FOSTERING GLOBAL COMPETENCIES AND DEEPER LEARNING WITH DIGITAL TECHNOLOGIES RESEARCH SERIES

TEACHER ENGAGEMENT, TECHNOLOGY INTEGRATION, AND LEADERSHIP IN STEM PEDAGOGY

Research & Information Services
Toronto District School Board
March 2018
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TITLE: Fostering Global Competencies and Deeper Learning with Digital Technologies Research Series: Teacher Engagement, Technology Integration, and Leadership in STEM Pedagogy

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Executive Summary

The goal of the Toronto District School Board’s (TDSB) STEM strategy is to build capacity among TDSB K-12 educators to enhance their STEM pedagogical knowledge, self-efficacy, and promote STEM implementation in classrooms. A critical factor in enhancing STEM across the Board is teacher engagement. Teacher engagement is paramount for student success, as studies have shown that teacher attitudes, behaviours and motivations are often passed onto students (Roth, Assor, Kanat-Maymon & Kaplan, 2007). Researchers (Parsons & Taylor, 2011; Reschly & Christenson, 2012) found student engagement can impact perceptions of school as well as school behaviours, particularly for at-risk youth.

During the 2014-15 school year, a study on teacher engagement was conducted with 227 educators, 167 STEM educators and 60 non-STEM educators, in the TDSB as part of the STEM strategy. This study examined: (1) teacher cognitive and emotional engagement, (2) social engagement with colleagues, students, and leadership, and (3) teacher engagement with STEM and digital tools.

Figure 1: Teacher Engagement Study Overview

Overall, the results suggest that there are many aspects of engagement (cognitive, emotional, social, technology, and digital learning) that are important for teacher and student engagement.
The findings provided insights into different groups of teachers based on STEM/non-STEM, gender, or years of experience. Each group had different responses to questions about engagement and these differences are important to note, as there are many influences on engagement. Furthermore, findings suggest STEM teachers show statistically significant increased engagement over non-STEM teachers in many areas of emotional engagement, social engagement with students, social engagement with colleagues, digital tools, and student use of technology and school leadership. Part I of the study illuminates teacher cognitive and emotional engagement, as follows:

<table>
<thead>
<tr>
<th>FINDING</th>
<th>EVIDENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Majority of educators were always cognitively engaged</td>
<td>The majority of STEM (60%) and non-STEM educators (54%) felt they were always cognitively engaged in their teaching.</td>
</tr>
<tr>
<td>2. Majority of educators were always emotionally engaged</td>
<td>Approximately half of STEM (54%) and non-STEM educators (45%) felt they were always emotionally engaged in their teaching.</td>
</tr>
<tr>
<td>3. Majority of educators enjoyed their work</td>
<td>The majority of STEM and non-STEM educators state they enjoy their work (mean of 5.38/6 for STEM educators and 5.15/6 for non-STEM educators).</td>
</tr>
</tbody>
</table>

### PART 1: Teacher Cognitive and Emotional Engagement

<table>
<thead>
<tr>
<th>FINDING</th>
<th>EVIDENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. STEM educators find teaching exciting and fun</td>
<td>STEM educators had statistically significantly higher emotional engagement compared to non-STEM educators for “excitement for teaching” and “find teaching fun.”</td>
</tr>
<tr>
<td>5. Less experienced educators report higher cognitive and emotional engagement</td>
<td>Educators with two or less years of experience rated their cognitive and emotional engagement questions more highly than educators with more than two years of experience.</td>
</tr>
</tbody>
</table>

Part 2 of the study examined teacher social engagement with colleagues, students and leadership, and the results are as follows:

### PART 2: Social Engagement with Colleagues, Students and Leadership

#### Social Engagement with Colleagues

<table>
<thead>
<tr>
<th>Finding</th>
<th>Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. STEM educators’ engagement with colleagues was statistically higher than non-STEM educators</td>
<td>STEM educators’ ratings for all areas of social engagement with colleagues (connecting, helping, valuing relationships, caring about problems of colleagues) were significantly higher than non-STEM educators.</td>
</tr>
<tr>
<td>2. Female educators’ ratings of engagement were significantly higher than males</td>
<td>Female educators’ ratings of engagement were significantly higher than males for cognitive, emotional, and social engagement with students and colleagues.</td>
</tr>
<tr>
<td>3. Around half of educators value their relationships with colleagues</td>
<td>Roughly half of non-STEM (47%) and 60% of STEM educators stated they valued their relationships with colleagues.</td>
</tr>
</tbody>
</table>

#### Social Engagement with Students

<table>
<thead>
<tr>
<th>Finding</th>
<th>Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. More than half of educators were always sympathetic and socially engaged with students</td>
<td>In terms of student engagement, well over half of STEM and non-STEM educators indicated they were always empathetic (67% STEM educators, 65% non-STEM) and always socially engaged with students (61% STEM, 56% non-STEM).</td>
</tr>
</tbody>
</table>
## Part 2: Social Engagement with Colleagues, Students and Leadership

<table>
<thead>
<tr>
<th>Finding</th>
<th>Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2. STEM educators’ awareness of students’ feelings was significantly higher than non-STEM educators</strong></td>
<td>STEM educators’ ratings for <em>awareness of students’ feeling</em> were significantly higher than non-STEM educators (mean of 5.37/6 for STEM educators compared to 5.15/6 for non-STEM educators).</td>
</tr>
</tbody>
</table>

### Social Engagement with Leadership

<table>
<thead>
<tr>
<th>Finding</th>
<th>Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. The results show a disconnect between educators’ expectations of leadership and their actual experience</strong></td>
<td>Nearly three-quarters of STEM educators suggested leadership meant <em>building, recognizing, demonstrating, believing in, involving, providing and creating in a school</em>. However, only 38% of STEM educators strongly agreed leaders were skilled and able to help students succeed.</td>
</tr>
<tr>
<td><strong>2. STEM educators’ perceptions of school leadership were significantly higher than non-STEM educators</strong></td>
<td>STEM educators’ rating for <em>all areas of school leadership</em> (building relationships, recognizing accomplishments, believing in skills and abilities, decision making, leadership opportunities and a shared vision) were significantly higher than non-STEM educators.</td>
</tr>
<tr>
<td><strong>3. Early career educators were more engaged in leadership than experienced educators</strong></td>
<td>The survey also revealed that educators early in their careers (with two years of experience or less) were <em>more engaged in terms of leadership</em> than more experienced educators (mean of 6.05/7 for &lt;1 year, 6.29/7 for 1-2 years, compared to mean of &lt;5.27 for all other years).</td>
</tr>
</tbody>
</table>

