

Toronto District School Board: 2015-2016

Project Title	STEM Teaching and Learning in Toronto District School Board (TDSB): Towards a Strong Theoretical Foundation and Scaling Up From Initial Implementation of the K-12 STEM Strategy
Description	<p>TDSB research has been focusing on “a number of pedagogical approaches grounded in an inquiry-based” teaching and learning framework including: discipline-based, inter-disciplinary based and trans-disciplinary based inquiries, project-based learning, problem-based learning and design-based learning. “[T]hese models vary in certain aspects from one another... [but in general] they share an emphasis on collaboration, creativity, citizenship, self-regulation, technological literacy, and fostering deep understanding.”</p> <p>In 2015-16 it is our vision to continue to:</p> <ul style="list-style-type: none"> <li>• Provide STEM education for all students.</li> <li>• Link real world issues to classroom teaching and learning.</li> <li>• Promote problem-based learning and STEM skills to allow students to stay current, inquire and engage in relevant issues of the world around them.</li> <li>• Encourage scientific discovery and <i>technological innovation</i> to shape how future citizens work collaboratively to provide creative and viable solutions to today’s and tomorrows’ real-life problems.</li> </ul> <p>Our goals through K-12 STEM Strategy that are directing our research includes:</p> <ul style="list-style-type: none"> <li>• Prepare our students to be <b>global learners</b> and leaders in <b>creating solutions</b> for emerging complexities.</li> <li>• Move public education forward - continue to improve on <b>culturally relevant</b> and responsive practices.</li> <li>• Use <b>problem-based</b> learning that instills <b>creativity</b> and <b>innovation</b>, in order to transform teaching &amp; learning.</li> <li>• Develop <b>creative and innovative thinking</b> in and across all disciplines.</li> <li>• Increase all students’ <b>confidence</b> and <b>engagement</b> in mathematics, science and technology.</li> </ul>
Context	<p><i>Number of students:</i> 1,800</p> <p><i>Number of teachers:</i> 90</p> <p><i>Number of schools:</i> 60</p> <p><i>Grades/Program:</i> JK-12</p>
Impact on Students	<p>TDSB research examined student learning and development of Science, Technology, Engineering and Mathematics (STEM) skills and global competencies as well as growth in achievement and engagement in relation to the TDSB STEM strategy. As an overt display of improvement, students engaged directly in STEM pedagogy showed higher achievement in EQAO Grade 9 Mathematics in both</p>

	<p>Academic (87% versus 80%) and Applied Courses (38% versus 27%) compared to the other students in the same schools with no engagement in STEM pedagogy. Students in Grades 3-12 and their teachers and school administrators from 60 STEM pilot schools in the TDSB participated in a survey on the TDSB STEM strategy.</p> <p><i>Student Engagement:</i> Based on the results of the initial year of implementation of the TDSB K-12 STEM strategy, student engagement in STEM education continues to be strengthened. Seventy-eight percent of secondary students strongly agreed, agreed, or somewhat agreed that STEM education is relevant and meaningful to their lives. Moreover, the results demonstrate that students are very interested in STEM careers. Additionally, students showed very high agreement with STEM skills and competencies, such as collaboration, creativity, critical thinking, and citizenship.</p> <p><i>Student Learning and Achievement:</i> 21st Century competencies have been identified as essential for work in society. Overall, students at the elementary and secondary levels showed very high agreement with the statements on 21st Century skills and competencies. For elementary students, overall agreement ranged from 84%-93% among the eleven statements, and for secondary students, overall agreement ranged from 79%-95%. These findings indicate that students expressed confidence about the 21st Century learning skills. However, students also revealed that they sometimes struggle with time management.</p> <p>The majority of elementary and secondary students indicated that the teachers in their school engaged them in inquiry-based learning; project-based learning, collaboration, practices fostering creativity, and technology use. These findings suggest that the elementary and secondary school teachers who participated in the TDSB STEM professional learning were becoming more comfortable with the role of teacher as facilitator of learning and were using strategies to promote independent student thinking. Research shows that when elementary students learn science through inquiry-based curriculum modules where teachers received professional learning sessions and access to coaches throughout the year, there were significant increases in students' science knowledge and achievement.</p>
<p><b>Impact on Instruction</b></p>	<p>At the end of the year 1 STEM implementation, over 90% of teachers strongly believed in the value of STEM for improving student learning. Teachers believe STEM education can help with preparing students skills and competencies, enhance student learning, solve real-world problems and engage in inquiry or problem-based learning. A majority of teachers (87%) believed that STEM education will improve their teaching practice. Teachers feel that they have the necessary understanding STEM pedagogy and resources.</p> <p>Most TDSB teachers in the study reported that they have tried to a great or</p>

	<p>moderate extent to develop students’ STEM skills, and that the students have in turn learned the STEM skills. However, about one third of the teachers reported that they have not been able to effectively assess students’ STEM skills.</p> <p>Teachers reported that the most common practices they used to support STEM learning to develop STEM competencies were enabling students to use technology to share information, take initiative when confronted with a difficult question and use technology to support team work and collaboration.</p> <p>Overall, the study findings indicated that there are a few areas that can be further development, which include: providing more opportunities for students to choose their own topic or questions, more examples of activities that require analysis of competing perspectives and fostering global connections.</p> <p>The results of the TDSB study showed that majority of teachers networked and collaborated with colleagues suggesting that collaborating in teams was a preferred teacher strategy for STEM planning and implementation.</p>
<p><b>Impact on System</b></p>	<p>The findings from initial implementation suggests that the coaching model is a highly viable model to promote STEM professional learning in schools and that it needs to be improved in certain areas to enhance its effectiveness. Such improvements will also be needed to scale up the STEM implementation across the board. This includes:</p> <ul style="list-style-type: none"> <li>• Hire more STEM coaches to support smaller groups of teachers in the same school or clusters of schools</li> <li>• Hire STEM coaches who are preferably teaching at a participating school to provide for frequent and consistent onsite presence</li> <li>• Designate coaches to a group of schools in the same area as their home school to facilitate consistent onsite access</li> <li>• Provide comprehensive STEM training for coaches that includes criteria and metrics for assessing STEM programs, STEM assessment and evaluation strategies, and STEM career information.</li> </ul> <p>TDSB has recently renewed its innovative vision for learning focusing on global competencies and digital fluency as the central elements of its learning vision. Our TLF innovation project aligned fully with TDSB vision for learning as well as Ontario’s renewed vision, Achieving Excellence. Through our TLF innovation project we will provide research based evidence informing practices across the board in setting achievement goals that will involve deep learning and educational technology.</p> <p>Current trends of declining numeracy results across the province as measured by EQAO and Ontario’s renewed Math Strategy released on April 4, 2016 aligned with our focus on improving numeracy achievement of our students through transdisciplinary STEM pedagogy and deep learning integrating meaningful</p>

	<p>educational technology in teaching and learning.</p> <p>Coding and robotics will remain a focus as we go deeper with specific curriculum connections that envelope the use of robotics and computational thinking. Our goal will be to go further and include technology enhanced improved in numeracy achievement through a STEM pedagogy. To this end we will be including specific Mathematics focused actions which will continue our technology and STEM focus but also emphasize mathematics and numeracy. We will expand the DLL (Digital Lead Learner) model.</p>
--	--