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Exploring Student Engagement in STEM Education: An Examination of STEM Schools, STEM Programs, and Traditional Schools

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High school students' perceptions and experiences regarding student engagement were investigated using 32 focus group sessions across 4 different types of STEM education settings in 2 metropolitan areas in the Midwest. Students' understandings and experiences related to student engagement were reflected via 5 categories: students' thinking of engagement, challenges influencing engagement, teachers' facilitation of engagement, course assignments and engagement, and facilitation of content utility. Compared to students in the Non-STEM Program and Traditional settings, students in STEM school and STEM Program settings were more likely to articulate the importance of engagement, to experience challenging work, to have greater cognitive and emotional engagement due to teachers' instructional practices, and to describe how course content is related to future careers and education.

Key Words: STEM Education, Student Engagement, High School, Qualitative Research

In the 2007 National Academies report, *Rising above the gathering storm: Energizing and employing America for a brighter economic future*, which describes science and technology innovation capabilities and capacity in the United States, the authors warned that the United States' ability to maintain global leadership in science, technology, engineering, and mathematics (STEM) was in jeopardy (National Academy of Sciences [NAS], the National Academy of Engineering [NAE], & Institute of Medicine [IOM], 2007). For example, regarding mathematics and science performance, the longer that K12 students are in school in the United States the poorer they perform, on average, compared to their peers in other countries (NAS, NAE, & IOM, 2007). Furthermore, the percentage of U.S. students enrolling in STEM higher education programs has remained constant (25% - 30%) over the last 20 years (NAS, NAE, & IOM, 2007), despite the need for more STEM capacity. This National Academies report focused on the provision of 20 recommendations, categorized into four broad areas, for increasing the United States' capacity in STEM fields; the four categories are comprised of: (a) K12 education, (b) science and engineering research, (c) higher education, and (d) economic and technology policy (NAS, NAE, & IOM, 2007). The release of the 2007 report was followed by the enactment of America COMPETES Act (2007), which provided funding for the implementation of the 20 recommendations.

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Examples of capacity building developments are of interest as efforts are put forth to implement the recommendations for preparing students in STEM. At the federal level, the National Science Foundation (NSF) and National Institute of Health (NIH) offer funding opportunities for formal and informal (out-of-school) STEM experiences, particularly those that reinforce inquiry-learning and student-centeredness (United States Government Accounting Office, 2005). At the state level, additional funding initiatives for STEM specialty schools are made available by organizations such as the Gates Foundation (2015) and the National Governor's Association Center for Best Practices (2011). It is hopeful that these and other initiatives will facilitate the preparation of more STEM trained professionals who enter the STEM pipeline.

With increased national and state funding available for the recommendation regarding building K12 STEM capacity, a common response from educators and policy makers has been the creation of distinct STEM schools and the incorporation of STEM Programs (e.g., Project Lead the Way, 2014) within larger schools. In 2010, President Obama's advisory board, President's Council of Advisors on Science and Technology (PCAST), a group of the nation's leading scientists and engineers, recommended that 1,000 new STEM schools be created across the United States by 2020.

It is difficult to determine the number of STEM high schools in the United States. In 2010, the estimate was 142 (Franco, Patel, & Lindsey, 2012). By 2014, the estimation was at 358 schools (Tofel-Grehl & Callahan, 2014). Contributing to the difficulty in determining the total number of STEM schools is the fact that there are no universal grade bands for a STEM school, or a Non-STEM school. STEM schools range from limited grade levels, such as K4, to all grades, K12. Furthermore, high school names do not reflect, inherently, a STEM focus. For example, among the top 250 U.S. high schools in 2014, only 20 school names included the word *STEM* or implied that the school focused on STEM content; however, closer inspection of the top 250 high schools' websites revealed that many more than 20 of the 250 schools were actually STEM focused (National rankings best high schools, 2015).

The fact that there are no generally accepted characteristics defining STEM schools increases the complexity of identifying STEM-focused schools. Some STEM schools are selective and some are inclusive. Tofel-Grehl and Callahan (2014) described five types of STEM elementary, middle, and high schools in operation throughout the United States: (a) STEM school-within-a-school, which allows students to select STEM specific classes while maintaining connections with the overall school community during Non-STEM classes; (b) STEM pullout programs, which allow students to enroll in one or more STEM courses offered externally to their home schools while maintaining enrollment in their home schools; (c) stand-alone STEM schools, which integrate STEM curriculum throughout content delivery in a building separate from the home school; (d) residential STEM schools, for which students reside and study in a community focused on STEM learning; and (e) university-based STEM schools, which are stand-alone STEM schools closely aligned with a local university for access to STEM resources, faculty, and courses. Within and among the types of STEM schools, there are vast differences in their respective mission and culture, despite the fact that all focus on encouraging students to take an interest in STEM fields (Tofel-Grehl & Callahan, 2014).

Research findings comparing the effectiveness of Non-STEM and STEM schools regarding student achievement and preparation for entering the STEM pipeline are beginning to appear in the literature. For example, in 2014, the Center for Elementary Math and Science Education (CEMSE) released the results of a multiple-state research effort that described how inclusive STEM schools define themselves, the strategies that they use, and the student experiences that they offer; however, the authors made no comparison of the STEM schools' effectiveness at the student level. Additionally, Wiswall, Stiefel, Schwartz, and Boccardo (2014) compared science scores between students in 30 selective and non-selective STEM high schools to science scores of students in New York City Non-STEM schools. The authors described positive impacts on some science examinations for those attending STEM high schools, but the analysis did not account for students' prior achievement.

In 2015, state level analyses of STEM school data were published for two states: Ohio and Texas. Bicer et al. (2015) compared student mathematics growth rates between Texas STEM and Non-STEM high schools. The authors reported that ninth-grade STEM students' mathematics scores were higher than were the ninth-grade Non-STEM school students' scores. Interestingly, the mathematics growth rates of STEM students between Grades 11 and 12 were not different from the mathematics growth rates between Grades 11 and 12 for students in the Non-STEM schools. For Ohio, Lavertu and Gagney (2015) studied the impact of Ohio STEM schools on student achievement and determined that traditional schools in Ohio prepared students better for the Ohio Graduation Test (OGT) than did STEM schools.

The quantitative research studies thus far reflect that there is no general consensus about the effectiveness of STEM schools compared to Non-STEM schools in regards to student achievement and preparation for the STEM pipeline. As the types and number of STEM schools proliferate and the research regarding STEM school effectiveness emerges, stakeholders and policymakers continue to grapple with what, if any, differences among the types of STEM schools there are regarding student achievement and preparation for the STEM pipeline. Do some types of STEM schools better prepare students for STEM-related careers than do others?

Purpose of Study

When comparing the effectiveness of STEM and Non-STEM schools in preparing K12 students for the STEM pipeline, there are numerous factors to consider. Typically, schools are compared based on students' American College Test (ACT, 2015) scores, Student Achievement Test (SAT, 2015) scores, and/or students' mathematics and science course grades. However, these scores alone do not reflect differences in school climate or teacher practices, both of which impact student engagement and student achievement. School climate represents the underground stream of norms, values, beliefs, traditions, and rituals that have built up over time in a school (Hoy, 2012); they can be positive or negative. Teacher practices within schools may range from traditional content delivery to inquiry-based delivery. Student engagement is a multi-dimensional behavior defined as "active, goal-directed, flexible, constructive, persistent, focused interactions with the social and physical environments" (Furrer & Skinner, 2002, p. 149). Because student engagement has been positively related to academic achievement (Chase, Hilliard, Geldhof, Warren, & Lerner, 2014; Sirin & Rogers-Sirin, 2005; Skinner & Belmont, 1993), investigating student engagement among different STEM education settings can provide additional insights regarding the differences in STEM and Non-STEM education settings.

