PDIG 2019-2020 Report: Integrating Coding and Robotics into the Core Curriculum

Project Description:

Starting in September, we held regular cycle meetings, which were attended by three Sir Wilfrid Laurier School Board (SWLSB) consultants: Vanessa Rayner (mathematics consultant), Samuel Altarac Hoffman (science consultant), and Chantal Kers (technology consultant). These meetings provided us with a wonderful opportunity to create monthly open ended problems, which our students then had to solve using the engineering process (view Appendix A). In contrast with our original proposal, we decided to not focus on robotics and technology as we realized it would be too challenging to create STEAM projects with a strong robotics focus in the junior grades, since the students do not already have prior knowledge of how to use technology. Instead, teachers kept the focus on engineering, science and mathematics. However, the senior grades were able to incorporate technology into their projects towards the end of the school year.

As a whole, this was a very successful endeavour. Most of our students developed the ability to solve a problem, from beginning to end, on an independent basis. Kindergarten and Cycle 1 students started the year being overwhelmed with the idea of tackling an open-ended challenge, but by Christmas, they were able to approach the problem, and try a variety of strategies to see if they might work. We noticed a drastic increase in critical thinking skills (all skills included in Bloom's Taxonomy - view Appendix B) , as well as very high levels of engagement during learning tasks. Students with learning disabilities were able to excel during all of the STEAM challenges and relished having a chance to shine. All students were extremely proud of their work and displayed a high level of satisfaction in their learning. Due to the success we witnessed in our students, we decided to hold a STEAM fair one evening during the month of November. This gave our community a chance to experience the wonders of participating in a STEAM challenge, and a chance to explore coding and technology with a variety of materials (ex.: ozobots, bluebots, spheros, drones, VR field trips, makerspaces, building circuits, etc).

While going through this process, we encountered a few challenges. Approximately ⅓ of the students had difficulty with perseverance, and open-ended thinking sometimes led to students copying one another. As these types of problems require creativity, it was quite challenging for students with autism to fully participate. The challenges pushed them to use creativity and challenged them to come up with their own steps to find a solution, both skills that do not come easily to children with autism. We also learnt that STEAM projects work best within one subject instead of in a cross-curricular approach, which placed high demands on the teachers and was difficult to organize in the daily schedule. However, we believe that working in a cross-curricular approach may be possible down the road, when projects have already been established and teachers can focus on simply adding another subject into it. Finally, acquiring all the supplies needed to properly conduct a STEAM challenge can be complex and expensive as finding funding is not always easy. Storing and organizing these materials within our small school, which holds very little storage space also proved to be a challenge.

The school shutting down as a result of the COVID-19 pandemic added an extra challenge to this project. There are several lessons that were created, which never had a

chance to be tried out in the classroom. The grade 1 classes did not have a chance to pilot the place value challenge or the leprechaun lockdown; cycle 2 did not have a chance to make it through their animal habitat and phases of the moon challenges (this last one was assigned as an a-home assignment during the covid-19 quarantine, and was done individually, not as teamwork); and cycle 3 did not have a chance to explore their candy creation challenge. In addition to these lessons, we planned on creating further challenges/projects during our March and April meetings, but we unfortunately did not have a chance to get those done.

The journal entries contain all of our lesson plans:

- Kindergarten created 6 theme-based STEAM challenges, as well as 1 science-focused challenge.
- Grade 1 created 5 theme-based STEAM challenges, as well as 1 math-focused challenge.
- Grade 2 created 5 theme-based STEAM challenges, as well as 1 math-focused challenge.
- Cycle 2 created 5 theme-based STEAM challenges, as well as 1 math-focused challenge & 1 technology-based challenge.
- Cycle 3 created 7 theme-based STEAM challenges as well as 1 robotics challenge.

The STEAM organizing committee also had to meet on 3 occasions in order to ensure things ran smoothly and to find ways in which we could support teachers in their implementation of the STEAM approach to learning.

Project Goals:

Our first goal for this grant was to provide teachers with appropriate professional development opportunities to create stimulating project-based learning opportunities involving technology. In our monthly meetings, all teachers on the team had access to the SWLSB consultants, who helped guide the lesson creation and development. They provided teachers with pedagogical content knowledge, resources and ideas to enhance the curriculum development. With the consultants' help, most teachers' style of teaching was expanded, and became much more hands-on. Rather than simply show new concepts to students, teachers focused on creating interactive and experiential learning experiences. STEAM thinking became a part of the everyday classroom, and an integral part of our daily philosophy. As a whole, our school has developed a shift in instructional philosophy that will lead to students becoming better able to adapt to the needs of an ever changing and technologically oriented society.

