

# January 2014

## Career Choices and Influencers in Science, Technology, Engineering and Math: An Analysis of the Maritime Provinces

### WISEatlantic Survey – Executive Report

The WISEatlantic Research Group has completed the first year of a five year study focusing on the engagement of junior high school students in science and math subjects, their competency in such subjects, and influencers of their future career decisions, particularly those focused on careers in science, technology, engineering and math. Research highlights are summarized in this Executive Report. For a copy of this report, or to learn more about the study, contact WISEatlantic.



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## WISEatlantic Sponsors and Partners



# Researcher Biographies

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**Dr. Tamara Franz-Odendaal, PhD., Lead Researcher**  
**NSERC Chair for Women in Science and Engineering**  
**Dept. of Biology, MSVU**

Dr. Tamara Franz-Odendaal is the NSERC Chair for Women in Science and Engineering (CWSE) for Atlantic Canada. She holds a Ph.D. from the University of Cape Town, South Africa, and is a faculty member in the Dept. of Biology at Mount Saint Vincent University. Dr. Franz-Odendaal serves on an Expert Panel for the Canadian Council of Academies and on a NSERC Discovery Grants review panel. She is also an associate editor for the Canadian Journal of Zoology and the Vice-Chair for the Comparative Morphology and Development Division of the Canadian Society of Zoologists. Dr. Franz-Odendaal is passionate about mentoring and supporting women in science and engineering and she has dedicated much of her time to understanding how to attract more women into science, technology, engineering, and math careers. She pioneered a week long science summer camp for girls at the Mount. In addition to her role as NSERC Chair for Women in Science and Engineering, she is the lead researcher for this research study.

**Dr. Karen Blotnicky, PhD., Co-Researcher**  
**Dept. of Business & Tourism, MSVU**

Karen Blotnicky is a faculty member in the Department of Business and Tourism at Mount Saint Vincent University, where she specializes in marketing. Dr. Blotnicky is also the program coordinator for tourism and hospitality management. She holds a Ph.D. from Northcentral University in Arizona. Dr. Blotnicky's research focuses on women in business, female entrepreneurship, and female representation in hotel management. Her varied research interests also include marketing philosophy in organizations and how it impacts the adoption of information and communications technology. She is a research specialist with over 25 years of experience combining industry and academic research. She is sought out for her expertise and is involved in many research collaborations and publications. In addition, Dr. Blotnicky was a small business columnist in both newspaper and radio, providing practical advice and an analytical perspective to modern business challenges. As a woman who pursued non-technical studies, but who ended up with a passion for applied statistics, Dr. Blotnicky has much in common with youth who are the focus of this research study.

**Dr. Fred French, PhD., Co-Researcher**  
**Dept. of Education, MSVU**

Dr. Fred French is a registered psychologist and a faculty member in the Faculty of Education at Mount Saint Vincent University. He holds a Ph.D. from the University of Alberta. Dr. French's primary areas of research deal with youth from the perspective of self-regulation and metacognition involving research into best practices in intervention and diagnosis. While his work is primarily with those who have learning disabilities, attention deficit hyperactivity disorder and behavioral disorders, he maintains an active long term interest in the career development of children and youth. He has provided leadership and consultative help to several initiatives in improving career development opportunities for youth in the public school system in several provinces. His research has implications for classroom practice, policy studies, leadership, exceptionality, human rights and inclusive practices; topics covered in various programs such as education, curriculum studies, educational and school psychology.

**Phillip Joy, MSc., Student Research Assistant**  
**Dept. of Applied Human Nutrition, MSVU**

Phillip Joy is a student research assistant for the WISE project. He holds a MSc. in Biology from Dalhousie University. He is completing a Bachelor of Applied Human Nutrition in dietetics at Mount Saint Vincent University and works as a lab instructor for the Dept. Phillip's research interests are many and he has greatly expanded his applied research knowledge by participating in a variety of research collaborations at MSVU. Phillip brings a unique background to this research, integrating both applied statistics and a scientific inquiry to the research process. He also brings a qualitative research perspective to the project. His research interests include the use of visual strategies in research, compassion in the community setting, medical ethics, employment and student Wellness programs, and low fat food product development for children.

# About this Study

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Educators have long been concerned that fewer women than men pursue STEM (Science, Technology, Engineering, Math) focused programs at the post-secondary level. Less than 25% of the STEM workforce in Canada is women. Research has indicated that this reality reflects a trend in high school that sees girls lose interest in STEM studies and careers.

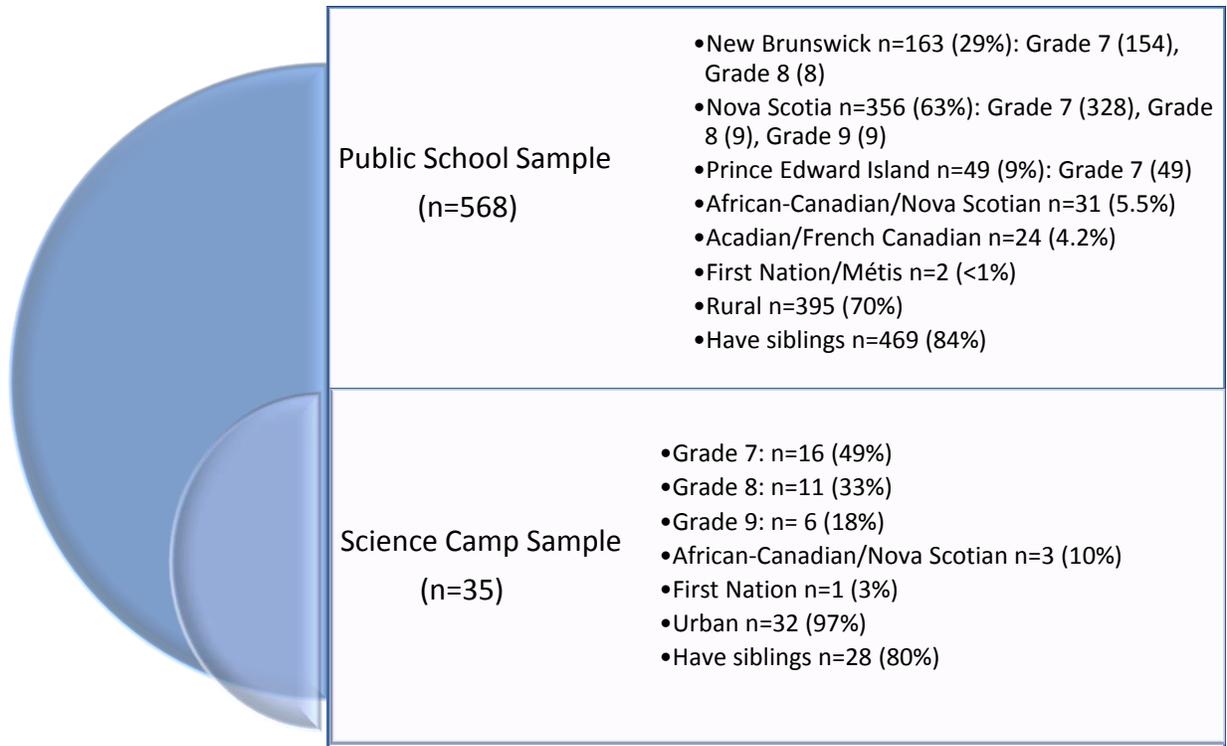
The **goals of this study**, which focused on junior high school students, was to **understand how engaged** they were in math and science, **their future intention** for studying science and math, and the **likelihood that they would consider a STEM career down the road**. Research also addressed students' knowledge of how relevant science and math were across various types of careers. Gender and grade differences, and influencers on science and math study, were also examined.