Research Questions

This report presents the findings from a strand of a large mixed methods concurrent triangulation study (Creswell & Plano Clark, 2011) to investigate differences in various high school level STEM education settings in two metropolitan areas. This report focuses on the qualitative analyses of the data. Student focus groups provided information regarding teacher practices and students' perceived levels of engagement with respect to STEM education. Among the various high school settings, understanding student perceptions of their learning and engagement and teacher practices that increase student achievement and engagement in STEM contributes to a deeper understanding of differences in STEM and Non-STEM schools. The research question was: In what ways do students across the four STEM education settings differ in their perceived experiences related to student engagement and learning opportunities?

Literature Review

In 2004, the National Research Council (NRC) and the Institute of Medicine (IOM) initiated an investigation regarding the role of motivation in high school students' achievement. A guiding question was: "What would be required to increase students' motivation to succeed and [to increase] their engagement in learning?" (p. 28). The authors presented Newmann, Wehlage, and Lamborn's (1992) premise as the best response: "If students are to invest themselves in the forms of mastery required by schools, they must perceive the general enterprise of schooling as legitimate, deserving of their committed effort, and honoring them as respected members" (p. 19). The premise includes descriptions of schools that support high student achievement and high student engagement. This literature review focuses on K12 student engagement and its relationship with student achievement.

Dimensions of Student Engagement

Numerous researchers have defined student engagement across three general dimensions: cognitive engagement, behavioral engagement, and social engagement (Chase et al., 2014; Fredricks, Blumenfeld, & Paris, 2004; Guthrie & Wigfield, 2000; Lutz, Guthrie, & Davis, 2006; Yazzie-Mintz, 2009). Authors of the NRC and IOM (2004) report developed the terms, "I can" (competence), "I want to" (value and goals), and "I belong" (social connectedness) as descriptors of three dimensions of student engagement (p. 34).

Student Engagement in Schools

Furrer and Skinner (2002) defined student engagement as a multi-dimensional behavior that is "active, goal-directed, flexible, constructive, persistent, focused interactions with the social and physical environments" (p. 149). Engagement is facilitated by support from teachers (Garcia-Reid, 2007) and students' perceived relatedness with others in the school (Connell, Halpern-Felsher, Clifford, Crichlow, & Usinger, 1995; Early, Rogge, & Deci, 2014). Engaged students exert great effort in tasks, take initiative, and display curiosity (Fredricks et al., 2004).

Most high schools provide students with outcomes-driven experiences that foster student engagement. Marks (2000) asserted that student engagement declined markedly during students' high school journey. Generally speaking, freshmen entering high school exhibited higher levels of engagement than did seniors. The author explained that student engagement peeked in the sophomore year when students began to embrace the importance of academics and began to participate more in high school activities. On the other end, student engagement tended to be lowest among high school seniors as they became more focused on pursuing higher education or entering the workforce.

Student Engagement and Student Achievement

Methods used to study the relationship between student engagement and student achievement have evolved as interest around engagement behaviors has persisted. For example, Fincham, Hokoda, and Sanders (1989) documented positive relationships between early student engagement and long-term academic achievement. The authors developed and administered student and teacher measures to collect data focused on cognitive and behavioral engagement from 108 students in Grade 3. In Grade 5, 2 years later, the same students' academic achievement in mathematics and reading was measured using the SAT. Path analyses demonstrated that Grade 3 students' academic engagement had significant path coefficients with their Grade 5 mathematics and reading scores, while controlling for the students' Grade 3 academic achievement scores. Students' Grade 3 low engagement (described as *learned helplessness*) had significant negative path coefficients associated with Grade 5 mathematics and reading scores. Similarly, teachers' ratings of students' high engagement (described as a student's *ability and effort*) in Grade 3 had significant positive path coefficients associated with Grade 5 reading scores.

Alexander, Entwisle, and Dauber (1993) collected teacher surveys using the National Survey of Children in their study of 790 first graders over 4 years. The first-grade engagement scores were predictive of fourth-grade student achievement, as measured by the California Achievement Tests (CAT, 2015), of students' reading (CAT-R) and mathematics (CAT-M) scores, after controlling for race, gender, parental education level, family economic level, and for students' first-grade CAT-R and CAT-M scores. The authors posited a lasting association between students' early engagement behaviors and their long-term levels of academic achievement.

In a longitudinal study of 1,335 Grade 4 (then Grade 8) students' achievement and engagement, Voelkl (1997) investigated early academic achievement and long-term student engagement, using student scores on the Comprehensive Test of Basic Skills (CTBS) (CTB/MacMillan/McGraw-Hill, 1990). When the students were in Grade 8, their teachers completed the Student Participation Questionnaires (Finn, Folger, & Cox, 1991) regarding their students' positive and negative learning and engagement behaviors such as effort, initiative taking, and disruptive participatory behaviors. The author reported that students' achievement scores in Grade 4 were significantly related to student participation levels in Grade 8 (Voelkl, 1997).

More recently, Chase et al. (2014) administered the Student Questionnaire of Positive Youth Development (PYD, 2015) and the Behavioral-Emotional-Cognitive School Engagement Scale (BEC-SES, 2015) to 10th-, 11th-, and 12th-grade students ($N = 710$) in a longitudinal study of student engagement. Longitudinal confirmatory factor analyses and structural equation modeling revealed that the three components of student school engagement (i.e., cognitive, behavioral, and social) were mutually predictive of student academic achievement.

Via quantitative analyses comparing high school student engagement measures across four STEM school settings, Patel, Franco, and Lindsey (2014) used the High School Student Survey of Engagement (HSSSE, 2015) to study the relationship between cognitive and emotional student engagement and academic achievement as measured by the SAT and ACT ($N = 2{,}695$). One of the key findings was that emotional engagement significantly predicted academic achievement regardless of settings, confirming Chase et al.'s (2014) findings.

Student Engagement and Teacher Practices

Numerous teacher practices contribute to high student engagement. For example, providing opportunities for students to study a topic of personal interest contributes to the work being more relevant to the student and also enhances the overall meaningfulness of school for that student (Fredricks et al., 2004); the personal interest facilitates the enjoyment of and the quality of learning (NAS, NAE, & IOM, 2007). In Davidson's (1999) study, a high school student provided the following example of an instructional practice that fostered her engagement:

> Like if you read something and everyone interprets it differently, she [the teacher] wants to hear everyone's opinion. . . . You learn different points of view and how to analyze different things. . . . It's not just memorizing facts and then spitting them back to the teacher. (p. 349)

Although individual student accountability is important, the teacher practice of assigning collaborative work also is conducive to higher student engagement (NAS, NAE, & IOM, 2007; Skinner, Furrer, Marchand, & Kindermann, 2008). Students are more receptive to challenging assignments when they can collaborate rather than work in isolation (Early et al., 2014; Skinner et al., 2008). Such group experiences can create a community of learners in which students are responsible for each other's learning rather than competing with their fellow students (Fredricks et al., 2004). The collaborative efforts include meaningful learning experiences and greater student engagement.