Part 3 of the study examined educator engagement with STEM and digital tools, and the results are as follows:

### Part 3: Teacher Engagement with STEM and Digital Tools

<table>
<thead>
<tr>
<th>FINDING</th>
<th>EVIDENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Educators support technology in the classroom, but some may feel uncomfortable using it</strong></td>
<td>While educators from all levels of experience seemed to equally favour the use of technology in classrooms, only about 30% STEM and non-STEM educators strongly agreed they felt <em>comfortable</em> using it.</td>
</tr>
</tbody>
</table>
Overall, this report and the data from the TDSB’s 2014-15 Teacher Engagement survey have shown that engagement involves much more than just learning and teaching and therefore many dimensions must be considered when examining the complexities of student and teacher engagement. Further research recommended to use and validate the “Engaged Teachers Scale” (Klassen, Yerdelen, & Durksen, 2013), in a broader system-wide interventions involving larger populations.

**Summary:** In the 2014-15 school year, a TDSB study on teacher engagement was conducted with 227 educators, 167 STEM educators and 60 non-STEM educators, as part of the TDSB’s STEM strategy. A critical factor in enhancing STEM across the Board is teacher engagement. Teacher engagement is paramount for student success, as studies have shown that teacher attitudes, behaviours, and motivations are often passed onto students (Roth, Assor, Kanat-Maymon & Kaplan, 2007). This study examined: (1) teacher cognitive and emotional engagement, (2) social engagement with colleagues, students and leadership, and (3) teacher engagement with STEM and digital tools. Overall, results have shown that engagement involves much more than just learning and teaching and includes many dimensions. A major finding from the study was that overall STEM teachers showed statistically significant increased engagement over non-STEM teachers in many areas of emotional engagement, social engagement with students, social engagement with colleagues, digital tools, student use of technology, and school leadership.
Background

Engagement is a complex and multidimensional construct incorporating beliefs, attitudes, social interactions, emotions, skills, and behaviour (Harris, 2008). While engagement involves both physical and cognitive elements, many studies have investigated only distinct dimensions of this construct (Harris, 2008). Consider the Australasian Survey of Student Engagement that suggested engagement is a “students’ involvement with activities and conditions likely to generate high quality learning” (ACER, 2011, p. 3), or the (North American) National Survey of Student Engagement (NSSE), which measures the extent to which students are actively engaged in learning, and provides insight into engagement. Fredericks, Blumenfeld, and Paris (2004) suggest that all elements of engagement, including behaviour, cognition, and emotion are equally important and represent different aspects of experience. They therefore suggest more multidimensional examinations of engagement.

![Figure 3: Elements of Engagement](image)

Research indicates teacher engagement is an important part of ensuring that students are engaged at school and in their learning (Klassen, Yerdelen, & Durksen, 2013).
Student engagement is critical for ensuring successful learning outcomes and a positive attitude towards learning. Due to the interrelationship between student and teacher engagement, understanding different dimensions of teacher engagement is also important.

Incorporating both the ideas that all the elements of engagement are equally important and that teacher engagement is important for student engagement, the current report aims to investigate teacher engagement at the Toronto District School Board (TDSB) across several domains using data from a recent 2014-15 survey (n=227) of the TDSB’s STEM teachers (n=167) and non-STEM teachers (n=60). In this study we have used “Engaged Teachers Scale” developed by Klassen, Yerdelen, and Durksen, (2013) to measure the teacher cognitive, emotional, and social engagement (with students and colleagues). This study is implemented within the 20 elementary STEM pilot schools in the 2014-15 school year and results are limited within this context. However, findings of this study are discussed and triangulated in relation to the most current and comprehensive research literature on teacher engagement.

This report positions findings within the context of the literature on engagement. The first section will illuminate TDSB teachers’ cognitive and emotional engagement. The second section will detail how educators are engaging with colleagues, students, and leadership in schools and the final section will address teacher engagement with technology and digital tools.
Cognitive and Emotional Engagement

While there are many different elements that make up the concept of engagement, some researchers, such as Jones (2008), have developed approaches based on three main domains: behaviour, emotion, and cognition. Jones (2008) created an Engagement-Based Learning and Teaching Approach (EBLT) wherein he defines the Cognitive Domain as the combination of beliefs and values, the Emotional Domain consists of motivation and feelings, and the Behavioural Domain involves habits and skills.
Jones (2008) suggests that parents and teachers must work with students within and across all three domains to develop an integrated approach to learning and student engagement. Trowler (2010) also provides a useful framework for understanding how these elements of engagement appear within positive engagement, non-engagement, and negative engagement (see Figure 6).

**Figure 6: States of Engagement**

<table>
<thead>
<tr>
<th></th>
<th>Positive Engagement</th>
<th>Non-engagement</th>
<th>Negative engagement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Behavioural</strong></td>
<td>Attends lectures,</td>
<td>Skips lectures with</td>
<td>Boycotts, pickets or</td>
</tr>
<tr>
<td></td>
<td>participates with</td>
<td>no excuse</td>
<td>disrupts lectures</td>
</tr>
<tr>
<td></td>
<td>enthusiasm</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Emotional</strong></td>
<td>Interest</td>
<td>Boredom</td>
<td>Rejection</td>
</tr>
<tr>
<td><strong>Cognitive</strong></td>
<td>Meets or exceeds</td>
<td>Assignments late,</td>
<td>Redefines parameters</td>
</tr>
<tr>
<td></td>
<td>assignment</td>
<td>rushed or absent</td>
<td>for assignments</td>
</tr>
<tr>
<td></td>
<td>requirements</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Source: Trowler, 2010, p. 6.*

Students, teachers, and stakeholders of all ages need to participate in education across all of these domains by being physically and intellectually involved, but this can only happen when they are included, cared for, and respected (Willms, Friesen, & Milton, 2009). The TDSB’s 2014-15 survey therefore aimed to look at teacher engagement in terms of cognition and emotion.

