, many teachers expressed pressure they feel to perform well on End-of-course exams, and the limited time they have to make it through all of the standards. E(4) stated, “but the test sometimes limits what we’re able to do as far as empowerment goes” when discussing the perceived limitations of this essential component in pedagogy. This theme was recurring, and teachers erroneously feel they have to choose between empowerment and content to prepare for tests.

The highest student and teacher means were caring. All teachers demonstrated a positive reaction to the highest student mean, and the value and importance to convey a sense of caring to students. Many acknowledged the sense of caring is elevated in this school, compared to other schools. The teachers discussed the sense of community and family that is emphasized at the STEM school, and since it is a school of choice it is crucial that staff makes students feel comfortable about transitioning to a new environment. One staff member acknowledged that students either choose the school in pursuit of STEM education, an attempt to find a new beginning, or to run away from a previous environment. Teachers reacted favorably to the highest teacher mean (caring), stating this is important for a true awareness in how students are treated.

Interpretation of Findings- Research Question Three

When students are interested in an assigned task or project, they are more likely to be motivated (Garcia, 2019). The lowest student mean was interest, which the teachers admitted was concerning, especially in a STEM school. In order to promote interest, students must see connections to life outside of school, which varies based on the students. Real-world connections are a primary goal of STEM education, so the low mean needs further explored. Teachers who make lessons relevant can captivate students through inquiry (Tripod™, 2014). Bowers and Flinders (1991) argued that cultural responsiveness is a key factor in attracting student interest. Teachers must take this into consideration when planning. Jones (2009) referred to usefulness as the perceived value of a lesson, and how the lesson impacts students' lives directly. Kauffman and Husman (2004) argued that student motivation increases when they feel the content is beneficial for the future. Teachers should take relevant assignments into consideration when planning and eliminate assignments that students perceive as useless (Garcia, 2019). Garcia (2019) also discussed the importance of making connections to the real world and life outside of school within lesson design. Students become more autonomous when the teacher clearly communicates the rationale behind the task and makes clear connections. Student motivation to learn is connected to activities that are meaningful and worth the effort when working toward the intended outcomes (Brophy & Good, 1986).

The empowerment factor in the MUSIC® model refers to educational strategies and planning that foster student autonomy through freedom and choice (Jones, 2017). Student empowerment leads to autonomy, which promotes intrinsic motivation (Deci & Ryan, 2012). A recurring theme throughout the interviews was stress teachers feel from the pressure due to End-of-course exams, which could explain why teachers perceive the low empowerment of students.

Teachers who allow for students to share ideas and include students' input promote autonomy and ownership (Tripod™, 2014). Choice means that students perceive that they provide input into decisions pertaining to lessons (Wang & Eccles, 2013). This can include students providing insight into classroom operations and activities (Ferguson & Danielson, 2014). Choice can lead to increased motivation toward a task, since students have input into the lesson design and implementation.

The highest student and teacher means was the caring sub-factor. In the MUSIC® model acronym, the caring factor determines if students believe that the instructor and others in the learning environment care about their learning and about them as people. Jones (2009) described caring as the trust and respect that teachers and students demonstrate toward each other. Garza, Alejandro, Blythe, and Fite (2014) explained caring as a combination of empathy, listening, scaffolding, and providing what students need academically. Teachers can demonstrate caring by showing support for students academically and emotionally (Ferguson & Danielson, 2014). In the STEM school, this is a crucial culture and non-negotiable. Teachers can show caring through developing personal relationships, creating a physically and emotionally safe environment, and establishing high standards, and this is consistent practice at the STEM school. Hoffman (2009) argued that it is important for teachers to work toward caring relationships and strive toward continuous improvement of that relationship. Shacklock (1998) argued that caring is an integral characteristic of teachers and a professional responsibility. In education, teachers must balance accountability with creating relationships with students. Creating a caring environment can be challenging for some; many teachers are trained in content and not on creating an emotionally safe classroom. Educational climate is not only indicative of interpersonal relationships, but more specifically empathy, fairness, and trust (Hattie, 2012). All of the teachers interviewed

expressed relief, pride, and contentment at the high scores from teachers and students regarding the caring factor.