Student Engagement and School Climate

Connecting school climate to improved student achievement and student engagement began with Coleman's (1961) research regarding the influence of students' social lives on their academic performance: adolescents' values and interests compete with the academic focus embedded in high schools. In other words, to be effective, school personnel must embrace the importance of students' social lives in addition to the importance of being engaged in academics. Following Coleman's work, school climate researchers identified two broad types of school climate: communal and bureaucratic. Communal schools employ "staff that share norms and values directed at student learning as the central purpose of schooling" (Wehlage & Stone, 1995, p. 2). Administrators, teachers, and staff in communal schools embrace shared high expectations for students in all school work and activities. Bureaucratic schools, on the other hand, have clearly defined hierarchical roles for staff. Students move from one content specialist to another on a regular schedule; tracking students by performance is the standard. Missing in the bureaucratic school is a community or social spirit (Wehlage & Stone, 1995).

Additionally, Bryck and Driscoll's (1988) research demonstrated that communally organized schools had better student attendance and higher student morale, both of which are indicators of high student engagement. In fact, the public and private schools with a communal climate recorded better student outcomes and represented schools with positive, conforming behaviors, and strong community support (Wehlage & Stone, 1995). More recently, McGuigan and Hoy (2006) posited that *academic optimistic* school climates foster high student engagement. Similar to the communally organized schools, academic optimistic climates comprise academic emphasis, collective efficacy of faculty and staff (shared high expectations), and faculty trust.

Teacher practice and school climate. McGuigan and Hoy (2006) investigated teacher and administration practices related to school climate and determined that a climate with high teacher collective responsibility for learning was a predictor of student outcomes. Collective responsibility for learning also can be described as teachers' academic emphasis and collective efficacy: the belief that all students can succeed and that teachers have the capacity to help all students achieve. DiPaola and Hoy (2005) offered the term *organizational citizenship behavior* (OCB) as school-wide behavior that yields a positive significant relationship with high student mathematics and reading achievement. The authors described OCBs as actions that are not prescribed but are willingly performed and that contribute to the organization's success, such as altruism, conscientiousness, sportsmanship, courtesy, and civic virtue. Regarding school climate, analyses regarding both academic optimism and OCB indicated positive relationships with student engagement and student achievement (DiPaola & Hoy, 2005; McGuigan & Hoy, 2006).

Students' descriptions of their school experiences regarding engagement included references to a rigorous curriculum and strong, consistent support from teachers (Early et al., 2014). Multiple research studies have documented that students who report caring and supportive interpersonal relationships with school personnel have more positive academic attitudes and values, are more satisfied with school, have better attendance rates, and attain greater academic achievement (McGuigan & Hoy, 2006; Shouse, 1996; Skinner & Belmont, 1993; Yowell, 1999).

Students interviewed in the NRC and IOM (2004) study described supporting teachers as those who

> tried to make classes interesting; who talked and listened to them; who were honest, fair, and trusting; and who showed concern for them as individuals by asking whether they needed help, making sure they understood what was being taught, and asking them if something was wrong. (p. 54)

Students referred to challenging assignments as an indicator of a supporting teacher who held high expectations for students and who believed that all students could succeed. Interestingly, in Newmann et al.'s (1992) study, 60% of the time, students referred to the same class when describing which courses were the most engaging and which were the most challenging.

In summary, the positive relationship between student engagement and student achievement is documented in both quantitative and qualitative research (Alexander et al., 1993; Chase et al., 2014; DiPaola & Hoy, 2005; Fincham et al., 1989; McGuigan & Hoy, 2006; NRC & IOM, 2004; Patel et al., 2014; Skinner & Belmont, 1993; Voelkl, 1997). High student achievement and engagement can be sustained in an environment that students perceive "as legitimate, deserving of their committed effort, and honoring them as respected members" (Newmann et al., 1992, p. 19). In an effort to understand the differences among four STEM education settings, the research reported herein utilized students' perceived experiences related to both student engagement and learning opportunities in their respective settings.

Method

This study was one part of a large mixed methods concurrent triangulation research study (Creswell & Plano Clark, 2011). In concurrent triangulation mixed methods, quantitative and qualitative methods are used to offset limitations from using either method alone. In addition, the qualitative and quantitative data are collected concurrently and analyzed separately. This study is an examination of the qualitative data from the large concurrent study. For this study, all data sources were weighted equally in the analyses. Triangulation will be implemented at the conclusion of both the quantitative and qualitative analyses. The rationale for using this design is that the research topic (student engagement across various high school STEM education settings) can be better investigated with both qualitative and quantitative data. For example, student academic scores (quantitative data) do not necessarily reflect teacher practices (qualitative); therefore, collecting both quantitative and qualitative data provided richer insights into the differences regarding student engagement among four distinct STEM education settings.

A social constructionist approach (Guba & Lincoln, 1998) informed the mixed methods concurrent triangulation research design to inform better the researchers of student experiences and perceptions regarding their engagement in their schools. Social constructionism as a qualitative inquiry approach that focuses on individuals' reality defined "interpersonally and intersubjectively" as they interact "in a network of relationships" (Patton, 2015, p. 121). Focus group sessions with students provided examples of students' personal and interpersonal understandings of what it meant to be engaged and what contributed to high and low student engagement. The data provided multiple perspectives to facilitate understandings related to student engagement within each of the four types of STEM education settings.

The authors/researchers are former K12 educators and current professors of education in higher education institutions. Their philosophical stance of interpretivism/constructionism was the basis for their development of the interview protocol and interpretation of what the students discussed in the focus group sessions. The researchers had been involved with educational research in STEM schools for a number of years. Their teaching and STEM research experiences affected how they interviewed participants and interpreted the data. The findings were shared with the leadership in each participating school as a form of a member check. The feedback contributed to understanding the words that the students used during the focus group sessions and to improving the researchers' interpretations/classifications of the students' words, both of which increased the trustworthiness of the research.

The procedures and school-level analyses for the focus group sessions are included in this presentation of the results. A finer grain of detail regarding all the work for this and the larger study is provided in the technical report (Patel et al., 2014).

Participants

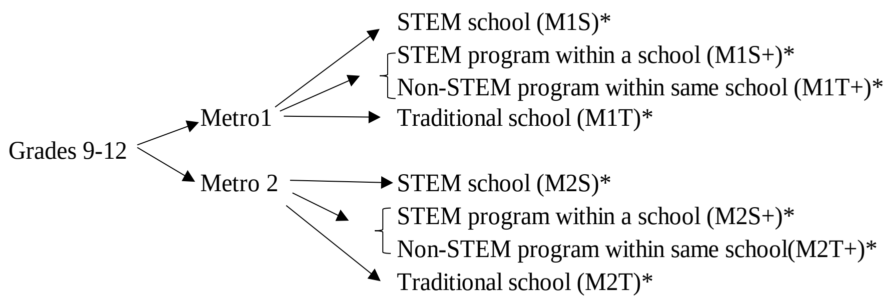
Six schools from two metropolitan areas in a Midwestern U.S. state participated in this study. In each metropolitan area, three schools participated: (a) a STEM school, (b) a traditional school with a STEM Program, and (c) a traditional school without a STEM Program. Within each metropolitan area, participants were enrolled in one of four high school settings: (a) a *STEM school*, (b) a *STEM Program* within a traditional school, (c) *Non-STEM Program* courses in the school that housed the STEM Program, and (d) a *Traditional school* with no STEM Program. All Grades 9-12 students in each of the six schools were invited to have parent permissions forms signed in order to participate in the focus group sessions. For each grade level, setting, and metropolitan area, a random sample of 3 to 11 students who submitted signed parent permission forms and student assent forms was selected for the 32 focus group sessions. Table 1 provides the number of participants in each focus group session.