Two samples were analysed in this study. The first sample comprises students attending public schools. Nearly 600 students in grades 7 through 9 completed an online survey during school hours in New Brunswick, Nova Scotia, and Prince Edward Island. While the survey was directed to both English and French language schools over 98% of respondents were English. The majority of respondents were from Nova Scotia and were in Grade 7. This sample was the first of a multi-year study that will track students from Grade 7 forward through Grade 12 at the cohort level.

The second sample was a case study of 35 girls in grades 7 through 9 who attended the Girls Get WISE Science Camp in the summers of 2012 and 2013 at the Mount. The science camp cohort provided a unique opportunity to study girls who were highly engaged in science and math subjects.

Most of the students did not indicate that they identified with a particular ethnic group. The majority of students lived in rural areas and had siblings living with them in the home. These demographics are summarized in Figure 1.

This research study was approved by the Research Ethics Board of Mount Saint Vincent University. In addition, permission was obtained from superintendants of education as required.



**Figure 1: Sample Allocation by Grade, Province and Demographic Profile.** Numbers in parentheses after grade level in the public school sample, indicate the number of students in that grade. Total sample size is denoted by the 'n' value. The sample percent is shown in brackets.

# Highlights

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## STEM Perception: How students feel about STEM subjects and school in general

- Significantly more grade 7 boys than girls rated General Science as their favourite subject;
- Grade 7 boys rated Math higher among their favourites than girls;
- Nearly 80% of students liked going to school and almost 50% of students reported that they also liked learning things.

## STEM Engagement:

- Over 60% of students had engaged in a STEM activity in the past 12 months;
- Girls who attended an all girls summer science camp showed higher levels of engagement in STEM activities than students in the public school sample;
- Grade 7 students who engaged in STEM activities learned Math more quickly than those who did not;
- As students mature (from Grade 7 through Grade 9) engagement in STEM activities appears to have less impact on STEM subject motivation;
- Of those who did not engage in any STEM activities, 40% indicated that they would do so if they had the opportunity.

## STEM Career influencers:

### What influenced students when thinking about their careers:

- Four themes emerged: the future itself (what it would hold), family and friends, STEM careers, and money. There were differences in these influencers by urban/rural location;
- Students in the public schools were more heavily influenced by the media than girls who attended the summer science camp.

### Who influenced students when thinking about their future?

- Three influencers emerged: family, non-STEM role models and teachers. Girls were more likely to list friends and teachers as influencers and boys were more likely to list non-STEM role models. There were also differences by urban/rural location;

### How and why were students influenced?

- Students responded that they received help and encouragement, future considerations, and exposure to STEM. Exposure to STEM was more common in the science camp cohort than the public school cohort. Girls were more likely than boys to be guided by help and encouragement in the public school sample. There were also differences based on rural/urban location.

### STEM Career Knowledge:

- Students in the science camp sample were more aware of math and science requirements for STEM careers than were students in the public school sample;
- Regarding engineering, most students reported that engineers build things. There were significant differences by urban/rural location and whether or not students had siblings. Science camp respondents appear to have a better grasp of the design aspects of engineering than the public school students.

### Future Plans:

- Most students planned to pursue a university degree with many more Grade 7 girls planning to go to university than boys;
- More Grade 7 boys planned to enter the workforce or pursue community college directly after finishing high school than girls;
- Participation in STEM activities appeared to influence more students to choose the university route.

### Career Interests and Activities:

- Girls in grades 7 and 9 are more interested in artistic, unusual, and creative activities than boys;
- More boys than girls preferred careers involving manual and mechanical or technical and scientific skills;
- More girls preferred careers involving working with people, or careers involving leading, persuading, and directing others, than boys;
- The science camp sample showed a greater preference for careers involving technical and scientific skills than students in the public school.

### Likelihood of choosing a STEM career:

- Science camp participants were far more likely to consider a STEM career;
- Grade 7 students who were engaged in STEM activities were more likely to consider a STEM career.

For girls: critical influencers were education-based, rather than community based. The strongest influencer was engaging in STEM activities. Students who had engaged in STEM activities were 2.7 times more likely to consider a STEM career. Interestingly, their feelings of competence in STEM subjects (i.e. getting good marks) was not a significant influencer of their STEM career choice. Although teachers were a significant influencer they did not increase the likelihood of choosing a STEM career. **These results show that the only effective means of increasing the likelihood for girls to consider STEM careers is by engaging them in highly active STEM activities.**

STEM competence, teachers, and highly interactive STEM activities did not significantly impact the likelihood that boys would consider STEM careers, nor did community-based influencers.

# STEM Perception

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## What is subject perception?

Subject perception captures how students feel about the subjects they take. Do they like them? Do they feel confident in their abilities? STEM perception was measured by focusing on favoured subjects, self-confidence (competence), and anxiety (tension, stress). Students were also asked how they felt about school in general.

## STEM Subject Favourites

Sixty percent of public school students rated General Science in their top two favoured subjects out of seven subjects ranked. **Significantly more grade 7 boys than girls (49% versus 36%) rated General Science as their favourite subject.** Grade 7 students in urban area schools rated this subject higher than those in rural areas. Also, students who had siblings also rated General Science higher in terms of favoured ratings, but this was only significant for the grades 8/9 levels.