**Cognitive Engagement**

The TDSB’s 2014-15 teacher survey looked at cognitive engagement levels via survey items that contained verbs such as *trying hard, throwing oneself into their work, paying attention,* and *working with intensity.* The vast majority of both non-STEM and STEM teachers indicated they always try their hardest to perform well while teaching. Of the 60 non-STEM teachers surveyed, 72% stated they always try their hardest and 76% of STEM teachers said so. STEM (n=126) and non-STEM (n=60) educators also indicated they were always cognitively engaged at 60% and 54% respectively. In fact, 100% of STEM and non-STEM teachers reported to be often/frequently/always cognitively engaged at work. These results are quite positive and indicate the majority of teachers remain consistently cognitively engaged in their work (see Figure 7 for the means and Table A1 in Appendix A for the frequencies).
Emotional Engagement

The TDSB’s 2014-15 survey tapped into emotional engagement implicitly through survey item verbs such as excited, happy, paying, love, and fun. Over half (58%) of non-STEM teachers said that they always “love teaching,” compared to 67% of the STEM teachers surveyed. STEM and non-STEM educators also indicated they were always emotionally engaged while teaching, at 54% and 45% respectively. Additionally, STEM educators had statistically significant results compared to non-STEM educators for “excitement for teaching” and “find teaching fun” (mean of 5.41 compared to 5.15, respectively, for excitement about teaching and a mean of 5.28 compared to 5.00 for find teaching fun). These results are also very positive and suggest that most teachers are emotionally engaged and enjoy their work (see Figure 8 for means and Table A2 in Appendix A for the frequencies).
The notion that humans learn best by being social and connecting with others has been shown theoretically and scientifically. Past social theorists, such as Vygotsky (1978) and Bandura, Ross, and Ross (1963), determined that each of us learn best via social interaction. We can choose to work alone but people may perform better, in theory, if we work collaboratively. Working with others has long been understood as an aspect of Vygotsky’s zone of proximal development (Hrastinski, 2009) and really emerges when we compare communal learning to the extent of learning one can achieve individually. However, when it comes to engagement, the social elements can be problematic in that “consistency and agreement among scholars and educational institutes about what constitutes social engagement is still non-existent” (Parsons & Taylor, 2011, p. 27).

Summary: Teachers were asked about their cognitive and emotional engagement with teaching. Overall, the majority of teachers reported being always cognitively and emotionally engaged. The majority of educators enjoy teaching. Nonetheless, STEM educators had statistically higher emotional engagement compared to non-STEM educators for “excitement for teaching” and “find teaching fun.” Less experienced educators report higher cognitive and emotional engagement with teaching.

Social Engagement: Colleagues, Students, and Leadership

The notion that humans learn best by being social and connecting with others has been shown theoretically and scientifically. Past social theorists, such as Vygotsky (1978) and Bandura, Ross, and Ross (1963), determined that each of us learn best via social interaction. We can choose to work alone but people may perform better, in theory, if we work collaboratively. Working with others has long been understood as an aspect of Vygotsky’s zone of proximal development (Hrastinski, 2009) and really emerges when we compare communal learning to the extent of learning one can achieve individually. However, when it comes to engagement, the social elements can be problematic in that “consistency and agreement among scholars and educational institutes about what constitutes social engagement is still non-existent” (Parsons & Taylor, 2011, p. 27).
Still, social interactions are an important part of engagement, and the TDSB’s 2014-15 survey therefore examined teacher engagement in terms of colleagues, students, and school leadership.

![Figure 9: Vygotsky’s Zone of Proximal Development](source)

**Social Engagement: Colleagues**

The TDSB’s 2014-15 survey of STEM and non-STEM educators examined social engagement with colleagues via survey items that contained verbs such as connecting, helping, relationships, and caring. Twenty-eight (28) non-STEM teachers (47% of those surveyed), indicated that they always value “relationships built with colleagues.” By contrast, 100 of the STEM teachers surveyed (60%) suggested they always value “relationships built with colleagues.” Figure 10 shows a comparison of the means of scores related to social engagement for STEM and non-STEM educators.
Teacher Engagement, Technology Integration, and Leadership in STEM Pedagogy

Gender and Teacher Engagement
Teachers were asked to indicate their gender on the survey: male, female, trans, androgy nous, gender-queer, or other. When elements of engagement were analyzed through gender, there was a significant difference between female and male teachers in cognitive, emotional and social engagement with both students and colleagues (see Figure 11). This indicates that female teachers’ ratings of engagement were significantly higher than male teachers’ ratings for many of the dimensions of engagement measured by the survey.
Summary: Teachers were asked about their social engagement with colleagues, via survey items that contained verbs such as connecting, helping, relationships, and caring. STEM educators’ engagement with colleagues was statistically higher than non-STEM educators for all areas of social engagement (connection with colleagues, helping colleagues, valuing relationships, caring about problems of colleagues). Approximately, half of educators (47% of non-STEM and 60% of STEM educators) reported they value their relationship with colleagues. Furthermore, female teachers’ ratings of engagement were significantly higher than male teachers’ ratings for many of the dimensions of engagement measured by the survey.

Social Engagement: Students
Teachers must find ways to engage with students and to help students engage with their learning. The term student engagement has, over the years, been described in numerous ways (Azvedo, 2015; Dixson, 2015). Reeve (2012) suggests student engagement is an observable display or manifestation of motivation and enthusiasm. While student engagement can be observed by looking through and within instances of motivation, this is only a fragment of student engagement (Dixson, 2015). Motivation can lead us to engage, but we must also engage in a manner that supports our learning (Mello, 2016).