Table 1

Focus Group Participants

Setting	*Metro Area 1* *N* M1S	*N* M1S+	*N* M1T+	*N* M1T	*Metro Area 2* *N* M2S	*N* M2S+	*N* M2T+	*N* M2T
Grade 9	8	8	8	6	3	7	4	4
Grade 10	10	9	11	7	5	5	6	3
Grade 11	7	10	8	7	4	4	7	6
Grade 12	6	10	9	7	8	5	5	10

M1: Metro Area 1; M2: Metro Area 2
S: *STEM school*, S+: a *STEM Program* within a traditional school, T+: *Non-STEM Program* courses in the school that housed the STEM Program, T: a *Traditional school* with no STEM Program.



*M: Metropolitan Area 1 or 2
*S: STEM school students
*S+: STEM Program students - enrolled in a STEM program within a traditional school
*T+: Non-STEM Program students - enrolled in STEM program school, but NOT in the STEM program
*T: Traditional students; students enrolled in a traditional school, without a STEM program

Figure 1. Focus groups and classroom observations within each of the two metropolitan areas

Measures: Focus Groups

The researchers used a set of 11 guiding questions for each of the focus group sessions. Students were asked to describe ways in which they were engaged in their school, how they participated in their school, and the ways by which their teachers made them want to work hard. Students also were asked to articulate why they were learning the content that they were learning and whether there was a "bigger picture" for the content that they were learning. Along the same lines, students were asked whether they had opportunities to connect content being taught in various classes. In addition, students were asked which classes were the most difficult, in which classes they put forth their best efforts, and what types of assignments allowed them to be creative. Finally, students were asked to describe what it meant to be successful in a class.

Procedures

Approval from the Institutional Review Board (IRB) was attained for all participating sites prior to data collection. Thirty-two structured focus group sessions were conducted: one for each setting in each metropolitan area and at each grade level. See Figure 1 for abbreviations used for each school setting. Prior to the focus group sessions, the two researchers developed a structured interview protocol focused on cognitive engagement. The HSSSE (2015) was used as the framework for cognitive engagement. Hence, the questions focused on behaviors indicative of cognitive engagement on the HSSSE. The researchers went through several iterations before finalizing the protocol. The researchers then discussed and agreed upon the order of the questions.

The researchers had attained parental permission for all participants in each focus group session. All focus groups sessions were conducted during the school day at each respective school. The school principals determined the specific time schedule of each session. At the beginning of each focus group session, the participants were asked to sign an assent letter, if they had not done so already. The participants were reminded of the confidential nature of the sessions and were asked not to use any specific names of peers, teachers, and/or other school personnel. Additionally, they were told that they were allowed to stop participating at any time. For each session, the facilitator audio recorded the session using an electronic device. Each focus group lasted approximately 45 minutes to one hour.

In Metro Area 1 (M1), the two researchers conducted the 16 focus group sessions. Each focus group session was moderated by one of the two researchers. For example, for the STEM Program school, one researcher facilitated the four back-to-back STEM Program sessions, whereas one researcher, simultaneously, facilitated the four back-to-back Non-STEM Program within a Traditional school sessions. In most instances, each researcher also had a graduate assistant to provide support as needed.

In Metro Area 2 (M2), an education-based consulting firm was hired to conduct the 16 focus group sessions. This was required because the locations of the three M2 schools impeded on the researchers' ability to conduct the sessions. Prior to M2 data collection, the two researchers met with the four members of the consulting firm working on the project. The researchers went through the focus group protocol in detail as well as the procedures for the focus group sessions to ensure that all focus group sessions were conducted in a similar manner. Graduate students in the two researchers' respective academic departments transcribed the M1 focus group sessions. The consulting firm transcribed the M2 focus group sessions.

The research design, procedures, and analyses embody Shenton's (2004) trustworthiness qualities of credibility, transferability, dependability, and confirmability. Credibility was established via the thorough literature review of the topic, triangulation of data sources, performing member checks with leaders in each setting, and unique reflexive commentaries created for each school setting. The study's transferability was enhanced via documenting the boundaries and details utilized in the implementation of the research. Dependability was strengthened by providing the details for future duplication of the study and by including future research suggestions. And finally, confirmability was augmented by providing details about the researchers' worldviews and past experiences with student engagement and STEM school research.

Data Analysis

This study was one part of a mixed methods concurrent triangulation research study focused on student engagement across various STEM education settings. The analysis and results provided in this article addresses the student focus group sessions. A mixed methods concurrent triangulation design refers to the simultaneous collection of both quantitative and qualitative data and the separate analysis of each data set (Onwuegbuzie & Johnson, 2006). Data sources were weighted equally. Triangulation of findings occurred after analyses of all data sources were complete.

NVivo (Version 10) (2012) was the program of choice to store and to code the transcribed audio recordings. Following Eisenhardt's (1989) suggestions regarding coding, the principal investigator and a trained graduate student adopted the elements of the HSSSE (2015) framework as *a priori* constructs for initial orientation in the coding. However, the theoretical framework did not restrain the coding. Using the constant comparative coding scheme (Glaser, 1965), similar and differing themes emerged across the subsamples, especially those central to student engagement and students' experiences that facilitate or hamper engagement. As suggested by Bazeley (2009), the researchers extended their analyses beyond the identification of general themes related to student engagement. In this vein, the researchers initially described the more broad themes that were derived from the data, after which, the themes were compared across the four STEM education settings. Finally, questions were asked about the circumstances under which the responses occurred. The in-depth analytical process allowed the researchers to generate five narrow categories from the data.

Although the focus groups included both male and female participants and participants of varying racial/ethnic backgrounds, data on these demographic factors were not collected. The purpose of this study was to examine the differences across four STEM education settings. Hence, analyses were focused on school setting level differences rather than on participant demographic differences. Additionally, because the focus groups were audio-recorded, rather than video-recorded, the researchers were unable to provide the number of participants who contributed to each category derived. In many cases, participants added multiple comments related to the same category. Furthermore, given the sample size of each focus group session, it was not appropriate to attempt to examine the number of participants who made commonly associated statements. Patton (2015) argued that efforts to report percentages of responses in situations in which there are 10 or fewer interviewees are not appropriate. Hence, the analyses focused on examination of focus groups as a whole across the four distinct STEM education settings.

Results and Discussion

The analyses of the focus group sessions addressed the overall theme of the ways by which students across the four STEM education settings are encouraged to be engaged in school. Further analyses revealed five specific categories related to how personnel in each setting influence student engagement. The five categories comprised: students' thinking of engagement, challenges influencing engagement, teachers' facilitation of engagement, course assignments and engagement, and the facilitation of content utility. Each of the five categories aligned with various combinations of the cognitive, emotional, and/or social engagements as defined by Fredericks et al. (2004), Furrer and Skinner (2002), and Yazzie-Mintz (2009).

Students' Thinking of Engagement

At the onset of each focus group session, participants were asked about their views of what it meant for students to be engaged in school. Although M1 participants mentioned being involved in their academic work in all four settings, this was much more pronounced in the STEM school and STEM Program settings(See Table 2). In both settings, students provided details about the ways in which they should be engaged with others in the school and the community. Participants in both settings referred to multiple specific cognitive-related behaviors that reflect engagement, and neither group discussed extra-curricular activities. In less pronounced ways, participants in the Non-Program setting and the Traditional setting shared that engagement included academic work. Furthermore, unlike their STEM and STEM Program setting peers, these participants highlighted participation in one or more of the various after-school activities offered at their respective schools.