Context of Findings- Research Question Three

The teachers' analyses of the answers pertaining to research question three were in the context of the STEM school, which is a school of choice serving 20 school districts regionally. The questions asked teachers to identify the highest and lowest student and teacher means and reflect upon these results from an instructional standpoint. The STEM school was in the third year with students at the time of the study and the majority of teachers had been teaching for three or fewer years. When discussing the highest teacher and student means, overall, the staff was happy that caring was the highest sub-factor; so much so, that many teachers' thinking evolved to caring as the number one important sub-factor by the end of the interviews. Some stated that the students choose to leave their home district to come to the STEM school, so teachers demonstrating they care, and students perceiving being cared for, is essential in the school. This buy-in and mentality was not always there, since high school teachers are content-trained, therefore content-driven. The STEM teachers are evolving to realize they must take more of an elementary teacher mindset in knowing and caring for students first, and teaching content second. The teachers expressed the importance of caring, and if a student does not feel cared for they will not learn.

The lowest student mean was interest. The teachers were overall disappointed by this result. One teacher mentioned the use of work-sheets and was surprised by the reaction of students not finding this interesting. Another educator indicated that interest was the most important factor, then changed to caring after reviewing the results. In the context of a STEM school, the content area interest may show lower results than a lab; however, STEM education is

intended to integrate STEM content across all contents. This needs further explored, and teachers will further their learning in not merely teaching content and standards but how to integrate STEM across the curriculum. Teachers explained the lowest teacher mean (empowerment) in terms of their feeling pressured to perform on End-of-course Assessment in a limited time frame, and the frustration that the STEM school students still have to take those tests even though the students have chosen a different style of education. As the interviews continued, many teachers reframed their most important factor to caring, and admitted that this is crucial in the context of the STEM school.

Implications of Findings- Research Question Three

The results indicated that the students and teachers rated caring as the highest sub-factor mean. In a STEM school, which is a school of choice, this culture is essential and must remain a priority. Many students attend the school because of negative experiences in their home districts. Additionally, one of the reasons students choose to come is to start a new beginning. Many students have home lives that are not ideal, and this may be some of the only caring they feel daily. The focus on caring in the school must continue as a priority, and proper and effective ways to show caring will continue to be a priority in working with staff. The research suggested overall positive reaction by the staff to the result of caring having the highest means, which says a great deal about the culture. Moving forward, school leadership will examine ways to continue to work with staff to increase empowerment (lowest teacher mean), which may in turn lead to higher interest (lowest student mean). If students feel empowered and have ownership through student-driven learning, it is possible they may be more interested in the content due to connections to their lives.

Research Question 4: *What do educators view as their responsibility in the educational process and outcomes of their students?*

Pertains to Qualitative Questions:

- *What do you think the role(s) of the teacher is in ensuring student success?*
- *What qualities define a caring student-teacher relationship?*
- *Which factor (MUSIC®) do you feel is the most important for student learning?*
- *What does an effective teacher look like?*
- *Explain how formative assessment is used in your lesson planning.*
- *What other takeaways do you have from a learner/teacher perspective based on the results?*

Summary of Findings

The teachers had varying responses when discussing their thoughts in the role of a teacher in ensuring student success. The teacher's role is a combination of leading and supporting, and that the teacher must establish clear expectations. Once the expectations are set, the teacher must then encourage and support students through their efforts. Part of this role is showing students that they are cared for by the staff. The most recurring sub-factor across research questions was caring. According to interview participants, the teacher must show respect to students; however, respect must go both ways. The teacher should convey an interest in students' lives outside of school. The concept of consistent feedback as a way to demonstrate caring surfaced throughout several interviews. Students can easily identify if a teacher does not truly care, and they are less likely to want to learn in that setting. The survey results indicated that teachers consistently stated that caring is the most important factor in student learning, and an effective teacher shows the students they care first. Part of showing caring towards a student

means developing relationships with them and validating and encouraging success to promote self-efficacy. In order to be effective, one teacher indicated the importance of challenging kids to prevent boredom, and setting challenging expectations is one way to show a student caring.