Student or learner engagement is important because it directly impacts achievement, behaviour and perception (of belonging) and can be linked to dropout rates of at-risk students (Parsons & Taylor, 2011; Reschly & Christenson, 2012). However, there are several understandings of learner engagement, therefore “. . . defining the concept is problematic as there is disagreement about what counts as student engagement” (Harris, 2008, p. 58).
In 1993, Skinner and Belmont also included motivation as an important part of engagement, and recently Davis (2006) suggested students may work harder for teachers they like. Hattie (2009), commenting on a meta-analysis, suggested engagement involves “. . . more respect of self and others, fewer resistant behaviours, greater student-initiated activities, and higher learning outcomes” (p. 119). Several findings support the idea that teacher-student relationships are a critical part of student engagement. For example, Roorda, Koomen, Spilt, and Oort (2011) revealed robust teacher-student relationships related to engagement and achievement. This builds upon the findings of Chen, Gonyea, and Kuh (2008), who demonstrated that learner satisfaction and achievement were well within a working definition of engagement. Willms (2011) also claimed engagement involved, “a long-term disposition towards learning — viewing learning as fun, seeing it as important, seeing the value of working with and functioning as part of a team, being part of a social institution” (p. 6).

*Figure 13: Effect of Teacher-Student Relationships on Engagement*
The opposite of engagement would be viewing learning as boring, seeing it as unimportant and working alone while remaining separate from the institution. This disconnection was identified by Klem and Connell in 2004, who found students of low socio-economic background often struggled academically, realized limited success in elementary school, and by secondary school 40% to 60% were disengaged. From the 1980s to 2010, Parsons and Taylor (2011) identified three shifts in how educators sought to reduce disengagement among students. In the 1980s when disengagement and disadvantaged students were identified, both participation and achievement were key, hence, a focus was to reduce dropout statistics. In the 1990s, classroom management grew in importance and the aim was to decrease disciplinary issues via engagement strategies. In the first decade of the millennium, the goal was to engage students as lifelong learners.

![Figure 14: Shifts in Reducing Student Disengagement](image)

Equity is also inherently tied to disengagement because “[it] is disproportionately experienced by students living in poverty, students with disabilities, and students from ethnic minority and Aboriginal communities” (Willms, Friesen & Milton, 2009, p. 7). All students should have an opportunity to experience engagement and this may be possible if Leithwood and Patrician (2015) are correct in suggesting that “parent involvement in their children’s learning is widely
acknowledged as having a positive effect on student academic success. . . [since] parent engagement can mitigate differences in socioeconomic status (SES) and family background” (p. 664).

**Figure 15: Parent and Student Engagement**

![Parent and Student Engagement Diagram](image)

*Source:* Leithwood & Patrician, 2015, p. 669

Engagement opposes disengagement as it requires energy, effort, and actions to complete a task (motivation) (Reschly & Christenson, 2012), which in turn connects to safe and supportive relationships within a respect for diversity (see Figure 16).

**Figure 16: Engagement in Schools**

![Engagement in Schools Diagram](image)

*Source:* American Institutes for Research, 2016, p.1

Student engagement can be understood via the thoughts of Gunuc and Kuzu (2014) who suggest engagement is really “. . . the quality and quantity of students’ psychological, cognitive, emotional and behavioral reactions to the learning process as well as to in-class/out-of-class academic and social activities to achieve successful learning outcomes ” (p. 589). Student engagement is situated
within sociology and understood conceptually as a psychological notion (Kahu, 2013). Järvelä et al. (2016) believe “engagement as a concept is a fusion of the socioemotional and cognitive aspects of learning” (p. 40), wherein the cognitive aspects of student engagement include the “need to feel like they are valued and belong and be in a good emotional and psychological state to learn” (Cobb, 2014, p.14). Gunuc and Kuzu (2014) claim that an “increase in class engagement not only increases students’ level of academic achievement but also leads to positive outcomes” (p. 210).

Figure 17: Student Engagement

Source: Gunuc and Kuzu, 2014, p. 588

Järvelä et al., (2016) suggest behavioural engagement “includes actions such as attendance and participation, emotional engagement includes a sense of belonging and of valuing learning, and cognitive engagement is described as willingness to engage in effortful tasks and strategy use” (p. 40). Ideally, all students will demonstrate positive behavioural engagement where students are “asking questions, taking an active part in classes, paying attention to classes and making efforts” (Gunuc & Kuzu, 2014, p. 590). If there is behavioural engagement, then student learning can unfold in a natural manner.

Social Engagement: Students Results

To tap into this important area of engagement, the recent TDSB’s 2014-15 survey of STEM (n=126) and non-STEM (n=60) educators measured social engagement with students via survey items that contained verbs such as showing warmth, feelings, awareness, caring, and empathy towards students. Of the 60 non-STEM teachers surveyed, 39 (65%) indicated that they are “empathetic
towards students” and 110 (67%) of STEM teachers also indicated that they are “empathetic towards students”. Over half of STEM (61%) and non-STEM (56%) teachers indicated they were always socially engaged with students. Furthermore, STEM educators’ ratings for awareness of students’ feeling were significantly higher than non-STEM educators (mean of 5.37/6 for STEM educators compared to 5.15/6 for non-STEM educators) (see Table A3 in Appendix A for frequencies and Figure 18 for means).

The survey also indicated that, in general, teachers with two years of experience or less were more engaged across measures of cognitive and emotional engagement, whereas rates of engagement with students and colleagues were similar across all groups of teachers (see Figure 19).
Summary: Teachers were asked about their social engagement with students, via survey items that contained verbs such as showing warmth, feelings, awareness, caring, and empathy towards students. Social engagement with students is important; it is a key factor in helping students engage with their learning. In terms of student engagement, well over half of STEM and non-STEM educators indicated they were always empathetic (67% STEM educators, 65% non-STEM) and always socially engaged with students (61% STEM, 56% non-STEM). STEM educators’ ratings for awareness of students’ feelings were significantly higher than non-STEM educators (mean of 5.37/6 for STEM educators compared to 5.15/6 for non-STEM educators).

Engagement: School Leadership
Traditionally, school leadership discussion has centred upon the Principal who is “. . . the key player when fostering trust among staff. Effective Principals display caring attitudes toward staff members, students and parents” (Ryan & Soehner, 2011b, p. 286). Indeed, a Principal’s interactions with staff, students, and parents illustrate leadership priorities. Järvelä et al. (2016) claim, “engagement is responsive to context and social interactions in collaboration” (p. 41). Within schools, “one of the fundamentally important dimensions of school climate is relational and involves how ‘connected’ people feel to one another in school’” (Cohen, McCabe, Michelli, & Pickeral, 2009a, p.185).
It is this very connectedness (engagement) that has surfaced as a growing area of research in leadership (Legros & Ryan, 2016). A leader who is aware of engagement and focused on decreasing disengagement will act in a different manner than a leader who is unaware of these elements.