The findings might be reflective of the reality that the STEM school has almost no non-academic-based after-school activity offered at the school. Students are able to participate in such activities in their home district schools. Additionally, those in the STEM Program have the opportunity to participate in various after-school activities that focus on STEM fields (e.g., robotics club). Perhaps this structure for STEM content delivery and participation in STEM-related after-school activities contributed to the students' ability to articulate a variety of examples and types of cognitive engagement.

Finally, there was a unique revelation regarding student voice in the school. Those in the STEM school noted that they believed that their engagement with school personnel allowed them to be part of the decision-making process. Meanwhile, participants in the Traditional school wished that they had an opportunity to work with school personnel in order to improve the school. The culture of the STEM school is focused on *habits of mind*, which reflect foundational skills for a school's culture (Costa & Kallick, 2009) that are infused within all aspects of the school. For the M1 STEM school, the original designers and faculty determined that facilitation of creativity, collaboration, communication, inquiry, and persistence would be the *habits of mind* for the school. It might be the case that the STEM school students viewed staff-student collaborations as equally important as student-student collaborations. Hence, the STEM school may take purposeful steps to facilitate students' voices in school decision-making processes.

Participants in M2 were much more focused on extra-curricular activities when discussing the nature of student engagement (see Table 3). Additionally, they did not share as many examples as did participants in M1. Overall, participants in all M2 settings provided examples related to various sports and clubs. Only two participants in the STEM Program setting mentioned academic engagement. However, the two statements were more general and addressed doing homework and paying attention; more specific examples were not provided.

Table 2

Metro Area 1: Students' Thinking of Engagement

Metro Area 1 Settings			
M1S	M1S+	M1T+	M1T
"…put forth the effort to accomplish something…." "…what you need to do to learn the material…." "…being engaged actively in the community of the school." "…conversing with students and teachers during academic time." "…you have engagement with learning and you have engagement with other students and then you also have your engagement with the faculty and staff … we can help make some decisions and are informed about what the school plans on doing."	"…listening in class." "…helping the teacher whenever possible." "…actively taking notes." "…eager to participate" "…fully involved or listening or responding."	"…join clubs and different activities." "…our school to be more united…and more accepting of everyone." "…language club, the action team, [and] student council.' "…not slacking off and waiting until the last minute to do a project or homework."	"…wish students and administrators work together." "…some community service." "…joining clubs and sports." "…involved in, like, the work…" "…participating in class and helping out with teachers."

M1: Metro Area 1; M2: Metro Area 2
S: *STEM school*, S+: a *STEM Program* within a traditional school, T+: *Non-STEM Program* courses in the school that housed the STEM Program, T: a *Traditional school* with no STEM Program.

Table 3

Metro Area 2: Students Thinking of Engagement

Metro Area 2 Settings			
M2S	M2S+	M2T+	M2T
"…social activities."	"Participating in extra-curriculars such as sports and clubs." "Doing their homework." "Paying attention in class."	"Participation in social activities." "School sports, including football and baseball." "Stuff that's cool such as STAR, media club and art club." "Choir, band, and foreign language groups."	"Social and sports events."

M1: Metro Area 1; M2: Metro Area 2
S: *STEM school*, S+: a *STEM Program* within a traditional school, T+: *Non-STEM Program* courses in the school that housed the STEM Program, T: a *Traditional school* with no STEM Program.

Table 4

Metro Area 1: Challenges Influencing Engagement

Metro Area 1 Settings			
M1S	M1S+	M1T+	M1T
"I don't find myself being challenged in the classes content wise, but I think what challenges me is when we have a lot of work from different classes that kind of piles up." "…makes it more difficult and challenges you to make something better or to learn something new…pushes you to do better…." "…specifically makes his tests very, very difficult so you'll have to think harder and so he gives you a chance because he wants to challenge you.…" "Calculus class does not "…have a large workload, we actually don't have a lot of homework, but it is really, really difficult."	"I work hard in French and World Studies, because those two classes are the hardest concepts to understand." "She gave us a problem without teaching us how to do it and she says figure it out." . "Yeah…If it's easy and I already know it, I'm not going to go out of my way to work harder." "I am going to say English too, and I really enjoy it and I like writing, but the type of writing we are funneled to do by these AP tests we have to take is a lot of analysis."	"Spanish, because we know English but Spanish we have to focus on each word, and I feel I work hard in every class, but Spanish I work hardest." "World Studies because all other classes kind of come easy to me but I don't remember stuff well.…" "I love putting effort in those classes but I know there are classes I should put more effort into."	"Mine is mostly just science. All other classes I find pretty easy." "Chemistry we're definitely challenged a lot just because our teacher, she's not there a lot. She expects us to catch on right there." "Some of my harder classes like physics I want to work hard in because I know that's what it is going to be like in college and I want to be prepared for that." "For me it would be my math class because I don't think that letters and numbers should ever mix."

M1: Metro Area 1; M2: Metro Area 2
S: *STEM school*, S+: a *STEM Program* within a traditional school, T+: *Non-STEM Program* courses in the school that housed the STEM Program, T: a *Traditional school* with no STEM Program.

Challenges Influencing Engagement

Participating in challenging content and putting forth effort in school are both indicators of cognitive engagement. Students shared examples of how they were challenged in school/courses, how they were not challenged, what type of work was challenging, and/or their perceptions of challenges. Overall, participants from the M1 STEM school and STEM Program school not only provided multiple specifics related to what was challenging in school, but also shared how the challenging work impacted their cognitive engagement with the work (See Table 4). The majority of students in all M1 settings argued that all content areas were challenging (sciences, language arts, foreign languages, government, and/or mathematics) and posited that more challenging work engendered more engagement. The students described examples of their strong efforts and shared details with other participants regarding similar demanding assignments. The students' conclusions that rigorous courses also were more engaging mirrored previous findings that the more rigorous the work, the more engaged the student (NRC & IOM, 2004; Newmann et al., 1992; Shouse, 1996; Skinner & Belmont, 1993; Yowell, 1999).

Although participants in each M1 school setting addressed the challenges in their coursework, those in the STEM Program school provided more specific examples of their challenging work and the ways by which they reacted to those challenges. Meanwhile, participants in the Traditional school setting shared more simplistic statements of being challenged. For example, the participants from the Traditional school had a tendency merely to state that the course was challenging. On the other hand, those in the STEM Program school tended to provide not only information on the nature of the challenges, but also the rationale for working hard to understand the challenging content. For instance, participants specified that a higher level of work was required for success in difficult and challenging courses, but that the effort increased their engagement. Likewise, they commented that low engagement was a consequence when they "never have to study" because the content is "common sense." They summarized that success in challenging work made them feel that they "really learned" the content and "accomplished more." One student deduced: "maybe I didn't get the best grade but maybe [the teacher] liked what I put in the project...that's a pretty good feeling." The participants in the STEM school, however, shared why their teachers gave students challenging work: to push the students to be successful in the future.