Another important part of this project was to have teachers work collectively by cycle to develop a unified approach to teaching that focused on enhancing competency development. Each team, whether cycle or grade, worked on developing their communication style as well as on merging their teaching styles together. The members of our in-school STEAM committee were also able to participate in various cycle meetings in order to help teachers achieve this, as well as to provide them with other concrete ideas to integrate robotics into their lesson creation process. Furthermore, through our STEAM fair, teachers were encouraged to create lessons and challenges that would be suitable for all elementary levels rather than simply the grade level they're accustomed to teaching. This shows growth and a willingness to approach all pedagogy using a STEAM ideology. As a result, we plan on continuing to develop our pedagogical

practices in future years to ensure our school continues down the STEAM path, as we have seen the many benefits this teaching approach provides to young learners.

Our ultimate goal was to incorporate technology and STEAM concepts into everyday learning of cross-curricular subjects. All STEAM challenges were presented from a real-world perspective, which truly helped students' thinking become more divergent. Here are some project examples:

- Kindergarten - create a shelter to protect your apple from predators
- Grade 1 - build a bat house that can keep them safe during the day while they sleep (it must protect them from the weather and predators)
- Grade 2 - create a 3D board game that is more stimulating than a regular 2D game
- Cycle 2 - Create something that could save a certain species being affected by the Australian Wildfires
- Cycle 3 - Create a barrier to protect a house from flooding

All lessons were based in at least one subject, and whenever possible, they were made cross-curricular. While it was challenging to incorporate technology and robotics in the STEAM challenges, our students are encouraged to use technology on a regular basis, through the use of laptops, ipads, google drive, cameras, VR sets, 3D printing, robotics, etc. By having an in-school STEAM committee, our teachers were able to get the support and knowledge required to incorporate more technology into their daily teaching.

Project Outcomes:

The approach that one takes to teaching has a drastic impact on the students' learning. Developing an inquiry based philosophy and applying it to our daily teaching of core subjects is by far the most important thing that teachers acquired through this project. We created a small library of highly innovative lesson plans that can be reused from year to year. These lessons can also be shown to new teachers in the coming years in order to demonstrate the type of open-ended teaching that is practiced at Our Lady of Peace Elementary School. We are committed to continuing our efforts in developing our open-ended philosophy in the coming years.

Our school has seen an increase in the amount of teamwork and collaboration by teachers used when planning for every day teaching. Our teaching staff, support staff, and students have developed a strong sense of unity around our school's identity as a STEAM school. Our STEAM fair provided a great opportunity for our school's community to come together and explore the engineering process and creative thinking involved in solving STEAM challenges. Our students and teachers are very comfortable with robotics and technology, and generally feel at ease using them on a regular basis. Doing a project of this magnitude took a big commitment from the teachers, and seeing it through to a successful ending has led to a wonderful sense of accomplishment on the part of the teachers.

Reinvestments:

As our world is becoming more technological, it is important to set students up for success in their future technology-oriented careers. A STEAM approach to teaching is an engaging and highly innovative way of achieving this goal. Any school that is interested in using

a STEAM approach to teaching can use our project as a guide. A Google Drive folder has been created to share supporting documents for this PDIG. In the folder, you will find all lesson plans, pictures of the students in action, and any supporting documents that were used in the implementation of this project.

Google Drive folder:
https://drive.google.com/drive/folders/1S4qtci84oJYELiSjmLOm1yKRFOLQug2e?usp=sharing

We think this would be a very valuable project for any other team to carry out. Students, regardless of gender, had a high level of engagement, and teachers developed confidence in their abilities to teach with an open-ended approach. We would recommend the following points to ensure a smooth implementation:

- Consultants should work with teachers in order to help guide them in the right direction.
- Base the challenges in one subject (i.e.: math). In the second year of implementation, take this same challenge and add an ELA, or science component to expand it.
- Find additional funding to have a fully stocked MakerSpace available for the students.
- Find a way to release all teachers to work with their cycle team to develop lessons and challenges. A few of our teachers were not part of the original PDIG application, so we applied for release from our school-based Professional Improvement Committee (PIC) so they could also participate in order to ensure the whole school was included.