When asked about how formative assessment is used in lesson planning, answers varied significantly. Some indicated utilizing quiz results, and real-life scenarios with attached questions that reflect the content previously taught. Informal feedback and conversations as a means to gauge student learning was a consistent theme. Three teachers discussed their usage of success trackers that follow the standards, tracking student progress at varying levels of competency. One educator uses formative assessment as little as one time per week. Teachers mentioned the usage of entrance and exit tickets, although they did not use specifics when discussing when and how they use the data to drive instruction.

The teachers indicated some additional takeaways from the results. Overall, most indicated gratification from the highest student mean (caring) and began to make connections to the other factors based on how important this is. Authenticity and treating students as individuals were recurring themes. Several participants evolved in their thinking more towards the interconnectedness of the factors as conversations progressed, and admitted it is difficult to tell where the impact of one factor ends and the other begins.

Interpretation of Findings- Research Question Four

The perceptions of the teachers' view of caring were analyzed in relationship to the students' views of caring (Jones 2017). Banerjee (2016) argued that student perceptions of teacher attitude toward them can lead to better academic performance. This is tied to the concept of caring and what this may look like according to student perceptions. These perceptions are key to whether or not a student feels safe enough to learn through trial and error, and if the

educational climate is not only indicative of interpersonal relationships, but more specifically empathy, fairness, and trust (Hattie, 2012). Hattie (2012) argued that students must feel safe and willing to fail during the learning process. He argued that leaders must create this similar culture for teachers as they learn to evaluate their impact on teaching. Caring was a consistent theme across all research questions, and its importance became more evident as the interviews progressed.

Research suggests a correlation between student motivation and achievement (Wang, 1993). As stated earlier, factors that motivate students can be intrinsic, extrinsic, or a combination of both (Conti, 2015). Educators must be aware of what motivates students and be able to monitor learning progress and outcomes to make necessary adjustments that improve student learning. In research question four, the teachers were asked to reflect upon the results from an instructional standpoint. Research question four encompasses theory from Ferguson and Danielson (2014), incorporating use of feedback and concept of an effective teacher. Hattie (2012) also discussed feedback as integral to effective teaching. The concept of visible learning overlaps with some components of the Tripod's 7Cs™ framework, which lays out elements of effective teaching. The framework is research-based and has three domains that encompass responsibilities in the classroom, planning instruction, and other professional responsibilities that combine for effective teaching.

Teachers provide feedback to students in a variety of ways, whether it is formal or informal, summative, and/or formative. When a teacher clarifies for a student, they help in student understanding of the content of the lesson and intercept confusion. This is more effective when checking for understanding frequently and providing specific feedback (Ferguson & Danielson, 2014). Teachers must frequently check for understanding and adjust instruction

before, during, and after the lesson. They can task students with self-evaluation against the rubric and goals set for the lesson. As teachers adjust their instruction, they are providing specific feedback that supports problem-solving and critical thinking (Ferguson & Danielson, 2014). Part of learning is trial and error, and students must feel safe to make errors and learn through this process while making adjustments toward improvement. Students must learn to embrace obstacles and tackle them enthusiastically. Teachers in the qualitative questions seemed to have varying concepts of what formative assessment is, how to use it, and how to monitor its effectiveness.

Context of Findings- Research Question Four

The teachers in this study work in a STEM designated public school, which is a school of choice and open-enrollment statewide. During the study, the school was in the third year of operation with students. The majority of staff has been teaching for three years or less. The sub-factor caring resurfaced in research question four; several teachers stated that this is the most important sub-factor. This sentiment seemed to grow as questions progressed. This is important in any school, but it is crucial in a school of choice where students left their home district for a variety of reasons. When asked what the primary role of an educator is in ensuring success, the teachers indicated that their role is to inspire students and facilitate their learning experiences. Teachers did not mention formative instructional practices when asked what an effective teacher looks like. They focused on the caring sub-factor, and also setting challenging and attainable goals while providing the assistance students need to achieve these goals. Teachers were inconsistent in their responses for how they utilize formative instructional practices. This could be due to the fact the school is so new, and the majority of the staff has been teaching for very few years. Several teachers mentioned that families are not involved, almost using it as an excuse

not to try to include them in the educational process. There tends to be a negative shift in focus to the families who do not respond when called rather than the need to continue to try to engage families regardless.