Educators understand and embrace the notion that what they do in the school and classroom impacts student learning (Ryan & Gallo, 2011a). Leadership definitely impacts teaching quality, and therefore a leader who increases engagement whether it be via a coherent instructional program (with useful feedback) or using data to improve the instructional program, can have a positive impact on classroom instruction (Robinson, 2011). Robinson (2011) states, “the most powerful way that school leaders can make a difference to the learning of their students is by promoting and participating in the professional learning and development of their teachers” (p.104). In doing so, engagement is enhanced and fortified.
Figure 21: Engagement within Leadership

Source: Parkland School Division, 2016, p.1

For example, Project Tomorrow (2014) has assembled the three Es of Education which suggest:

- Enabling students to reach their potential through increased access to educational resources and experts that extend learning beyond the capacities or limitations of their school or community.
- Engaging students in rich, compelling learning experiences that develop deeper knowledge and skill development, especially the problem solving, creativity and critical thinking skills so highly desired for our world today.
- Empowering students to take responsibility for their own educational destinies and to explore knowledge with an unfettered curiosity, thus creating a new generation of lifelong learners. (p. 12)

Figure 22: Three Es of Education

Source: Project Tomorrow (2011)
An informed educator conscious of these three Es will **act differently** than a leader who is less informed. Recently, Hughes and Pickeral (2013) laid out five practical engagement strategies for Principals embracing distributed leadership:

1. Leadership can be seen as a partnership amongst all stakeholders
2. Participants have a shared vision
3. With shared responsibility comes shared accountability
4. All ideas (not personalities) are recognized
5. Inner strength of all participants is valued. (p. 76)

To enact these strategies requires an investment in social relationships with teachers, students, and stakeholders; this engaged leadership affects **student** learning.

Figure 23: Five Practical Engagement Strategies for Principals

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**Engagement with Leadership Results**

The recent TDSB’s 2014-15 survey partially focused on **school leadership**. School leadership was sampled via survey item verbs such as builds, recognizes, demonstrates, believes, involves, provides and creates states of being for teachers through **school leadership** actions. STEM educators’ rating for all areas of school leadership (building relationships with teachers, recognize accomplishments
of individual teachers, respect for teachers, believing in skills and abilities of teachers, involving teachers in decision making, providing teachers with leadership opportunities and a shared vision) were significantly higher than non-STEM educators. Overall, within the area of school leadership, 55% of non-STEM educators versus 80% STEM teachers rated high that school leadership involves building, recognizing, demonstrating, believing in, involving, providing and creating in a school. This could mean that STEM teachers expect more than non-STEM teachers when it comes to leadership in schools (see Figure 24).

Figure 24: School Leadership

Echoing the findings regarding cognitive and emotional engagement, Figure 25 also illustrates that early career teachers are more highly engaged than teachers who have over three years of experience in relation to school leadership (Mean of 6.05/7 for <1 year, 6.29/7 for 1-2 years, compared to means of less than 5.27 for all other years of experience).
These results are supported by other recent research, such as that of Price (2015), which claims that focusing “on how principals' social interactions with teachers influence teachers' perceptions of students' engagement provides a theoretical link as to how principals indirectly influence student achievement” (p.1). Indeed, “shared leadership and instructional leadership are important variables, but they are indirectly related to student achievement” (Seashore-Louis et al., 2010, p. 51). However, it seems the sharing “relationships that principals build with teachers have real implications, [centering upon] the beliefs of trust and support among teachers in a school and [has] a ripple effect on teachers' perceptions of student engagement” (Price, 2015, p.1). With engagement being a vital element in schools and education, “frequently moving principals among schools is not an ideal policy” (Price, 2015, p.1). As noted earlier within the work of Trowler (2010), it is behaviour, emotion, and cognition that underpin engagement, non-engagement and negative engagement, and this can be changed simply with the movement of a Principal from one school to another school.
Engagement: STEM and Digital Tools

This report has so far explored the elements of cognitive, emotional, and social engagement using data from STEM and non-STEM teachers within the TDSB. Another important area for student and teacher engagement is digital literacy and learning. This section will address engagement through the STEM initiative and teacher engagement with technology and digital tools. From the onset, it is important to understand that “students’ knowledge of career requirements can significantly impact their career choices” (Franz-Odendaal, Blotnicky, French, & Joy, 2016, p. 167). Therefore, exposure to STEM disciplines seems even more critical at an early age.

STEM has been described as “the integration of Science, Technology, Engineering, and Mathematics into a new transdisciplinary subject in schools” (International Technology and Engineering Education Association, 2009, p. 1) within the TDSB there has been a steady movement towards STEM (see Figure 26).
Recently, Bybee (2013) suggested STEM could be understood by embracing the following elements:

- Knowledge, attitudes, and skills to identify questions and problems in life situations, explain the natural and designed world, and draw evidence based conclusions about STEM-related issues;
- Understanding of the characteristic features of STEM disciplines as forms of human knowledge, inquiry, and design;
- Awareness of how STEM disciplines shape our material, intellectual, and cultural environments; and
- Willingness to engage in STEM-related issues and with the ideas of science, technology, engineering, and mathematics as a constructive, concerned and reflective citizen. (p. xi)

The TDSB STEM strategy encompasses these ideas (see Figure 27).
Franz-Odendaal et al. (2016) found that STEM activities in many schools were limited to “. . . (a) visiting an exhibit at a science center or museum or aquarium; (b) having a special group visit the class for STEM-based activities; and (c) attending a special STEM-based program or competition (such as Math Olympics, science camps, science fairs)” (p.167).

Figure 28: STEM Activities

However, the TDSB has sought to expand educators’ understanding and use of STEM through consistent coaching (see Figure 29). Seventy-three percent (73%) of educators reported working with a STEM coach regularly or sometimes.