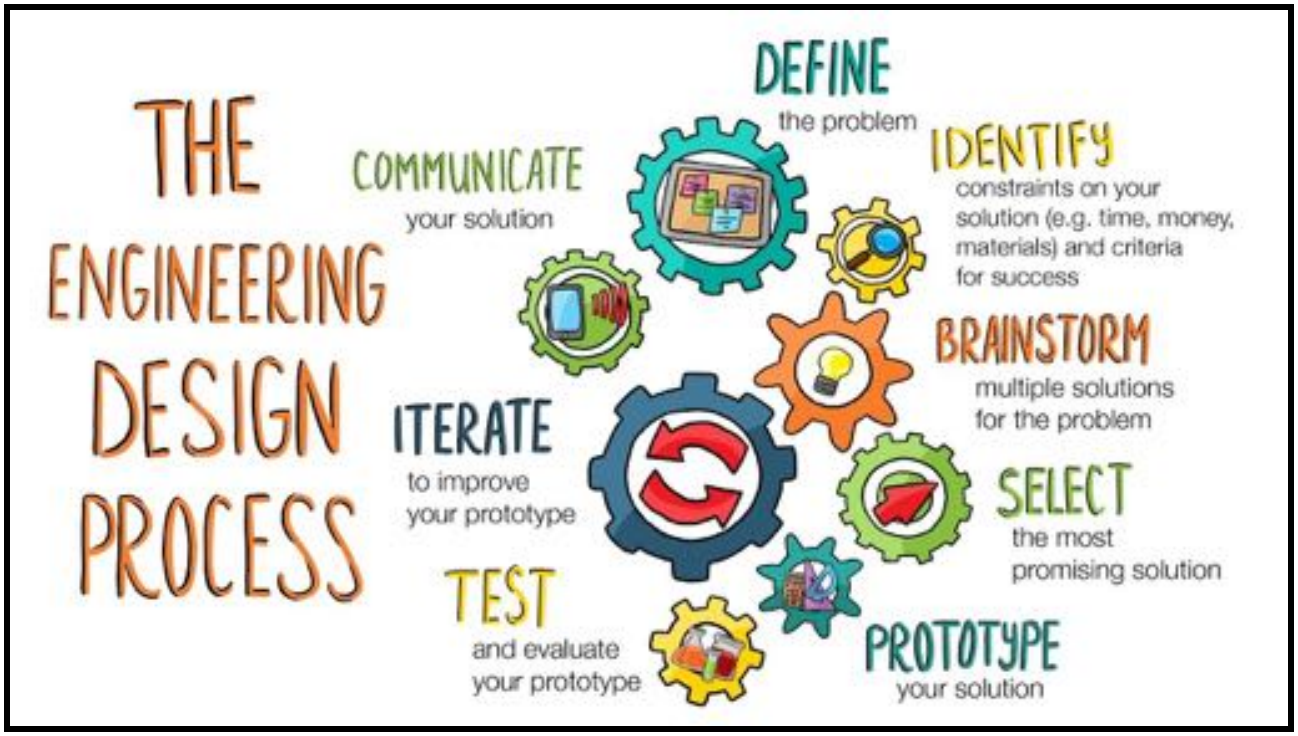
Supporting Documents:
Here are some of the websites that were used during the planning sessions:

https://scitech.swlsb.ca/curriculum-maps/elementary
https://edtech.swlsb.ca

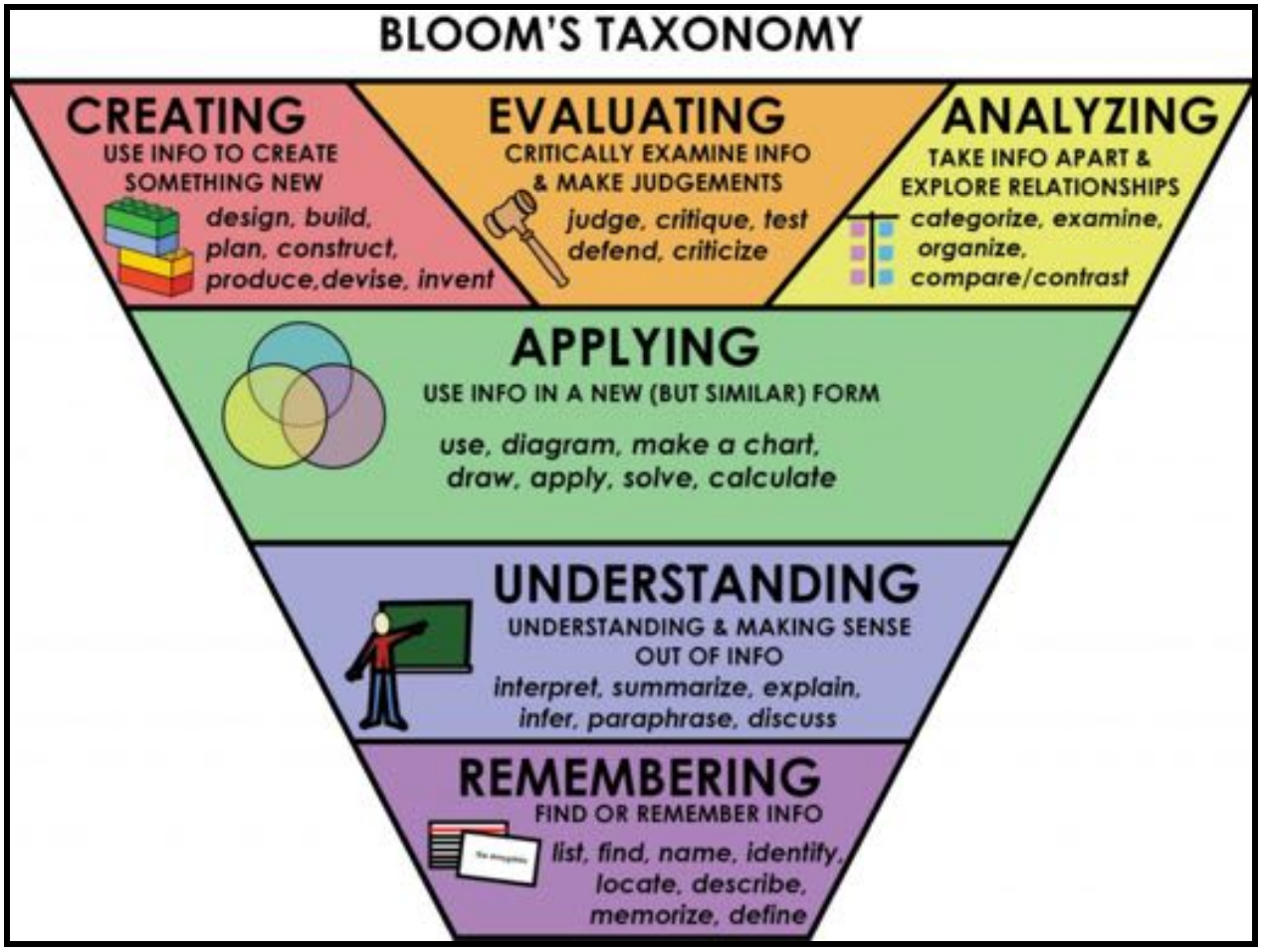
Team Members:

Cycle 1 Teachers	Cycle 2 Teachers	Cycle 3 Teachers
Cassandra Dubois	Esther Luceno	Steve Narine
Claudia Santangelo	Michelle Cortese	Stephanie Charest
Nathalie Guay	Samantha Sobol	Jaclyn Michelon
Antonella Continelli	Brian Benoit	Stephanie Larouche (PIC release)
Amelie Cloutier/Melanie Sciassia		Jenn Ackad (PIC release)
Bessy Tsakris (PIC release)		Laurie Salina (PIC release)

Appendix A


THE ENGINEERING DESIGN PROCESS
DEFINE
the problem
IDENTIFY
constraints on your solution (e.g. time, money, materials) and criteria for success
BRAINSTORM
multiple solutions for the problem
SELECT
the most promising solution
PROTOTYPE
your solution
TEST
and evaluate your prototype
ITERATE
to improve your prototype
COMMUNICATE
your solution

Appendix B


BLOOM'S TAXONOMY
CREATING
USE INFO TO CREATE SOMETHING NEW
design, build, plan, construct, produce, devise, invent
EVALUATING
CRITICALLY EXAMINE INFO & MAKE JUDGEMENTS
judge, critique, test defend, criticize
ANALYZING
TAKE INFO APART & EXPLORE RELATIONSHIPS
categorize, examine, organize, compare/contrast
APPLYING
USE INFO IN A NEW (BUT SIMILAR) FORM
use, diagram, make a chart, draw, apply, solve, calculate
UNDERSTANDING
UNDERSTANDING & MAKING SENSE OUT OF INFO
interpret, summarize, explain, infer, paraphrase, discuss
REMEMBERING
FIND OR REMEMBER INFO
list, find, name, identify, locate, describe, memorize, define