Create and Build
Illustration 1

STUDENT COLLABORATES WITH TEAM AND ENHANCES TECHNICAL SKILLS

Self-assessment and critical analysis

Throughout the *self-assessment and critical analysis* component of her capstone preparation (see pages 15–21 in the Career Education 10-12 Guide for more information about the components of capstone), the student shared that she wasn't sure about her plans for graduation yet, but was very excited about her experiences with the school's robotics club. She wondered if she could pursue this passion in some way as part of the capstone *process and representation* component. With the guidance of her Career-Life Connections (CLC) teacher-mentor, the student decided she wanted to focus on furthering her technical skills and developing effective strategies for engaging with her team members with increased confidence.

Process and representation

Learning focus: Collaborating as part of a team and enhancing technical skills to design and build

Topic focus: Engineering and robotics

Context

The student is part of the school's Robotics Club and is completing coursework in Engineering 11. She has decided to collaborate with a team of students with complementary skills to explore an inquiry question in the field of robotics. The team of students recently watched a video that demonstrated the use of robots to lift and move items in a warehouse. The video inspired the team to design, create, and build a smaller-scale robot that can carry and move personal items. Their inquiry question is: How can we design and build a robot that will lift, carry, and move personal items for the user?

Connections

Curricular or domain connections

Career Education – Analyzing internal and external factors to inform personal career-life choices for post-graduation; Assessing personal transferable skills, and identifying strengths and those skills that require further refinement; Collaborating with teacher-mentor; Reflecting on learning experiences and personal development in the Core Competencies; Preparing for next steps in personal lifelong learning journey

Engineering – Applying design and user-centred principles, programming languages and applications, manufacturing, quality control methods, interpersonal and consultations skills to interact with clients

Mathematics – Understanding how to apply mathematics concepts to functional design, measurement and diagramming techniques, computational thinking and programming

Community connections

Robotics Club and team

School community

Connections to First Peoples Principles of Learning

Learning involves patience and time: Working collectively as a team on common goals, seeking input and feedback from potential users throughout the creating and building process, repeated trial and error cycles to develop prototypes and iterations; Learning is most effective when it occurs in a setting where the learning can be applied in an authentic context

Learning is holistic, reflexive, reflective, experiential, and relational (focused on connectedness, on reciprocal relationships, and a sense of place): The student's learning is experiential, as she works with her team through iterations and feedback to create a functional robot

Core Competencies connections

Communicating – Connecting and engaging with others; Acquiring and presenting information

Collaborating – Working collaboratively

Creative Thinking – Creating and innovating; Generating and incubating; Evaluating and developing

Critical and Reflective Thinking – Designing and developing; Reflecting and assessing

Social Awareness and Responsibility – Contributing to community and caring for the environment; Building relationships; Valuing diversity

Create and build process

Understand and define the context

- Although the team was already determined to design a robot that would lift, carry, and move personal items, there were many details to figure out regarding who might use this type of robot and for what purpose. The team pursued a market survey of students in the school community and decided to create an assistive technology that could carry items between lockers and classes for those students who found it difficult to do so on their own.
- Applying one of the strategies to develop her confidence with team members, the student decided to show initiative and volunteered to draft success criteria for their robot that she would later share with them for finalization. She interviewed a couple of students that teachers recommended might benefit from this type of robot and used the resulting information to write up the draft success criteria. The student later shared that she learned surprising insights from the students she interviewed and felt proud of how impressed her teammates were with her work on this task.
- The team shared their initial plans with their Robotics Club supervisor, and he was able to help them access the school's 3D printer, robotics components, and other resources to begin the design work.

Ideate, prototype, and test

- The team of students had many experiences with building robots from prior club activities to draw from, but they still ended up creating a few prototypes. For each iteration, they sought input and feedback from the Robotics Club supervisor.
- The student took the lead in documenting and recording their various designs and prototypes, including diagrams and photographs. She used these records as evidence of technical learning to reflect on and to self-assess Core Competency development.
- Taking the lead as record keeper for the group helped to build the student's confidence in contributing to the group in a key role. She was able to use the documentation activity as a means to initiate conversations and share her thoughts related to their progress with fellow team members.
- The student also volunteered to take the lead in connecting with users to get their input and feedback on designs and prototypes, as she had already developed relationships with them.