Table 5

Metro Area 2: Challenges Influencing Engagement

Metro Area 2 Settings			
M2S	M2S+	M2T+	M2T
"…not only know what's being taught but…can actually use what's being taught." "…very frustrating but they challenge you a lot." "…if it's just too much and I don't understand it, I just don't do it and I'll ask the teacher questions the next day." "…it's easy to stop caring." "…really big workload in a short amount of time." "…stop caring normally" and "do [work] just because my grade is on the line."	"…learning college stuff…." "Bio-Med requires a higher level of thinking", is "…fast-paced", and "…it's so self-guided." "When I check my grades, if I have a lower grade then I try harder in that class just to get it up, but I don't let my other ones go down." "…won't accept a bad grade and if you get anything below a C he'll have you redo the assignment." "…some classes are hard but they're fun so you want to learn about them."	"…just explains it well enough you're not like challenging yourself to get it done." "…hard to understand right off the bat but once you get used to it its just remembering it." "…you can't just show up and turn in your homework you actually have to pay attention to the notes and the videos he shows you." "…your junior and senior year you see your future a lot more so you want to try harder."	"…you can try but you're going to fail no matter what [math]." "…if you push too hard then some kids would give up." "Teachers don't grade as hard…I can be more laid back with my work and not try as hard." "75% of the my [English] class just does what they want to do during class." "…maybe five people answer and that's it…everyone else just sits there and does nothing [math]."

M1: Metro Area 1; M2: Metro Area 2
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Similarly, in M2, the participants in the STEM Program were more likely to share how they were effectively challenged in their classes and how the challenging work facilitated their cognitive engagement (see Table 5). They explained how their teachers had high expectations for them and that they tried hard when they were not performing well in class. Also, they noted that participating during class was essential for success. Participants in the Non-STEM Program setting shared similar experiences, but not to the extent as their peers in the STEM Program.

In a dissimilar vein, participants in the STEM school noted that the challenging work led to frustration, rather than facilitating cognitive engagement. They explained how the mastery requirement (80% in the course or fail) made students do the work just to get the grade rather than promoting critical thinking of the content. The mastery requirement was unique to the M2 STEM school. Perhaps this helps to explain the differences in responses between the STEM school participants in the two metro areas. Those in M1 sought out more cognitive engagement because of the challenging work and developed a desire really to learn the content. However, the mastery requirement seemed to have stifled the cognitive engagement and quest for meaningful learning for M2 STEM school students. On the other hand, participants in the Traditional setting reported a general lack of challenging work throughout their coursework. Many students indicated that their teachers did not engage them during class time with critical thinking; they described disengagement in classes regularly because of the monotony of the work. Student responses revealed that these students needed teachers to find a balance between providing too much support and making the work too difficult. In either case, the participants did not respond with increased cognitive engagement.

Teachers' Facilitation of Engagement

Teachers' high expectations of students and teachers' ability to develop and to sustain student interest in the content facilitated students' cognitive engagement. Students' emotional engagement is fostered when teachers develop a rapport with students, when students trust their teachers, and when students view their teachers as a source of support. Examples provided during the grade level focus group sessions affirmed that not all of the teachers were utilizing these practices. In many cases, students described the practices that they would have liked teachers to utilize.

Table 6

Metro Area 1: Teachers' Facilitation of Engagement

Metro Area 1 Settings			
M1S	M1S+	M1T+	M1T
"…does not give answers, makes you work, pushes, challenges and encourages students." "…allow students to revise tests, help on projects.…" "…available for contact, reach out to students and spend time helping them understand concepts." "…encourage students to ask questions, care about what they say.…" "…develop personal relationships/ bonds with teacher/ can trust them." "…sense of humor, relaxed environment in the classroom."	"…personality and quality of teachers." "Math teacher explains how one concept will build into another concept, show how it will be applicable in the future." "…teacher personality-interactive and well respected teachers, and teachers who take the time to help students." "Receiving quality feedback so students can learn from their mistakes." "…creating an environment that encourages asking questions."	"Provision of rubrics by teachers helps students understand the expectations and motivates them to earn a higher grade." "Activities involving competition in labs are more fun, facilitate engagement." "…when teachers talk to students one on one, encourage them on a personal level to work harder, students want to work harder to show teacher that they can improve their grades." "Teacher ensures that students have understood the concepts.…"	"In-class activities increase engagement and maintain interest in subject." "…positive feedback from teachers, encouragement and building confidence.…" "…making classes and content fun." "…teachers who make jokes, are fun, relaxed in class.…" "When teachers sit down and explain concepts to student one on one.…" "…negative/ sarcastic attitude from teachers, environment where students don't feel comfortable asking questions.…"

M1: Metro Area 1; M2: Metro Area 2
S: *STEM school*, S+: a *STEM Program* within a traditional school, T+: *Non-STEM Program* courses in the school that housed the STEM Program, T: a *Traditional school* with no STEM Program.

Within M1 in general, participants in all four settings reported common teacher-based experiences that facilitated their engagement (see Table 6). That is, many teachers across all four settings exhibited similar behaviors and actions that promoted students' cognitive engagement in school. First, their teachers rather consistently allowed choices in terms of the projects that they completed. Along with this, teachers were supportive in that they made time to help their students when students were struggling. For example, participants in the Traditional school setting shared that their teachers ensured "…that students have learned material before moving on to other topics."

The M1 participants shared the importance of teacher attitudes and behaviors in class. The responses highlighted the need for students to be engaged emotionally in school. Students' positive personal connections with their teachers facilitated their cognitive engagement in those courses. Participants across the settings noted that their teachers had a "personality," which facilitated their engagement because it created a "relaxed environment" in the classroom. Those in the STEM school expanded such feeling when they specifically mentioned the importance of building personal relationships with their teachers. The STEM school participants may have provided more depth in describing the importance of these relationships given the relatively small student population of this school (N = 161) and specific concerted efforts on the part of the school to facilitate the building of such relationships. Comparatively, the average Grades 9-12 population of the other two schools in M1 was approximately 1,000 students.

A key difference across the settings was revealed between the Traditional school setting and other settings. Those in the Traditional school noted that sometimes they received a "negative/sarcastic attitude from teachers," which then created an "…environment where students don't feel comfortable asking questions." Meanwhile participants in the other three settings felt very comfortable asking questions in class and even felt encouraged to ask questions in class.

Table 7

Metro Area 2: Teachers' Facilitation of Engagement

Metro Area 2 Settings			
M2S	M2S+	M2T+	M2T
"…rubrics…get all the guidelines right…."	"…always give good, constructive criticism…."	"…finds different ways to do it that are really interesting. Like the other day we had some chemicals that we set on fire and different chemicals burnt different colors...."	"…looking more at the bad in you than the good."
"…if you are lost they will get you back on the right track."	"…don't say negative things about it, they don't put you down, they keep you up so then you want to work harder and stuff."	"…to make sure they know like actually what they're doing like if someone else doesn't know what they're doing and everyone else does, he'll go off to the side and actually help you."	"…doesn't explain what you did wrong."
"…will come and explain it to you and go through the entire problem…just to help you."	"…the teachers always keep it interesting…and actually let you get interacting…."	"…always keeps you wanting to know…."	"…when the teachers are cool with us it makes the students want to work…."
"…really active in trying to get you to complete assignments...."	"…always compliments [students] …even if their answer isn't always the best."	"…usually never in a bad mood. She's always fun and we can talk to her and stuff and have a personal conversation or something."	"Two [science] teachers…will stay all day with you if you need it…or when we're working on our own I usually go up to them and ask them."
"…the way he's more engaging and he tells stories…."	"…in Engineering…. we work a lot of sketching hands-on stuff… we're in the wood shop and we're going to do a puzzle cube project…."		"…never see a kid struggling in a science class because all of our science teachers here are so great, it makes you want to go to class…."

M1: Metro Area 1; M2: Metro Area 2
S: *STEM school*, S+: a *STEM Program* within a traditional school, T+: *Non-STEM Program* courses in the school that housed the STEM Program, T: a *Traditional school* with no STEM Program.