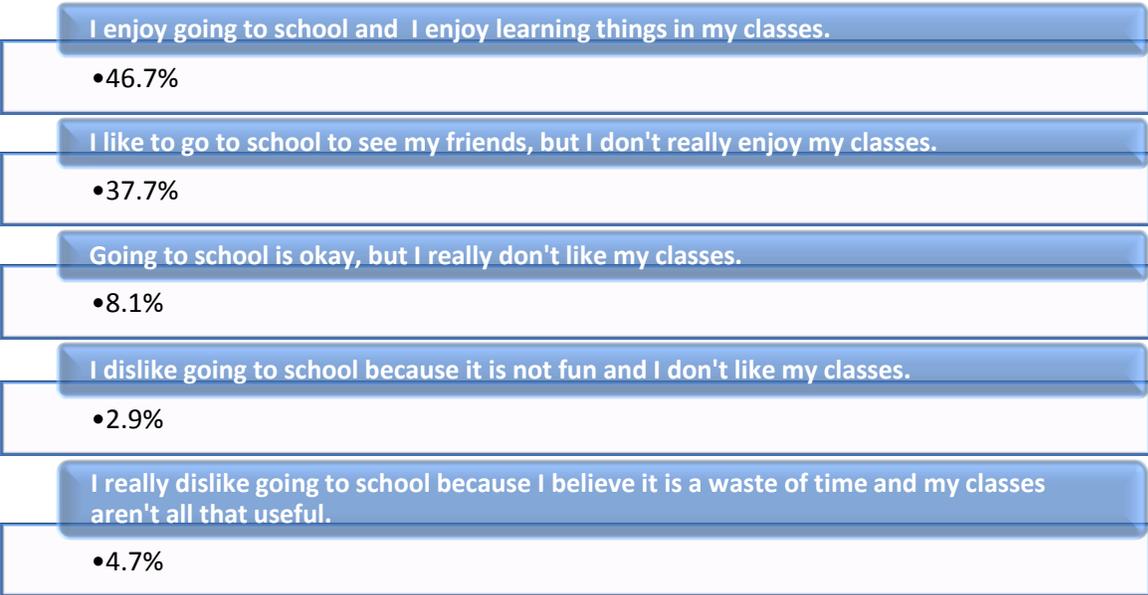
Almost 48% of public school students rated math in their favourite subject choices. **Grade 7 boys rated Math higher among their favourites than girls.** There were no statistically significant differences in the math ranking by siblings or urban/rural location.

Anglophone students were asked to rank English, and Francophone students were asked to rank French, among their subject favourites. **Grade 7 girls significantly rated their English/French subject higher as favoured than boys did (85% in girls versus 78% in boys).** Also, more girls than boys rated the subject as their best subject overall. There were no statistically significant differences in English/French subject favourite rankings based on siblings or urban/rural location.

There were no statistically significant differences for favourite subject ratings for biology, chemistry, or physics.

## Feelings about School

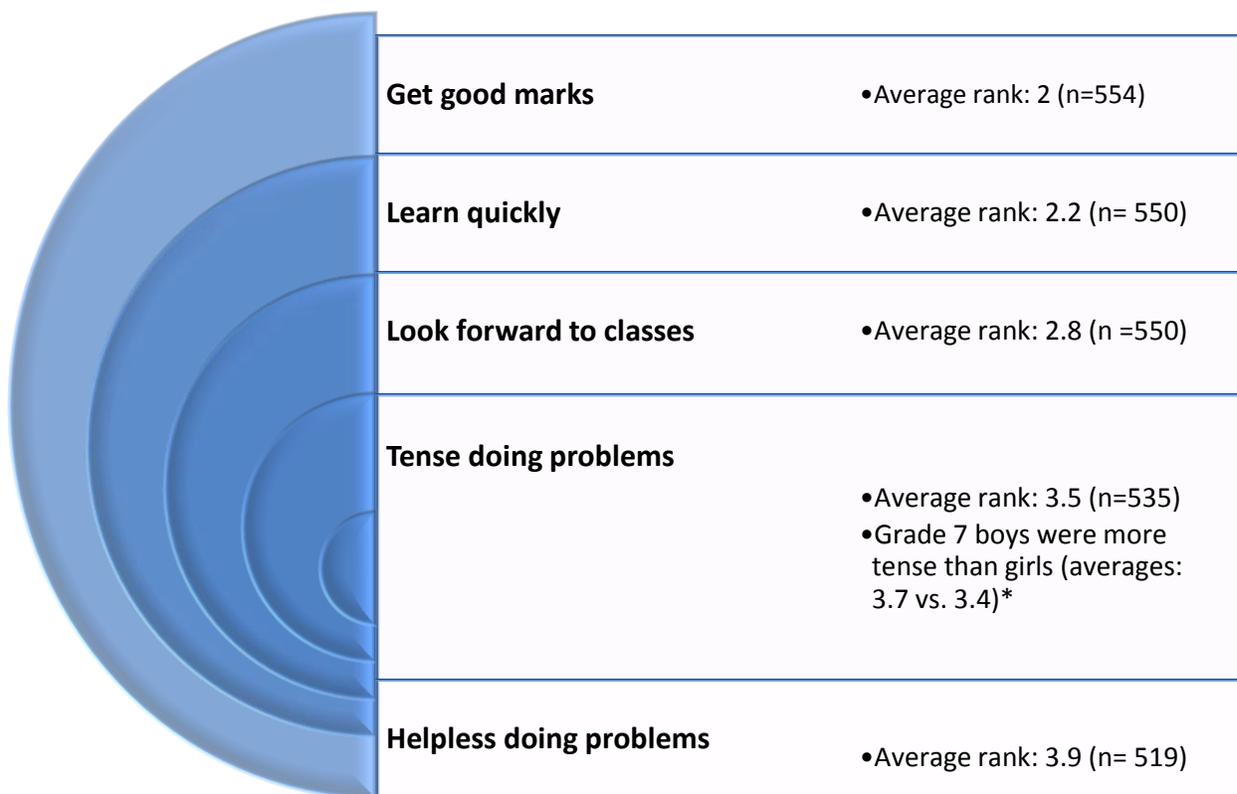
Over 80% of students liked going to school and nearly half reported that they also enjoyed learning things in their classes. Less than 10% did not like their classes, disliked going to school, or felt it was a waste of their time. School perceptions are shown in **Figure 2**. There were no statistically significant differences in perceptions by gender, siblings, or rural/urban location.