Implications of Findings- Research Question Four

The concepts Hattie (2012) outlined are the connections between the factors. In moving forward in this school, based on the results of the research, the implementation of formative instructional practices must be refined. Leaders should invest time in ensuring rigorous lessons aligned to standards, while ensuring cross-content integration. Additionally, teachers must learn to use formative instructional practices, and monitor effectiveness. From there, they must consistently modify and enhance lessons based on feedback that occurs before, during, and after the lesson. Teachers must balance the empowerment of students with the required course outcomes, and demonstrate they care through their actions. The concept of teacher care is difficult to qualify, and the relationship between student success and feeling they are cared for is worth further exploration. Ultimately, the more teachers understand the interconnectedness of the sub-factors and ways they can increase motivation for individual students, the more equipped they will be in responding to students' needs. The building leader is ultimately responsible for ensuring this occurs and providing the teachers with what they need to accomplish these goals.

Limitations of Study

Limitations to the research include a small sample size, limited to the answers of students in one school building. Replicating this study in another school(s) could provide more information due to a larger and more diverse sample. Additionally, the only achievement data used for the purposes of this study were End-of-course exams and GPAs. The concept of GPA is subjective and arbitrary and is inconsistent between educators. There are other sources for

achievement data that could be examined, such as assessments related to 21st Century skills like industry credentials. Another limitation is that some students did not take the survey, so their data could not be used, further limiting the sample size. The response rate was 84%, so the data are a good representation of the entire sampling frame. The school was in the third year of operation during the study, which could affect the data since the staff and students were so new. Student achievement was measured in the six End-of-course exam results, which is narrow in scope compared to what other types of courses are offered at the STEM school; however, End-of-course exams are a standardized measure so it may provide a better indication of students' preparation and achievement than the GPAs. Lastly, there could be social desirability bias of the survey responses by both the teachers and the students, as well as the responses in the interviews.

Future Research

The results of this study are a catalyst for future research. Caring is the sub-factor that reappeared consistently throughout the research questions and was the highest teacher and student mean. Although it was the highest mean, the research suggested a divergence between teacher and student perceptions of caring. This could mean that the definition of caring varies between the teachers and students, so it would be beneficial to examine how teachers and students define caring, and what that means in the context of a STEM school. The success sub-factor showed the greatest correlation in four of six End-of-course assessments. Since caring was rated the highest, but success showed the strongest correlation, it would be valuable to study if relationships exist between success and caring, and what impact a teacher may have on a student feeling successful by demonstrating care in a classroom setting. Future research could include translating this research to other forms of assessment that include 21st-Century tests such as industry credentials. This would reflect the values of a STEM school better than state

assessments. In tandem with Hattie's (2012) research, further study could examine the relationship between effective formative assessment and feedback, and how that relates to care and success. Overall, the interconnectedness of the sub-factors could warrant further research. Lastly, further research could include the impact of teacher self-reflection on student achievement and outcomes.

Conclusion

Based on the high mean scores for caring by both students and teachers, the research suggests that caring is a priority in the STEM school. The research also suggests a correlation between the success sub-factor and four out of six End-of-course exams. The results of the study suggested that the success sub-factor shows a correlation with the End-of Course exams in these four areas, indicating a possible relationship and impact on student achievement. Teacher empowerment was the lowest sub-factor, while the students rated interest the lowest. Worth examining is the possibility of a relationship between the two; perhaps students are not as interested because the teachers feel they could empower the students more towards student-centered learning. In two courses (ELA 10 & Algebra), there was a negative correlation between motivation and GPA. This could indicate that learning targets are too low and not rigorous enough. Perhaps the GPA is high in these classes, but students are not motivated because they desire a greater challenge. Formative instructional practices implementation and monitoring needs refined in this group which could be attributed to the fact the school was in the third year in the time of the study, and the average teaching years was only ($M=3.12$). This should be a focus for building leadership moving forward. Teacher reflection through the qualitative questioning was effective in truly evaluating the needs of the teacher, and how they prioritize the sub-factors. This prioritization was fluid throughout the interviews, and caring was the sub-factor