Upon examination of M2 focus group sessions, the data revealed that participants in the STEM school, STEM Program, and Non-STEM Program settings had very similar experiences with respect to how their teachers promoted their engagement in school. In all cases, participants explained how their teachers consistently were fun and engaging, that their teachers provided one-on-one support as needed, and that teachers created an environment that made students want to learn. The participants focused on how they were treated by their teachers: the teachers were respectful, complimented their students, and facilitated collaborative efforts in work.

Meanwhile, the participants in the Traditional setting shared limited ways by which their teachers facilitated their engagement in school. Most notably, they discussed how the science teachers were always there for students and how these teachers supported their success. Participants noted that the same teachers who were fun and engaging also made students want to learn in the classes. Unfortunately, this experience was not typical. The participants tended to address how their teachers focused more on what students were doing wrong rather than helping them to be successful. The participants believed that their teachers did not provide enough support and often left it to the students to undertake tasks on their own.

For both metropolitan areas, student responses confirmed the finding that personal relationships with teachers (emotional engagement) spilled over into the classrooms, making student-teacher interactions more fluid and meaningful and consequently increasing cognitive engagements. Although teachers in all M1 settings consistently took steps to build personal connections with teachers, it appears that such efforts were not, as effectively, taken at the M2 Traditional school.

Course assignments and engagement

Challenging assignments, hands-on experiences, and collaborating with others facilitated students' cognitive engagement in school. Additionally, opportunities for students to express their creativity promoted cognitive engagement. The data revealed that differences existed across school settings with respect to the ways by which teachers challenged their students academically.

Table 8

Metro Area 1: Classroom Assignments and Engagement

Metro Area 1 Settings			
M1S	M1S+	M1T+	M1T
"Hands-on projects- help keep students engaged."	"Engineering class- can go from the computer to a 3D model."	"Provision of rubrics help students understand expectations."	"Taking notes all the time disengages students…."
"Working in group projects gives students the opportunity to learn from each other."	"Assignments that offer scope for creativity promote engagement."	"…feel comfortable asking questions in classes."	"…have nothing to do if they have completed a project in Design."
"Non-STEM teachers… making CDs of different war songs in US History, create big drawings and wood statues in art class."	"…can pick the level of challenge in their assignments."	"In math, students can solve problems using unique or creative ways."	"Use of technology such as iPads, Macs and laptops…"
"…role-play simulations in history."	"…being able to pick their own topic for their research paper, focus on common content between subjects…."	"English - students participate in Socratic circles and in-class debates."	"Teachers provide an outline for the project and allow students to determine the details."
"…write an apocalyptic novelette in language arts."	"…use of activities and labs get students involved, give them opportunity to move around instead of being in their seats for the entire class."	"…group work required more application and working together with peers."	"Job-shadowing experiences facilitated engagement- like working with the nurse or school librarian."

M1: Metro Area 1; M2: Metro Area 2

S: *STEM school*, S+: a *STEM Program* within a traditional school, T+: *Non-STEM Program* courses in the school that housed the STEM Program, T: a *Traditional school* with no STEM Program.

In M1, participants focused on the ways by which teacher-assigned work facilitated their engagement in school (see Table 8). Participants in the STEM school and the STEM Program shared common examples of how their assignments maintained their engagement in school. Both groups explained how their teachers in all content areas provided them with a great deal of choice in projects and that they were allowed various creative options to meet the criteria for their projects and assignments. Participants in the Non-STEM Program setting noted that their teachers' provision of rubrics and a few engaging in-class activities were important in facilitating their engagement. Meanwhile, those in the Traditional school merely noted a general use of technology as engaging. Hence, the focus group sessions clearly indicated that teachers in the STEM school and the STEM Program were more effective in cognitively engaging their students via meaningful assignments than were teachers in the Non-STEM Program and Traditional settings. Moreover, participants described projects that included topics of personal interest and that allowed for creativity, confirming Meece's (1991), McLaughlin's (2000), and Davidson's (1999) findings that assignments with said characteristics are more engaging. In fact, Traditional setting participants noted that they are often disengaged because of "taking notes all the time" and that even when they are undertaking projects, they "have nothing to do if they have completed a project…" prior to the due date.

Table 9

Metro Area 2: Classroom Assignments and Engagement

Metro Area 2 Settings			
M2S	M2S+	M2T+	M2T
"…engage students in a group environment…and incorporates objectives from…different classes…." "…internships…really to get a job and be successful…." "…a lot of discussions [about] current events at the beginning of class…" and get into "…a lot of heated debates every once in a while." "…math and science …because it's mostly formulas…memorization" "…science…it's more difficult…to be creative because they are so specific."	"…make circuit boards and electronic dice and doing something hands on…." "…you're sitting there and the teachers telling you, like lecturing you more." "There's usually little quizzes that go along but…it's like this whole big, huge unit that you have to study for...." "…we get to see our progress and all the work that we've done I mean it really encourages us to work hard in there." "…in Engineering…. we work a lot of sketching hands-on stuff… we're in the wood shop and we're going to do a puzzle cube project…."	"…gave a persuasive speech…about health benefits of coffee and then also what's bad about it… you can be creative…." "…a lot of hands-on stuff." "…made Glogster things in Spanish and we could put whatever we wanted on it." "in Wood Tech you can basically make anything you want as long as it's not inappropriate." "…if the teacher's creative and comes up with cool ways [to do things]…." "…finds different ways to do it that are really interesting."	"…say, look in your book and fill out this piece of paper…." "…can pick whatever topic we want…" and "…we can do a lot of different things." "…gives us multiple options." "actually get to do something [in art] instead of just sitting there, staring and jotting down notes…." "…get more involved when they can be creative." "…you can't really be creative because it's just like learning knowledge."

M1: Metro Area 1; M2: Metro Area 2
S: *STEM school*, S+: a *STEM Program* within a traditional school, T+: *Non-STEM Program* courses in the school that housed the STEM Program, T: a *Traditional school* with no STEM Program

Overall, participants in all four settings in M2 agreed that many of their teachers gave them various options to complete projects, which allowed students to express their creativity in their assignments. Differences between the Traditional setting participants and those in the other three settings were found in the level of specifics provided. Participants in the latter three groups were able to provide specific assignments in courses that facilitated their engagement. Those in the Traditional school were more apt to share how some teachers did not facilitate engagement via their assignments and that the more engaging activities were focused on a few select courses.

Facilitation of content utility

Students' understanding of the future utility of the content learned facilitated cognitive engagement in school. During the focus group sessions, participants indicated that it was important to them to understand how the information that they were learning in school may be used in their future educational and career aspirations. Participants in both the M1 STEM school and STEM Program focus group sessions responded similarly when discussing their understanding of how their learning would be used in their future endeavors (see Table 10). They noted how teachers explained and provided experiences for them to understand the real-world application of information that would help them in the future. The participants also focused on the fact that their teachers facilitated their development of various skillsets that they would be able to utilize in various circumstances. The STEM school participants highlighted the skills identified as part of the school's *habits of mind* (Costa & Kallick, 2009) that are infused within all aspects of the school.

Unlike those in the STEM school and STEM Program, those in the Non-STEM Program were more likely to have shared that they knew that they would need some information and skills in the future, but they did not share specific ways that their teachers facilitated this knowledge. Meanwhile, the participants in the Traditional school noted how their English teacher helped them to see how their learning would be helpful in the future; other teachers did not. Furthermore, the Traditional setting participants in M1 were the only participants who stated that they had teachers who explicitly shared that pieces of the knowledge students were learning would not be useful in the future and that their teachers, in general, did not tend to explain how the information could be useful in the future.