**Figure 2: Feelings about School.** Sample size: n = 555.

## Math Competence

To determine math competence, students were asked to rate their agreement with the competency statements on a scale ranging from 1) Strongly agree to 5) Strongly disagree<sup>1</sup>. **Students rated themselves quite competent in math**, agreeing that they got good marks in math and that they learned math quickly. Overall, students did not feel tense or helpless when doing math problems. Despite their apparent competence in math, nearly one-third had sought extra help in the subject in the last 12 months. Also, **more Grade 7 boys than girls reported feeling tense when doing math problems**. The results are shown in **Figure 3**.



**Figure 3: Math Competence.**

This was a ranking question where students ranked their response from 1 (Strongly agree) to 5 (Strongly disagree). Sample size is indicated by “n”. \*Differences are statistically significant.

These results demonstrate that students generally like school and that those in Grade 7 enjoy their STEM classes and their English/French class. These differences seem to disappear in the higher grades. And while boys were more tense doing math in Grade 7 than girls, this feeling had dissipated by grades 8 and 9.

<sup>1</sup> See Methodology Notes at the end of this report for more information on statistical measures.

# STEM Engagement

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**Over 60% of students in the public school sample had engaged in a variety of STEM activities** over the past 12 months. Over 50% had visited a science centre, museum, aquarium, or marine life centre. Just over a quarter had participated in a science fair or competition. Ten to 14% had been involved in school-related activities, such as having a math or science group visit their class, or having a special science program in their school. Only four percent had been involved in a science camp.

**Those who engaged in STEM activities had different profiles from those who had not.** Grade 7 students in urban areas were more likely to have participated than students from rural area schools. In fact, Grade 7 students in rural areas were more likely not to have been exposed to any STEM activities. For example:

- Significantly more Grade 7 urban students (23%) visited an aquarium/marine life centre compared to Grade 7 rural students (15%)
- Significantly more Grade 7 urban students (9%) participated in a science camp compared to Grade 7 rural students (3%)
- Significantly more Grade 7 urban students (31%) participated in a science/math class visit compared to Grade 7 rural students (7%)

Interestingly, Grade 7 students in rural areas were significantly more likely to have participated in science fairs or competitions (29%) than urban area students (16%).

These results demonstrated that location of school can be an advantage for some students and a disadvantage for others. The results also show that as students' progress through junior high school urban/rural location ceases to be a problem because there were no statistically significant differences in grades 8 or 9; albeit the Grade 8/9 cohort was smaller. The next phase of our research will re-examine this trend.

## What is STEM engagement?

Students can engage in a variety of STEM activities, both inside and outside of school. Such activities include visitation to science centres, museums, and aquariums, class visits for math or science groups, and participation in math or science camps and competitions. This kind of engagement was measured by recording the STEM activities students had engaged in over the last 12 months.

Students in the **science camp sample had much higher levels for STEM engagement** overall compared to the general sample. For example:

- 26% of science camp students had participated in a science/math class visit compared to 14% of the public school sample
- 14% of science camp students had participated in a special science program<sup>2</sup> compared to 10% of the public school sample
- 40% of science camp students had visited an aquarium/marine life centre compared to 18% of the public school sample
- 54% of science camp students had visited a science/discovery centre or museum compared to 33% of the public school sample

Grade 7 students who had participated in special math or science programs in their schools, or who had a math or science group visit their class, indicated that they **learned math more quickly than those who had not participated in that activity**. Also, Grade 7 students who did not participate in any STEM activities were less likely to look forward to math class. These students were also less likely to report feeling helpless when doing math problems.

However, for Grade 9 students who had visited an aquarium or marine life centre, or who had experienced a science or math group visit their class, reported negative scale ratings for getting good math marks. These results indicated that **as students mature, engagement in STEM activities may contribute less to academic success, or alternatively that these types of engagement are less motivating to this age group**.

Grade 7 students who engaged in STEM activities seemed to be more tense when doing Physics problems. Students who had visited an aquarium or marine life centre, had a science or math group visit the class, or engaged in a special science program experienced more stress in Physics. These patterns were not significant for students in Grades 8.

Grade 7 Biology students looked forward to class more when they had experienced a special science program in their school. Also, Grade 7 students were less likely to feel helpless in Biology if they had visited a science or discovery centre, or museum. Grade 7 biology students were less likely to feel tense if they had visited an aquarium or marine life centre. There were no statistically significant differences for students in Grades 8 and 9.

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<sup>2</sup> Special science programs include activities that are designed to fully engage students in STEM activities, provide mentors, and/or other specialized experiences (eg: Techsploration) ([www.techsploration.ca](http://www.techsploration.ca))

Chemistry studies also seemed to be positively affected by some science-related activities. Grade 7 students who had gone to a summer or March break science camp, or who had a science or math program in their schools, felt less helpless than those who did not. There were no statistically significant differences for students in Grades 8 and 9.

Of those who had not participated in any STEM activities, **40% said they would engage in such activities if they had the opportunity to do so.** There were no statistically significant differences in urban/rural area, siblings, or gender, based on whether or not students were willing to participate in STEM activities.

# STEM Careers: Influencers

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## **Teacher Influence on STEM Subject Perception**

Research focused on the gender of those teaching STEM subjects and whether or not this influences students' perceptions of STEM subjects. Results revealed that **teacher's gender has no significant influence on the perception of STEM subjects.**

## **What Influences Students?**

When asked what influenced them the most when thinking about their future, **four key themes** emerged (i.e. these four had >10% of the responses) in the public school sample:

1. The future
2. Family/friends
3. STEM careers
4. Money

Teachers were listed by only 5% of respondents. Other themes with less than 10% included helping, media, non-STEM role models<sup>3</sup>, STEM role models<sup>4</sup>, and nothing. Interestingly, there were differences observed between the science camp and the public school sample, **the only statistically significant difference between the two cohorts was for the media theme.** The results are summarized in **Figure 4.**

**Within the public school sample,** there were some statistically significant patterns in the themes by urban/rural area. In the Urban schools, two themes were higher: Family/friends (21% in urban versus 12% in rural) and Teachers (10% in urban versus 4% in rural). In rural schools, three themes were higher: Money (4% in urban versus 11% in rural), Don't Know (3% in urban versus 9% in rural), and Helping (3% in urban versus 8% in rural).

## **Influencers of STEM career choices?**

Research focused on what, who, and how/why students' career interests were influenced. While the emphasis was on STEM careers, overall career influencers were gathered by asking students open ended questions. Themes emerging from this qualitative analysis were then examined in the light of exposure to STEM activities, as well as gender, sibling, and urban/rural influences.