Figure 29: TDSB STEM Coaching

Recently within the Primary division, one educator developed a “STEM project to engage kindergarten and first-grade students in science and engineering using role-play as a pedagogical
strategy” (Dolenc, Wood, Soldan, & Tai, 2016, p. 30). The introduction to this STEM activity prepares students for an “active role in the classroom. [R]ole-play has been shown to increase interaction and engagement” (Dolenc et al., 2016, p. 30). There is little debate about the importance of STEM in schools since it can, and does, support disciplinary literacy learning (Wilson, Smith, & Householder, 2014). Early exposure to any of the STEM disciplines may launch a career or lead to new levels of literacy. For instance, engineering can happen at the elementary school level, requiring the application of science and math (Berland, Steingut, & Ko, 2014).

Many believe that the “effective integration of technology in class is important for increasing students’ class engagement” (Günc & Kuzu, 2014, p. 218). STEM can foster engagement because of its particular linguistic interdisciplinary challenges and science instruction that can inspire marginalized youth to succeed (Henrichs & Leseman, 2014). Additionally, “engagement in more intensive STEM activities and teacher influence were statistically significant predictors of the likelihood to choose a STEM career” (Franz-Odendaal, et al., 2016, p.167). This complements the research of Nadelson and Seifert (2016) who found “knowledge seeking, embracing change, exploring opportunities, and acting on a sense of responsibility were . . . indicators of teacher . . . engagement in educational innovations” (p. 63).

Figure 30: Importance of STEM
Teaching with Technology Results
Unlike the findings from previous areas of engagement, the TDSB’s 2014-15 survey revealed that the use of technology may not necessarily be the only domain of younger teachers. As noted in Figure 31, teachers with less than a year of teaching experience and those with 11 or more years of teaching experience seemed to be at similar levels of technology use. Teachers with 1 to 2 years of teaching experience have the highest average of using technology in teaching and learning.

Figure 31: Years Teaching and Students’ Use of Technology

The TDSB’s 2014-15 survey also examined teaching with technology via survey items that contained verbs such as feeling at ease, comfortable, confident, and able to incorporate technology in teaching. Within the area of teaching with technology, 80% of non-STEM teachers and 86% of STEM teachers indicated that they strongly felt at ease “earning about technologies for teaching and learning.” Interestingly overall, 78% of STEM and 69% of non-STEM educators agreed with the suggestion that they felt at ease, comfortable, confident, and able to teach with technology (see Figure 32).
Within the survey of STEM (n=165) and non-STEM (n=60) educators, student use of technology was illuminated via survey prompts that contained verbs such as *use, augment, enhance, and extend assigned tasks via digital technology*. STEM educators showed significantly higher student use of technology, in substituting, augmenting and redefining learning, than non-STEM educators.

**Figure 33: Levels of Technology Integration**

Of the 165 STEM teachers surveyed, 51% indicated that students very frequently/frequently substituted tools, including technologies, to complete tasks, compared to 28% of non-STEM teachers. Additionally, 40% of STEM teachers enabled students to enhance and augment their learning very frequently/frequently, whereas of the 15% of non-STEM teachers surveyed suggested students’ use of technology enabled them to augment their learning very frequently/frequently. Fifty four (54%) of STEM educators indicated that very frequently/frequently/sometimes students’ use of technology caused them to modify the task compared to 45% of non-STEM educators (see Figure 34).

![Figure 34: Students’ Use of Technology](image)

**STUDENTS’ USE OF TECHNOLOGY**

- Students substitute tools, including technologies, to complete tasks (e.g., students submit an assignment in a Word document rather than handing it in on paper).
- Students use technologies to augment their learning and improve how they are doing tasks (e.g., students use the text-to-speech function on a word processor to help the writing process).
- Students modify their learning and task completion using technology (e.g., students place their essay on an online discussion board to seek feedback from classmates).
- Students use technology to completely redefine their learning and task completion (e.g., students submit a short documentary using Windows Movie Maker instead of an essay).

**Overall**

### Significant difference between groups *(p < 0.05)*

**Non-STEM**

- Never / Rarely: 35% (165), 28% (165)
- Sometimes: 37% (165), 39% (165)
- Very Frequently / Frequently: 23% (165), 15% (165)

**STEM**

- Never / Rarely: 23% (165), 28% (165)
- Sometimes: 26% (165), 45% (165)
- Very Frequently / Frequently: 51% (165), 37% (165)
The TDSB’s 2014-15 survey of STEM and non-STEM educators also revealed the extent of use of digital tools (technology) via survey items that itemized hardware such as computers/laptops, whiteboards, mobile tech, as well as, software, social media, video conferencing and collaboration tools.

The majority of non-STEM teachers (84%) indicated that they never used video conferencing and 76% said they never used social media. A large proportion of STEM teachers also suggested they did not use video conferencing (86%) or social media (69%). Many STEM teachers stated they very frequently/frequently used computers/laptops (74%), which was statistically higher than non-STEM teachers (62%). Similarly, another statistically significant result was that, 54% of STEM educators suggested they used interactive whiteboards very frequently/frequently, compared to 34% of non-STEM teachers. Overall, more digital tools were never used by non-STEM educators compared to STEM educators (see Figure 36). These results suggest that digital tools are used, but the frequency and selection of tools can be challenging for some educators in classrooms.
Digital learning allows students to reside in one place yet study in another; for instance, a student can be living in Egypt and taking Canadian courses online (Ryan and Young, 2014). An online course has a global platform/classroom and we must therefore consider global insights into online learning (Khe Foon, 2016).

In summary, these results suggest that technology and digital learning is important for student and teacher engagement, but that additional traits including self-confidence, enthusiasm, and experience (prior knowledge) are also important influences (Andersen & Ponti, 2014). Cognitive, emotional, and behavioural engagement are all important. For example, online discussion forums can increase student engagement because they allow students to exchange words, terms and phrases, thereby creating a sense of online community (Hollands & Tirthali, 2014). This bonding and building of community online is a digital phenomenon that can be applicable to a wide variety of courses (Mello, 2016). Research supports this idea, as Goldberg et al. (2015) found a very positive correlation amid student engagement evidence and course achievement.
**Conclusion**

STEM has a strong positive effect on multiple elements of teacher engagement. Through teachers’ cognitive/emotional engagement, engagement with colleagues, teachers and leadership and engagement with technology and digital tools, teachers show stronger levels of engagement in all three domains after taking part in STEM.