In M2, those in the STEM school revealed many mixed views about how their schools facilitated students' understanding of how their learning would be useful in the future (see Table 11). Whereas one student explained that the entire school culture is focused on meaningful learning and the development of lifelong skills, other students made more general comments about being able to apply the knowledge in the future. On the other hand, some participants explained how they would not utilize various content in their future and did not understand why they needed to learn it. This similar feeling was much more pronounced among the participants in the Non-STEM Program setting and the Traditional school setting. Over and over, participants noted that they did not understand why they have to learn much of what they do learn; their teachers did not make this explicit. Additionally, they perceived that certain knowledge is only useful for individuals who are choosing to go into particular fields, such as teaching. Unlike their peers in other three settings, the participants in the STEM Program setting consistently shared how their teachers took purposeful efforts to make connections between what students learn and the future application of that information. For example, teachers specified the career roles at the onset of each new laboratory in science, assigning group members with career roles such as landscape architect, project manager, and community liaison. The student responses indicated that they were not only interested in making the connection between their courses and other content areas, but also they were interested in connections between their courses and their future aspirations, all of which are indicators of cognitive engagement. Perhaps the STEM curriculum emphasis on the connection between STEM content and future careers is a contributing factor to their understandings.

Implications for Practice

The findings from this study support three implications for the practice of faculty in high school settings. First, in various focus group sessions, participants noted the importance of emotional engagement with school personnel. Participants shared how they value strong rapport with their teachers and how such connections made students more comfortable asking questions of their teachers. The literature confirmed the positive relationship between student engagement and student achievement (Alexander et al., 1993; Chase et al., 2014; DiPaola & Hoy, 2005; Fincham et al., 1989; McGuigan & Hoy, 2006; NRC, & IOM, 2004; Patel et al., 2014; Sirin & Rogers-Sirin, 2005; Skinner & Belmont, 1993; Voelkl, 1997). Consequently, it may be prudent for schools to provide professional development focused on how teachers can facilitate such relationships with students in effective and meaningful ways. In addition, teacher preparation programs should include more focus on the development of emotional engagement in coursework and field experiences. To promote further the importance of students' emotional engagement, policy makers who legislate teacher evaluation systems should incorporate the requirement of evidence demonstrating emotional engagement within teacher evaluation systems as a means to improve achievement.

Second, with respect to cognitive engagement, participant feedback reflected students' preferences for active learning experiences in class and smaller more challenging assignments rather than large amounts of non-challenging, busy work, regardless of setting. Teachers might benefit from professional development regarding assessment and evaluation to refresh their understandings of active learning activities and assignments as opposed to mundane, repetitious assignments. Students preferred the meaningful assignments with substantive teacher feedback. And finally, an understanding of future use of knowledge learned was described as motivating by students in the focus group sessions. There are multiple methods to infuse the understandings of the future utility of content learned, some of which might be enhanced with professional development.

Table 10

Metro Area 1: Facilitation of Content Utility

Metro Area 1 Settings			
M1S	M1S+	M1T+	M1T
"…give good examples of how content…can be used in everyday life." "…STEM teachers will teach something and then show how it is applied in everyday life…[others] don't explain how it's used like they just say here is something to learn, we'll help you learn it…." "…creativity, collaboration, communication, persistence, and inquiry: those are five things that you're going to need in life." "…has real-world applications, it is not stuff that you just have to memorize from a textbook…."	"…will build into another concept and another concept which [they] will use later in life." "…you'll read a book and before you read it, you'll learn all of this history and why what happens in the book." "…will openly say that…so they recognize there are large-scale connections." "…not so much the content that you are learning, but the skills that you are learning." "…could be taking other, more valuable classes."	"…you never know when you're going to run into something in real life situations dealing with what you've learned." "You don't want to just stand back and just not know what they're talking about." "…learning the things that we're learning to prepare ourselves for the future and post-high school education, such as college or something like that…."	"…some teachers just come out and say that we will probably never use this again." "…sometimes, before [physics] class starts he will explain how we will use this in life." "…I understand why we do the things we do in English…the teacher does a good job to… build up our writing skills." "…English helps a lot because it doesn't matter what class you're in, you are writing papers." "…understand why we have to learn those things..." but that teachers "…don't really explain to you why we need to know it."

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Table 11

Metro Area 2: Facilitation of Content Utility

Metro Area 2 Settings			
M2S	M2S+	M2T+	M2T
"…to move on to go to college." "…actually understand it [the content] in depth and how to apply it to the world…." "…don't think I'm going to need it in life, like certain math and stuff…." "…is pointless because it will never be used for me." "…actually understand it [the content] in depth and how to apply it to the world…" and that they are "…not just memorizing things." "…the whole…experience I believe is focused around developing the individual and thus you'll learn and use these skills throughout the rest of your life whether you know it or not."	"…we have to learn history because we don't want bad things in history to repeat itself…." "…a lot of times you apply stuff and they teach you how it applies." "…gives a lot of real-life examples." "…want to go into like Bio-Med you can go into any kind of surgery type things." "…a lot of times you apply stuff and they teach you how it applies." "…a speaker Luke Reynolds who came in and talked about his career." "…in all of our introductions when we start a new lab they always say you are taking the role…."	"…the graphing in Algebra, I don't think we really need that." "…like I'm never gonna use ever again, the only time I'm going to use it is in this class and then once I leave this classroom I'm never going to see it or use it ever again." "[history]…that's in the past I'm looking for the future man not the past." "…have to know how the government works when we get out there."	"…you really only need to know science if you're going to be a scientist or a teacher." "….I don't care why grass grows….I'll find a place that already has grass." "…I usually just decide on my own what I think I'll actually probably need when I get out or what I won't need so that wouldn't make a difference to me." "…ask a teacher "when am I ever going to use this? They'll get mad." "Teachers don't focus on the skills... They don't tell you how to apply those skills to the real world."

M1: Metro Area 1; M2: Metro Area 2

S: *STEM school*, S+: a *STEM Program* within a traditional school, T+: *Non-STEM Program* courses in the school that housed the STEM Program, T: a *Traditional school* with no STEM Program.

Future Research

For future studies regarding student engagement and achievement in multiple settings of STEM education, it is important to select the school settings based on school and non-school level characteristics and demographics that reflect a finer grain of detail such as family ethnicity, median income, and community setting (rural, urban and suburban). By adding the aforementioned details, researchers can ensure more trustworthiness for the findings. In addition, it is recommended that future researchers include teacher, counselor, and school leader interviews regarding student engagement and achievement.

The additional viewpoints would provide the opportunity to understand the perceptions of student engagement from different perspectives and to note the differences between the staff perceptions of student engagement and the students' perceptions. Finally, including a student-shadowing component in the data collection activities would provide an additional source of data regarding student engagement in the lived experiences of high school students in the types of schools being studied.

Conclusions

To increase the U.S. STEM capacity, policy makers have supported and facilitated the trend of the development of stand-alone STEM schools and STEM Programs. Although this trend continues, there is relatively little empirical evidence supporting its necessity. Consequently, it was of the utmost importance to examine the differences across various STEM education settings in engaging students. Student focus group discussions indicated that students in STEM schools and STEM Programs, compared to those in Non-STEM Programs and Traditional settings, were more likely to (a) grasp the importance of student engagement, (b) experience challenging work, (c) increase cognitive and emotional engagement through teacher instructional practices, and (d) understand how course content is related to future careers and education. Hence, there seems to be something unique that occurs in STEM schools and STEM Programs that is facilitating students' cognitive engagement that is not occurring, as consistently, in the other two settings.

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