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<sup>3</sup> Non-STEM role models included responses such as athletes, celebrities, musicians, writers, etc.

<sup>4</sup> STEM role models included responses such as doctors, scientists, technologists, engineers, etc.

Influencers	Public School Sample (%)	Science Camp Sample (%)
The Future	36	25
Family/Friends	15	20
STEM Careers	13	0
Money	10	8
Helping	7	0
Don't Know	7	0
Role Models – general	2	8
Non-STEM role models	3	4
STEM role models	1	1
Media	5*	0*
Teachers	5	4
Other	16	4

**Figure 4: What Influences Students When Thinking About the Future.** Public school sample: n = 500; Science camp sample: n = 26. \*Differences are statistically significant.

### Who Influences Students?

In the **public school sample**, when asked who influenced them the most when thinking about their future, **three key themes** emerged (i.e. with >10% of the responses):

1. Family
2. Non-STEM role models
3. Teachers

Other themes with less than 10% included friends, themselves, no one, and STEM role models.

In the **science camps** cohort, **four out of five** themes had over 10% of responses. These were: family, teachers, themselves, and friends. One remaining theme, Non-STEM role models, was listed by less than 10% of respondents.

There were a number of significant differences between who influenced students in the public school sample compared to students in the science camp sample. **Science camp participants were more likely to report being influenced by their teachers themselves, and STEM role models than public school students.** The results are summarized in **Figure 5**. Further analysis however, that selected only the highly engaged girls from the public school cohort did not differ significantly from the science camp cohort.

Influencers	Public School Sample (%)	Science Camp Sample (%)
Family	63	65
Non-STEM role models	15	9
Teachers	12*	32*
Friends	8	13
Themselves	8*	26*
No one	6*	0*
STEM role models	5*	0*
Don't know	4	0

**Figure 5: Who Influences Students When Thinking About the Future.** Public school sample: n = 495; Science camp sample: n = 23. \*Differences are statistically significant.

**Within the public school sample**, there were some statistically significant patterns in the themes by urban/rural area, gender, and grade.

Students in urban areas were more likely to have listed themselves as influencers (13% versus 6%), and friends as influencers (14% versus 6% in rural), than rural area students. Also, rural area students were more likely to be unsure about who influenced them than urban area students (6% versus 1%).

**Girls were more likely to list friends (12% versus 4%) and teachers (16% versus 8%) as influencers than boys were. Boys were more likely to list non-STEM role models as influencers than girls were (19% versus 12%).**

Finally, Grade 8/9 students were more likely to say that no one influenced them more than Grade 7 students were (16% versus 5%).

### ***The How/Why of Influence?***

Respondents were asked to elaborate as to how or why these factors influenced their thinking about the future. Students in the public school sample responded that they received help and encouragement, STEM exposure, future considerations, or that they were unsure. These were similar to the themes expressed by those in the science camp cohort, except that the science camp cohort were more likely to list STEM exposure than the public school students. Those who influenced students in thinking about their futures did so primarily by exposing them to different experiences. **The results are shown in Figure 6.**

Influencers	Public School Sample (%)	Science Camp Sample (%)
Help & Encouragement	70	71
Future Considerations	15	24
STEM exposure	10*	45*
Unsure	8	0

**Figure 6: Significant Differences in How/Why Students are Influenced When Thinking About the Future.** Public school sample: n = 495; Science camp sample, n = 21.

\*Differences are statistically significant.

A special breakout sample of girls engaged in highly interactive STEM activities was taken from the public school cohort for comparison to their peers in the science camp group. Highly interactive STEM activities included participation in science camps, competitions, or special school programs. Science camp students still demonstrated more STEM exposure compared to the breakout sample. In addition, the breakout sample was more likely to report STEM exposure as an influencer than were the other students in the public school sample.

**Within the public school sample**, there were statistically significant differences by gender and urban/rural area. **Girls were more likely than boys to be guided by help and encouragement (76% versus 64%).** Those in the urban area were also more likely to express help and encouragement (77% versus 67%) and less likely than students in rural areas to say that they were unsure (2% versus 11%).

# STEM Career Knowledge

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The top ranked careers for each of the public school and science camp cohorts (those with 50% or more indicating that math and science were required) showed that the **students in the science camps were much more aware of STEM career requirements than were those in the public school sample (Figure 7)**. Only ten careers were listed by half of the public school students, while 19 careers were included by half of the science camp respondents.

## What do students know about STEM careers?

Students were presented with a list of 24 different occupations. They were asked to indicate if each career required high school math or science. Students could indicate yes, no, or that they were uncertain about the requirement.

Even some key medical/doctoral careers were not connected with math or scientific knowledge by most of the students in the public school sample. Such careers include: medical technician, nutritionist, physiotherapist, oral hygienist, behavioural psychologist, and ophthalmologist. **These results clearly demonstrated that students do not have a clear understanding of how many careers require math and science knowledge.**

The results reveal that science camp respondents appeared to be more knowledgeable with more students recognizing STEM careers. Nineteen out of 24 careers were listed by at least 50% of science camp students as requiring STEM skills compared to only 10 careers out of 24 careers for the public school sample.

There were statistically significant differences between boys and girls in their recognition of the math and science requirements for conservationists and pharmacists. More girls than boys recognized that pharmacists need math (75% vs. 61%). For conservationists, more boys than girls recognized the math/science knowledge requirement (53% vs. 38%), however only 28.9% of respondents recognised this career as requiring math/science.

Rank	Public School Sample (%)	Science Camp Sample (%)
1	Teacher (70%)	Teacher (92%)
2	Mechanical engineer (63%)	Computer hardware engineer (88%)
3	Pharmacist (60%)*	Mechanical engineer (84%)
4	Veterinarian (59%)	Medical technician (84%)
5	Computer hardware engineer (59%)	Pharmacist (81%)
6	Geologist (59%)	Geologist (79%)
7	Medical technician (56%)	Veterinarian (81%)
8	Architect (55%)	Nutritionist (80%)
9	Landscaper (51%)	Oil industry engineer (76%)
10	Oil industry engineer (50%)	Landscaper (76%)
11		Architect (76%)
12		Graphic artist (70%)
13		Forensic Analyst (67%)
14		Lawyer (65%)
15		Oral hygienist (62%)
16		Physiotherapist (65%)
17		Land surveyor (56%)
18		Behavioral psychologist (52%)
19		Human resource manager (50%)

**Figure 7: Careers requiring Math or Science in high school that were listed by 50% or more of students in each sample.** Public school sample: n= 225 to 328; Science camp sample: n = 23 to 27. \* Denotes a statistically significant difference based on gender, more girls than boys knew that pharmacists required math/science knowledge (75% vs 61%).