most discussed and emphasized as important. The value placed on caring increased as conversations continued. Caring is crucial in the vision of the STEM school, and a great place to start from a standpoint of building culture to further study the impact of these factors on student achievement in a STEM school.

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Appendix A

MUSIC® Inventory (Adapted from Jones, 2017, Professor version, present tense)

List a course for which you want to assess students' motivation: _____

Respond to the items below in relation to this one course using this scale:

1 Strongly disagree	2 Disagree	3 Somewhat disagree	4 Somewhat agree	5 Agree	6 Strongly agree
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Note that the word "coursework" refers to anything that students do in the course, including assignments, activities, readings, etc.

Students believe that:

- _____ 1. the coursework holds their attention.
- _____ 2. they have the opportunity to decide for themselves how to meet the course goals.
- _____ 3. in general, the coursework is useful to them.
- _____ 4. I am available to answer their questions about the coursework.
- _____ 5. the coursework is beneficial to them.
- _____ 6. the instructional methods used in this course hold their attention.
- _____ 7. they are confident that they can succeed in the coursework.
- _____ 8. they have the freedom to complete the coursework their own way.
- _____ 9. they enjoy the instructional methods used in this course.
- _____ 10. they can be successful in meeting the academic challenges in this course.
- _____ 11. the instructional methods engage them in the course.
- _____ 12. they have options in how to achieve the goals of the course.
- _____ 13. they enjoy completing the coursework.
- _____ 14. they are capable of getting a high grade in this course.
- _____ 15. the coursework is interesting.
- _____ 16. I am willing to assist them if they need help in the course.
- _____ 17. they have control over how they learn the course content.
- _____ 18. throughout the course, they could be successful on the coursework.
- _____ 19. the coursework is relevant to their future.
- _____ 20. I care about how well they do in this course.
- _____ 21. they will be able to use the knowledge they gain in this course.
- _____ 22. I am respectful of them.
- _____ 23. the knowledge they gain in this course is important for their future.
- _____ 24. I am friendly.
- _____ 25. I care about their feelings.
- _____ 26. they have flexibility in what they are allowed to do in this course.

Appendix B
Instructions for Scoring the MUSIC® Inventory (Professor version)

To obtain a score for each of the five scales, place the item numbers from the prior page onto the corresponding line below. Then, average the values for the items in each scale by adding the numbers

and dividing by the total number of items in the scale as shown below.

(item 2 + item 8 + item 12 + item 17 + item 26) / 5

(_____ + _____ + _____ + _____ + _____) / 5 = _____ = eMpowerment

(item 3 + item 5 + item 19 + item 21 + item 23) / 5

(_____ + _____ + _____ + _____ + _____) / 5 = _____ = Usefulness

(item 7 + item 10 + item 14 + item 18) / 4

(_____ + _____ + _____ + _____) / 4 = _____ = Success

(item 1 + item 6 + item 9 + item 11 + item 13 + item 15) / 6

(_____ + _____ + _____ + _____ + _____ + _____) / 6 = _____ = Interest

(item 4 + item 16 + item 20 + item 22 + item 24 + item 25) / 6

(_____ + _____ + _____ + _____ + _____ + _____) / 6 = _____ = Caring

NOTE: Do not sum or average all 26 items because this produces a meaningless value. It is inconsistent with the principles of the MUSIC model to assume that motivation is the sum of empowerment, usefulness, success, interest, and caring. Although this may be true in some cases, it is possible that a student is highly motivated and engaged when only one or two of her MUSIC perceptions are high and the others are low.