STEM helps to connect a teacher more with their teaching increasing the levels of emotional and cognitive engagement. Although the levels of enjoyment in being a teacher were already high, teaching STEM increased them higher. Further, teachers reported having “fun” more often when they included STEM in their classroom. Deeper, and more positive, connection with other teachers makes teachers more willing to lesson plan, take risks in their classroom and seek out colleagues to expand their knowledge of STEM and even export the enthusiasm to other teachers.

As the personal satisfaction a teacher has in their own teaching grows they become more willing to expand their professional connections. This leads to teachers helping, connecting with, and building relationships with their fellow teachers more often. Additionally, teachers are shown to be more socially engaged and aware of their students’ feelings. Teachers involved with STEM more clearly see the contributions of their school leadership than non-STEM teachers, specifically, in the

**Summary:** Teachers were asked about their teaching with technology and students’ use of technology and digital tools.

While educators from all levels of experience seemed to equally favor the use of technology in classrooms, only about half of STEM and non-STEM educators said they felt comfortable using it. STEM educators showed significantly higher student use of technology (in substituting, augmenting, and redefining learning) than non-STEM educators’.

STEM educators indicated statistically higher usage of computer technology and interactive whiteboards than non-STEM educators. However, there were some digital tools that were rarely used. STEM educators and non-STEM educators alike never or rarely used social media and video-conferencing when teaching.
areas of their administrator, and/or, STEM leadership building, generating buy in, believing in, and creating a positive school atmosphere.

STEM teachers showed higher rates of technology use than their colleagues. These teachers used technology in their class more often and when they did their students used the technology in more advanced ways. The connection between STEM and the use of technology helps in terms of acclimatizing classrooms more so to STEM and making technology usage a more routine element of student life.

In their totality, growth across all three areas that were studied shows the beneficial effect that STEM has on the engagement of STEM teachers. As noted, earlier in this report, there is a correlation between teacher engagement and student engagement. This means that having STEM within schools is a positive for overall engagement within the school and can act as a positive force across other school-related domains. Findings from this research show that incorporation of the STEM pedagogy has positive results in terms of creating more engaged classrooms, students, and schools.

Findings from this report help to booster findings from additional reports in the STEM, global competencies, and deep learning report series. Whereas those reports discussed positive effects STEM has on student achievement, global competencies and technology usage in the classroom, this report shows some information as to why those effects occur. The answer begins with STEM pedagogy increasing teacher engagement which in of itself leads to a plethora of positive effects. STEM in the classroom connects teachers more so to their jobs.

In summary, these results suggest that technology and digital learning is important for student and teacher engagement, but that additional traits including self-confidence, enthusiasm, and experience (prior knowledge) are also important influences (Andersen & Ponti, 2014). Cognitive, emotional, and behavioural engagement are all important. For example, online discussion forums can increase student engagement because they allow students to exchange words, terms and phrases, thereby creating a sense of online community (Hollands & Tirthali, 2014). This bonding and building of community online is a digital phenomenon that can be applicable to a wide variety of courses (Mello, 2016). Research supports this idea, as Goldberg et al. (2015) found a very
positive correlation amid student engagement evidence and course achievement (student performance).

This report and the data from the TDSB’s 2014-15 survey have shown that the engagement setting involves much more than just learning and teaching and therefore, many dimensions must be considered when examining the complexities of student and teacher engagement. Further research is recommended to use and validate the “Engaged Teachers Scale” (Klassen, Yerdelen, & Durksen, 2013) in a broader system-wide intervention involving larger populations.

**Figure 37: An Embedded Multi-Dimensional Student Engagement Framework**

![Diagram of Engagement Framework]

*Source: Pickford, 2016, p. 1*
References


Goldberg, L. R., Bell, E., King, C., O'Mara, C., McInerney, F., Robinson, A., et al. (2015). Relationship between participants' level of education and engagement in their completion of the understanding Dementia Massive Open Online Course. *BMC Medical Education, 15*(1), 60.


**APPENDIX A: SUPPLEMENTAL TABLES**

### Table A1: Cognitive Engagement

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<th>Frequently</th>
<th>Always</th>
<th>MEAN</th>
<th>Never</th>
<th>Rarely</th>
<th>On Occasion</th>
<th>Sometimes</th>
<th>Often</th>
<th>Frequently</th>
<th>Always</th>
<th>MEAN</th>
<th>Significant difference between groups</th>
<th>Sig (2-tailed)</th>
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<tr>
<td>I try my hardest to perform well while teaching.</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>8% (5)</td>
<td>20% (12)</td>
<td>72% (43)</td>
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<td>0% (0)</td>
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<td>0% (0)</td>
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<td>76% (166)</td>
<td>5.73</td>
<td>p = .209</td>
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<td>While teaching, I really &quot;throw&quot; myself into my work.</td>
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<td>0% (0)</td>
<td>0% (0)</td>
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<td>18% (11)</td>
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<td>While teaching, I pay a lot of attention to my work.</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>9% (5)</td>
<td>36% (21)</td>
<td>56% (33)</td>
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<td>0% (0)</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>4% (7)</td>
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<td>56% (93)</td>
<td>5.58</td>
<td>p = .252</td>
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<td>While teaching, I work with intensity.</td>
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<td>0% (0)</td>
<td>0% (0)</td>
<td>3% (2)</td>
<td>18% (11)</td>
<td>42% (25)</td>
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<td>0% (0)</td>
<td>0% (0)</td>
<td>2% (4)</td>
<td>13% (22)</td>
<td>36% (60)</td>
<td>48% (80)</td>
<td>5.30</td>
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COGNITIVE ENGAGEMENT:

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<td>5.40</td>
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**Table A2: Emotional Engagement**

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<th>Never</th>
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<th>MEAN</th>
<th>Significant difference between groups</th>
<th>Sig (2-tailed)</th>
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<td>I am excited about teaching.</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>10% (8)</td>
<td>12% (7)</td>
<td>32% (29)</td>
<td>47% (28)</td>
<td>5.15</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>1% (5)</td>
<td>8% (4)</td>
<td>11% (6)</td>
<td>21% (12)</td>
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<td>I feel happy while teaching.</td>
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<td>8% (5)</td>
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<td>46% (76)</td>
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<td>I love teaching.</td>
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<td>0% (0)</td>
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<td>7% (4)</td>
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<td>64% (107)</td>
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<td>I find teaching fun.</td>
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EMOTIONAL ENGAGEMENT:

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**Table A3: Social Engagement: Students**

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<th>Never</th>
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<th>MEAN</th>
<th>Significant difference between groups</th>
<th>Sig (2-tailed)</th>
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<tr>
<td>In class, I show warmth to my students.</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>2% (1)</td>
<td>13% (8)</td>
<td>25% (15)</td>
<td>60% (36)</td>
<td>5.43</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>0% (0)</td>
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<td>29% (48)</td>
<td>63% (105)</td>
<td>5.54</td>
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<td>In class, I am aware of my students’ feelings.</td>
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<td>0% (0)</td>
<td>0% (0)</td>
<td>5% (3)</td>
<td>15% (9)</td>
<td>40% (24)</td>
<td>40% (24)</td>
<td>5.15</td>
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<td>0% (0)</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>2% (3)</td>
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<td>In class, I care about the problems of my students.</td>
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<td>3% (2)</td>
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<td>66% (108)</td>
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<td>p = .145</td>
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<td>In class, I am empathetic towards my students.</td>
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<td>0% (0)</td>
<td>2% (1)</td>
<td>7% (4)</td>
<td>27% (16)</td>
<td>65% (39)</td>
<td>5.55</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>1% (1)</td>
<td>9% (14)</td>
<td>24% (40)</td>
<td>67% (100)</td>
<td>5.57</td>
<td>p = .851</td>
</tr>
</tbody>
</table>

SOCIAL ENGAGEMENT: STUDENTS:

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Rarely</th>
<th>On Occasion</th>
<th>Sometimes</th>
<th>Often</th>
<th>Frequently</th>
<th>Always</th>
<th>MEAN</th>
<th>Never</th>
<th>Rarely</th>
<th>On Occasion</th>
<th>Sometimes</th>
<th>Often</th>
<th>Frequently</th>
<th>Always</th>
<th>MEAN</th>
<th>Significant difference between groups</th>
<th>Sig (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>4% (8)</td>
<td>10% (23)</td>
<td>31% (75)</td>
<td>56% (134)</td>
<td>5.40</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>1% (8)</td>
<td>6% (50)</td>
<td>30% (201)</td>
<td>61% (407)</td>
<td>5.52</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Significant difference between groups (p<0.05)
### Table A4: Social Engagement: Colleagues

<table>
<thead>
<tr>
<th>At school, I connect well with my colleagues.</th>
<th>NON-STEM</th>
<th>STEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>0% (0)</td>
<td>1% (2)</td>
</tr>
<tr>
<td>Rarely</td>
<td>0% (0)</td>
<td>0% (0)</td>
</tr>
<tr>
<td>On Occasion</td>
<td>3% (2)</td>
<td>0% (0)</td>
</tr>
<tr>
<td>Sometimes</td>
<td>17% (10)</td>
<td>2% (4)</td>
</tr>
<tr>
<td>Often</td>
<td>20% (12)</td>
<td>3% (5)</td>
</tr>
<tr>
<td>Frequently</td>
<td>46% (27)</td>
<td>15% (25)</td>
</tr>
<tr>
<td>Always</td>
<td>14% (8)</td>
<td>35% (59)</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td>4.49</td>
<td>5.07</td>
</tr>
</tbody>
</table>

**Significant difference between groups (p<0.05)**

<table>
<thead>
<tr>
<th>At school, I am committed to helping my colleagues.</th>
<th>NON-STEM</th>
<th>STEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>0% (0)</td>
<td>0% (0)</td>
</tr>
<tr>
<td>Rarely</td>
<td>0% (0)</td>
<td>0% (0)</td>
</tr>
<tr>
<td>On Occasion</td>
<td>0% (0)</td>
<td>0% (0)</td>
</tr>
<tr>
<td>Sometimes</td>
<td>3% (2)</td>
<td>0% (0)</td>
</tr>
<tr>
<td>Often</td>
<td>36% (2)</td>
<td>0% (0)</td>
</tr>
<tr>
<td>Frequently</td>
<td>39% (23)</td>
<td>0% (0)</td>
</tr>
<tr>
<td>Always</td>
<td>5.10</td>
<td>9% (15)</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td>4.66</td>
<td>34% (57)</td>
</tr>
</tbody>
</table>

**Significant difference between groups (p<0.001)**

<table>
<thead>
<tr>
<th>At school, I value the relationships I build with my colleagues.</th>
<th>NON-STEM</th>
<th>STEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>0% (0)</td>
<td>0% (0)</td>
</tr>
<tr>
<td>Rarely</td>
<td>0% (0)</td>
<td>0% (0)</td>
</tr>
<tr>
<td>On Occasion</td>
<td>5% (3)</td>
<td>0% (0)</td>
</tr>
<tr>
<td>Sometimes</td>
<td>7% (10)</td>
<td>0% (0)</td>
</tr>
<tr>
<td>Often</td>
<td>32% (19)</td>
<td>0% (0)</td>
</tr>
<tr>
<td>Frequently</td>
<td>47% (28)</td>
<td>11% (18)</td>
</tr>
<tr>
<td>Always</td>
<td>5.20</td>
<td>28% (46)</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td>4.92</td>
<td>60% (100)</td>
</tr>
</tbody>
</table>

**Significant difference between groups (p<0.02)**

<table>
<thead>
<tr>
<th>At school, I care about the problems of my colleagues.</th>
<th>NON-STEM</th>
<th>STEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>0% (0)</td>
<td>3% (1)</td>
</tr>
<tr>
<td>Rarely</td>
<td>2% (1)</td>
<td>0% (0)</td>
</tr>
<tr>
<td>On Occasion</td>
<td>3% (2)</td>
<td>0% (0)</td>
</tr>
<tr>
<td>Sometimes</td>
<td>15% (9)</td>
<td>0% (0)</td>
</tr>
<tr>
<td>Often</td>
<td>24% (14)</td>
<td>0% (0)</td>
</tr>
<tr>
<td>Frequently</td>
<td>34% (20)</td>
<td>1% (1)</td>
</tr>
<tr>
<td>Always</td>
<td>22% (13)</td>
<td>4% (7)</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td>4.51</td>
<td>17% (29)</td>
</tr>
</tbody>
</table>

**Significant difference between groups (p<0.03)**