# What Do Engineers Do?

## What do students know about STEM careers?

Research by Engineers Canada (2009)\* showed that students might not clearly understand what engineering entails. A goal of the current research is to determine whether by grades 10 through 12, students have a better understanding engineering. Future research will compare cohorts across grades.

Further analysis focused on whether or not students could describe what engineers do. Key themes emerged for both science camp and public school samples. **These themes included: build, design, math/science, make the world better, I don't know.** The most common theme was 'building' for both groups.

Within the public school sample, there were also statistically significant differences by gender, urban/rural area, and siblings:

- **More boys (23%) than girls (13%) used the theme 'Design'**
- **More urban students (25%) than rural students (15%) used the theme 'Design'**
- **More students without siblings (12%) than those with siblings (5%) used the 'Math theme'**
- **More urban students (8%) than rural students (3%) used the theme 'Make World Better'**
- **Fewer boys (14%) than girls (22%) used the theme 'Don't Know'**

When the science camp students were compared to the public school cohort there were no statistically significant differences. **Science camp respondents appear to have a better grasp of the design aspects of engineering than the public school students (Figure 8).**

Theme	Public School Sample (%)	Science Camp Sample (%)
Build	68	53
Design/Invent	18	32
Math/Science	6	11
Make World Better	4	11
Don't Know	18	11

**Figure 8: Responses to the question 'What Engineers Do?'**. Public school sample: n = 486; Science camp sample: n = 19.

\* Source: Engineers Canada and Canadian Council of Technicians and Technologists (2009). *Engineering and Technology Labour Market Study*.

# Future Plans

## What were students planning to do after high school?

Students were asked about their plans after finishing high school. The results revealed that most students plan to pursue a post-secondary credential and that the science camp cohort was more likely to pursue a university degree than those in the public school sample. The results are summarized in **Figure 9**.

Students in Grade 7 may be starting to think about what interests them and what they might do when they finish school. Researchers wanted to know about plans for post-secondary studies, workforce entry, and other activities following high school graduation.

In addition, **participation in STEM activities appeared to influence more students to choose the university route.**

Future Plans	Public School Sample (%)	Science Camp Sample (%)
Enter Workforce	7	10
Community College certificate/diploma	7*	0*
University Degree	56*	76*
Take a Year Off before Entering Workforce/Study	20*	3*

**Figure 9: Future Plans Following High School Completion.** Public school sample: n = 553; Science camp sample: n = 29. \*Differences are statistically significant.

When the public school sample was analyzed further it was found that there were statistically significant differences by gender. These included the following:

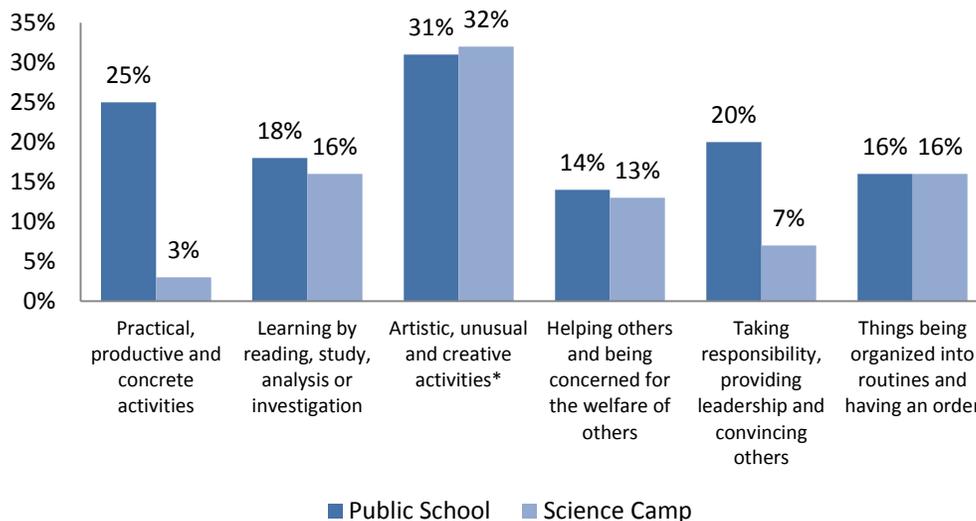
- **More Grade 7 boys (9%) than Grade 7 girls (5%) planned to enter the workforce directly after finishing high school**
- **Many more Grade 7 girls (64%) than Grade 7 boys (7%) were planning to go to university**
- **More Grade 7 boys (12%) than Grade 7 girls (4%) were planning to go to pursue a community college certificate or diploma**

# Career Interests and Activities

## What kind of careers are students interested in?

Researchers used two different career interest tools to understand what students enjoyed and how it may lead to future career decisions. One tool focused on activities that students enjoyed doing and the other focused on specific career interests.

Students were asked to do two things. First, they were asked to rank a list of career activities from 1 (first choice) to 6 (last choice) in order of interest. Then, they were asked to rank a list of career interests from 1 (first choice) to 6) last choice, based on their level of interest. The lists of activities and interest statements were chosen from a variety of research tools used to examine career choices and interests. The six career activities and the percent of students who rated each most favourite<sup>5</sup> are shown in **Figure 10**. Analyses revealed that most rankings did not differ based on gender, siblings, or urban/rural area. **The only statistically significant difference for interest in career activities was between Grade 7 and 9 boys and girls for artistic, unusual and creative activities. Girls rated these activities higher than boys.** Unlike results in other research, this study did not find that girls were more favourable towards helping activities.