Look at your scores for each MUSIC component. Higher numbers indicate that your instruction is more consistent with the strategies related to those MUSIC components. Lower numbers indicate that you may be able to implement more strategies consistent with those MUSIC components. These results cannot be interpreted precisely. Instead, they are intended to help you diagnose areas of possible strengths and weaknesses. So obviously, also use your beliefs about your instructional strengths and weaknesses related to students' MUSIC perceptions. To corroborate your beliefs, you can assess students' perceptions by asking students to complete the student version of the MUSIC Inventory available at www.theMUSICmodel.com.

Appendix C
MUSIC® Inventory

(Adapted from Jones, 2017, Middle/High School Student Version, present tense)

Directions

Respond to the items below in relation to this one course using this scale:

1 Strongly disagree	2 Disagree	3 Somewhat disagree	4 Somewhat agree	5 Agree	6 Strongly agree
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These items ask you about your current CLASS and TEACHER. Please select one of the numbers from 1 to 6 below and write it in the space next to each question.

- _____ 1. The knowledge I gain in science class is important for my future.
- _____ 2. I am confident that I can succeed in science class work.
- _____ 3. My science teacher cares about how well I do in science class.
- _____ 4. I am capable of getting a high grade in science class.
- _____ 5. I have the freedom to complete my science class work in my own way.
- _____ 6. The science class work is interesting to me.
- _____ 7. I feel that I can be successful in meeting the academic challenges in science class.
- _____ 8. I enjoy completing science class work.
- _____ 9. In general, science class work is useful to me.
- _____ 10. During science class, I feel that I can be successful on the class work.
- _____ 11. My science teacher is friendly.
- _____ 12. I have choices in what I am allowed to do in science class.
- _____ 13. I find science class work to be relevant to my future.
- _____ 14. My science teacher is willing to assist me if I need help in science class.
- _____ 15. My science teacher is respectful of me.
- _____ 16. I have control over how I learn the content in science class.
- _____ 17. The science class work holds my attention.
- _____ 18. I have options in how to achieve the goals in science class.

Appendix D

Instructions for Scoring the MUSIC® Inventory

(Adapted from Jones, 2017, Middle/High School Student Version, present tense)

Instructions for Scoring the MUSIC Inventory (Middle/High School Student version)

To obtain a score for each scale, average the values for the items in the scales as shown below:

Empowerment score = (item 5 + item 12 + item 16 + item 18) / 4

Usefulness score = (item 1 + item 9 + item 13) / 3

Success score = (item 2 + item 4 + item 7 + item 10) / 4

Interest score = (item 6 + item 8 + item 17) / 3

Caring score = (item 3 + item 11 + item 14 + item 15) / 4

Other important notes:

Do not sum or average all 18 items because this produces a meaningless value. It is inconsistent with the principles of the MUSIC model to assume that motivation is the sum of empowerment, usefulness, success, interest, and caring. Although this may be true in some cases, it is possible that a student is highly motivated and engaged when she is high on only one or two of the MUSIC components and low on the others.

Scales	Items by Scale
Empowerment (4 items)	<ul style="list-style-type: none"> • I have the freedom to complete my science class work in my own way. • I have choices in what I am allowed to do in science class. • I have control over how I learn the content in science class. • I have options in how to achieve the goals in science class.
Usefulness (3 items)	<ul style="list-style-type: none"> • The knowledge I gain in science class is important for my future. • In general, science class work is useful to me. • I find science class work to be relevant to my future.
Success (4 items)	<ul style="list-style-type: none"> • I am confident that I can succeed in science class work. • I am capable of getting a high grade in science class. • I feel that I can be successful in meeting the academic challenges in science class. • During science class, I feel that I can be successful on the class work.
Interest (3 items)	<ul style="list-style-type: none"> • The science class work is interesting to me. • I enjoy completing science class work. • The science class work holds my attention.
Caring (4 items)	<ul style="list-style-type: none"> • My science teacher cares about how well I do in science class. • My science teacher is friendly. • My science teacher is willing to assist me if I need help in science class. • My science teacher is respectful of me.

Appendix E

IRB Approval