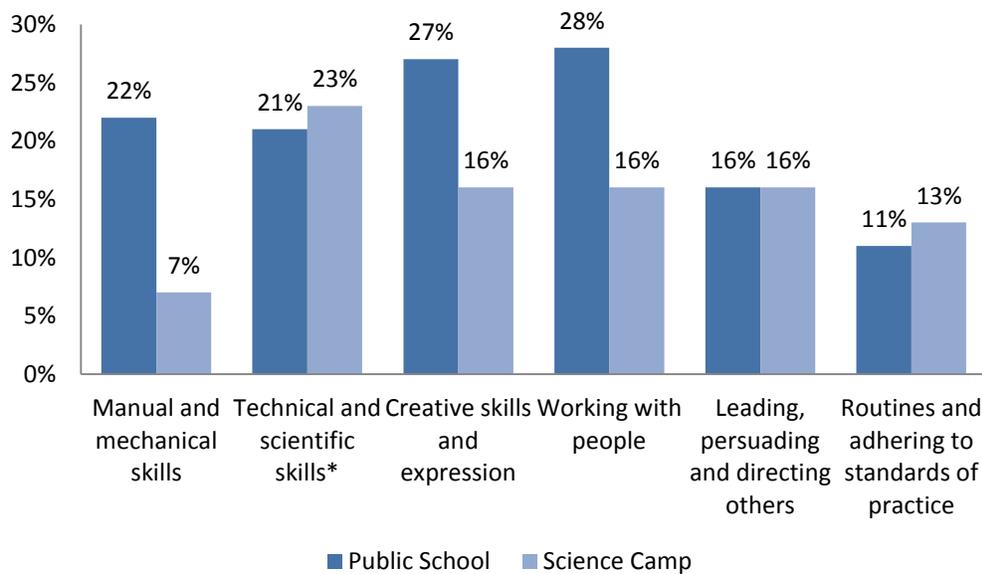
**Figure 10: Percent of Students Ranking Each Activity as Their First Choice**

Students ranked each activity from 1 (First choice) to 6 (Last choice). Public school sample: n = 302 to 489; Science camp sample: n= 24 to 26. \*Overall, girls ranked artistic, unusual and creative activities higher than boys did in both grades 7 and 9: Median girls rank 2/6 for grade 7 and 3/6 for grade 9 compared to median boy rank 3/6 for grade 7 and 4/6 for grade 9; Girls ranking it first: 41% in Grade 7 and 31% in Grade 9. Boys ranking it first: 20% in Grade 7 and 8% in Grade 9.

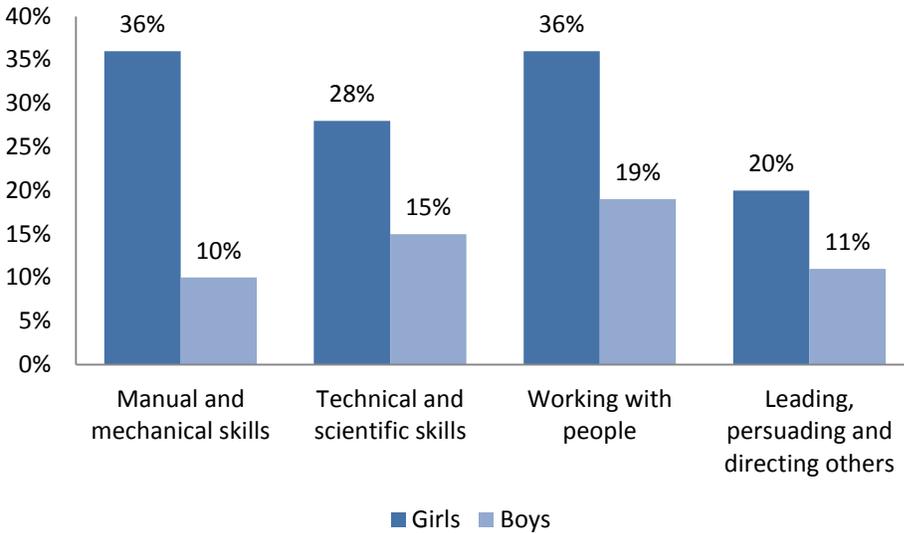
<sup>5</sup> See Methodology Notes at the end of this report for more information on these measures.

When compared to the public school sample, the science camp cohort was more likely to prefer artistic, unusual, or creative activities. Their median rank was higher, although there was little difference in the percentage of students who rated the activity in their top two more enjoyed activities. They were less likely to prefer helping others and being concerned for their welfare; taking responsibility, providing leadership, and convincing others, and routine and ordered activities.

Students were also asked to rank a list of six different career interests from 1) first choice to 6) last choice. The six career interests and the percent of students who rated each the highest is shown in **Figure 11**. Analyses revealed that most rankings did not differ based on siblings, or urban/rural area, but **there were differences based on gender**. For example, more Grade 7 boys than girls preferred careers involving manual and mechanical skills, or technical or scientific skills. More girls in Grade 7 were interested in careers involving working with people than boys. They also ranked careers involving leading, persuading, and directing others, higher than boys. The results are shown in **Figure 12**.



**Figure 11: Percent of Students Ranking Career Interest First (Favourite).** Students ranked each career interest from 1 (First choice) to 6 (Last choice). Public school sample: n = 473 to 476; Science camp sample: n= 25 to 26. \*Overall, the science camp sample ranked careers involving technical and scientific skills higher than the public school sample: Median rank for science camp students was 3/6 and 23% ranked it highest. Median rank for public school students was 4/6 and 21% ranked it highest.



**Figure 12: Gender Differences in Career Interests in Public School Sample Grade 7 Students – Percent Ranking Each as Favourite**

Public school sample: n = 473 to 476; Science camp sample: n = 25 to 26.

Students ranked each career interest from 1) First choice to 5) Last choice. The graph shows the percent of each gender ranking the activity 1 out of 6 (highest). All had statistically significant differences in median ranks: Manual/mechanical skills (Girls' median = 5/6 and boys' median = 3/6; Technical/scientific skills (Girls' median = 3/6 and boys' median = 4/6); Working with people (Girls' median = 3/6 and boy's median = 4/6); Leading/persuading/ directing (Girls' median = 3/6 and boys' median = 3/6).

When compared to the public school sample, the science camp cohort was less likely to prefer many of the career interests listed, but the differences are mixed because the medians did not differ greatly. However, **the science camp cohort had a higher median for careers involving technical and scientific skills** than the public school cohort.

# Likelihood of Choosing a STEM Career

## How likely are students to consider choosing a STEM career?

The ultimate goal of STEM educators, and those who are interested in encouraging more women to enter STEM fields, is to get students to consider a STEM career as early as possible. Students were asked how likely they were to do so. Then researchers investigated the impact of various influencers on the likelihood measure.

Overall, about 64% of public school students indicated that they were somewhat or very likely to consider pursuing a career based on math or science. The average likelihood rating was 2.29 on a 4-point scale: 1) Very likely, 2) Somewhat likely, 3) Somewhat unlikely, 4) Very unlikely. While this measure was positive in terms of student interest, over 90% of those in the science camp cohort were either very or somewhat likely to do so. The average rating in the science camp study was 1.7 on the 4-point scale. The differences in the scale ratings were statistically significant. **Science camp participants were far more likely to consider a STEM career than those in the public school sample.**

There were no statistically significant differences in the public school sample by gender, urban/rural location, or siblings. However, **Grade 7 students who had female role models in STEM careers were more likely to consider such a career.** Also, **those who were engaged in STEM activities**, including visiting a science centre, a museum, or having had a class visit, **were more likely to consider a STEM career than those who had not participated in any STEM activities.** Those who had participated in **special science program, a science camp, or a science competition, were also more likely to consider a STEM career than those who had not participated in STEM activities.** The differences are summarized in **Figure 13.**

Scale Rating	Public School Sample (%)	Science Camp Sample (%)
1) Very likely	27	45
2) Somewhat likely	37	45
3) Somewhat unlikely	17	10
4) Very unlikely	20	0
<i>Total**</i>	100	100
Scale Statistics		
Average rating	2.29*	1.7*
Standard deviation	1.07	0.7
Sample size	535	31

**Figure 13. Likelihood of Pursuing a STEM Career.** \*\*Percentages may not add to 100% due to rounding. \* Differences are statistically significant on 4-point scale rating: 1) Very likely, 2) Somewhat likely, 3) Somewhat unlikely, 4) Very unlikely.

# Critical Influencers for STEM Careers

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## What are the most salient influencers of STEM career choice?

Regression analysis showed that the greatest single positive influence on STEM career choice was involving students in highly interactive STEM activities, such as science camps, science fairs, and special programs.

A deeper analysis was conducted to determine what factor(s) had the greatest influence on a student's likelihood to choose a STEM-related career. Two broad themes were chosen for logistic regression analyses.<sup>6</sup> One theme relates to educational influences and the other relates to community influences. The themes are:

- Educational Influences: teachers, STEM competency, STEM engagement
- Community influences: urban location, money, family/peer

**Results revealed that for girls only educational influences were statistically related to STEM career choice.** The regression analysis for the community influencers was not statistically significant and none of the factors were found to influence boys. The regression results demonstrated that:

- **Students who participate in highly engaging STEM activities**, such as science fairs, competitions, and camps, **were 2.7 times<sup>7</sup> more likely to consider a STEM career than those who do not.**
- **Teacher influence had a negative impact for girls only. Those who reported teacher influence were only 0.27 times as likely to choose a STEM-based career as those who did not report teacher influence.**
- **STEM competence**, including getting good marks in courses such as math, biology, and/or chemistry, **had no influence on STEM career choice.**

**These results demonstrate that the only really effective means to increase the likelihood for women to consider STEM careers is to expose them to highly interactive and engaging STEM activities. Ideally, this should be done before girls reach high school when they may have already opted out of studying STEM subjects.**

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<sup>6</sup> See Methodological Notes at the end of the report for more information on this measure.

<sup>7</sup> The odds ratio indicates the change in the likelihood of engaging in a STEM career for students who were exposed to the influencers, such as participating in highly engaging STEM activities, or seeking the advice of a teacher. For the estimated odds ratio ranges (95% confidence intervals) and the logistic regression equation see the Methodological Note at the end of this report.

# Methodological Notes

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Various measures and statistical tests were used in this study. This note provides an overview of the methods used for analysis.

Overall results were analyzed by using counts and percentages for all survey questions, as well as averages and standard deviations for items measured on a scale (eg: Strongly agree (1) to Strongly disagree (5)). The average was used as a measure of central tendency that described the most typical case for scaled items. The largest percent was used to show the most typical case for non-scaled data.

For questions that involved ranking courses, career interests, or career activities (eg: First Choice (1) to Last Choice (6)), counts and percentages were used to highlight the top-ranked items and medians were used to describe the overall distribution for each. The median is a measure of central tendency that describes the most typical case. The median equals the middle rank in an ordered list of ranked items. To determine statistically significant differences between measures, Z-tests, t-tests, and median-difference tests were used. In addition, certain tests were used to investigate correlations between measures. These tests included: Chi-Square, Analysis of Variance, Regression.

When interpreting the results of this study it is important to remember that the researchers used the survey method of data collection. As a result, **cause-effect relationships are outside the scope of this research.**

A direct entry bivariate logistic regression was used to determine if educational influencers had statistically significant impacts on the likelihood for students to consider STEM careers. Logistic regression provides information on the increase in likelihood (i.e the odds) that a predictor will result in an outcome (such as being likely to consider a STEM career). The logistic regressions conducted in this research were done separately for boys and girls. Three influencers were considered: STEM Competency, STEM Engagement, and Teacher Influence. Only the analysis for girls was statistically significant. The educational influencers measured explained 77% of the variation in girls' likelihood to choose a STEM career.<sup>8</sup> Within that model, STEM Competency was shown to have no influence on STEM career choice. However, STEM Engagement and Teacher Influence were both statistically significant influencers:

Likelihood of Choosing a STEM Career (ODDS) Girls =  
1.009 (STEM Engagement) - 1.271 (Teacher Influence)

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<sup>8</sup> McFaddens R<sup>2</sup>=0.77

The statistically significant odds ratios for STEM Engagement and Teacher Influence are expected to have the following impact on the likelihood that girls will choose a STEM career. Those who have engaged in highly interactive STEM activities are 2.7 times more likely to choose such careers. With the margin of error of the study (95% confidence interval) the odds would range from a minimum of 1.494 times to a maximum of 5.038 times. Therefore, STEM Engagement has a strong positive influence on the likelihood that girls will choose a STEM career. However, teacher influence was negatively correlated with STEM career likelihood for girls, with an odds ratio of .28, which is less than one. With the margin of error of the study (95% confidence interval) the odds for teacher influence range from .129 times to .611 times, both of which are less than one. This means that teacher influence negatively impacts girls' likelihood to choose a STEM career. The nature of this relationship is not explained by this research and requires further study. Detailed regression results appear in **Figure 14**.

<b>Measure*</b>	<b>Regression Coefficient</b>	<b>Odds Ratio</b>	<b>Significance Level</b>	<b>95% Confidence Interval for Odds Ratio</b>
Constant	-.002	.998	.994	
STEM Competency	.520	1.681	.089	.924 to 3.059
<b>STEM Engagement*</b>	1.009	2.744	.001	1.494 to 5.038
<b>Teacher Influence*</b>	-1.271	.28	.001	.129 to .611

**Figure 14. Detailed Results for Logistic Regression of Educational Influences on Girls' Choice of STEM Careers in the public school sample.** Sample size, n = 240/302 girls.

\* Denotes significant difference.

# Notes

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