Make and share

- The team built a final iteration of their robot design; however, the students were not satisfied with the results. The complexity of this type of robot made it difficult to produce to a standard that would be viable as an assistive technology in a real way. However, the Robotics Club supervisor pointed out how much the students had learned about robotics design and development generally through their many trial-and-error experiences, thus defining the process as a learning success. At the year-end Robotics Club event, the team shared a model of the robot they had hoped to build, discussing its assistive benefits, the challenges they had in building it, and what they had learned throughout the process.
- The student felt she had made good progress in enhancing her technical skills throughout the process. In addition, she was especially proud of her progress in developing confidence and leadership skills from working with other team members, as well as her progress in developing and sustaining relationships with the students who had provided input and feedback on the design.

Teaching and mentoring tips

- When helping students develop inquiry questions for design thinking, begin with either a desire to change a design or to explore an idea from a provocation or from a student's personal interest in a domain.
- For students who may need support with project management and timelines, consider chunking the process at each stage with smaller tasks/milestones to accomplish, and then putting it all together at the end.
- Graphic organizers for steps and processes are useful to help students determine and reach goals, as well as providing a framework for reflection (e.g., students can keep a journal to document ideas, process, progress, and understandings of learning).

- Safety procedures must be followed when developing and working with robotics – ensure that appropriate adult supervision for production and use of machinery and electronics is in place.
- Some students may need help coping with failed attempts and frustrating challenges. Remind them that failures are a normal part of the design process and should be used as a platform for learning, not to mention an opportunity to build resiliency and grit.

Additional resources

- A Day in the Life of a Kiva Robot (video)
- 3D printer

Formative assessment

- Co-constructing criteria with students helps ensure clarity of expectations and encourages student ownership of learning. Once the student and the CLC teacher-mentor had developed the criteria together, the teacher-mentor used it to frame descriptive feedback based on observations of the student's practice and application of teamwork strategies and technical skills.
- Additionally, the student used a graphic organizer to inform reflections on learning at various stages of the design, creation, and application process to move her thinking and development forward. (See page 53 for sample of a reflection graphic organizer.)
- For some capstone approaches, a collaborative effort among teachers can help tap into diverse sources of expertise for learning and assessment purposes. During regular check-in conversations, the CLC teacher-mentor provided the student with suggestions and feedback on ways to provide input in a confident manner to her peers on the team, one of her learning goals. While the team worked on their inquiry, the Robotics Club supervisor provided ongoing feedback to the whole team about their progress in the design and development of the robot, which the student reflected on and shared with her CLC teacher-mentor as part of her second learning goal.

Showcase and celebrate

At the school's capstone showcase, the student shared a synthesis of her learning journey to family, school staff, and peers, including demonstrations of learning from the record-keeping and accompanying reflections. In addition, the student spoke about how she had experienced an unexpected side benefit from the capstone process: she had learned much about the mobility challenges of her fellow students and had become very interested in the potential of assistive technologies to change their quality of life. As such, she was planning to study biomedical engineering.

Create and Build Reflection Graphic Organizer

***Create and Build* process stage I am working on**	**Strengths (incl. evidence)**	**Stretches and/or challenges (incl. evidence)**	**What I am learning (e.g., about myself, re. capstone goals)**	**Notes: (e.g., questions I still have; resource(s) I need, etc.)**	**Next steps**
Inspiration and Ideation Given my prior knowledge, personal experiences, and skills, I can frame and clarify the type of problem I am solving and focus my exploration by identifying what I know and need to know about the design challenge.					
Design • I can design a plan to solve my challenge that is viable and includes time constraints and benchmarks. • I can create a system for gathering feedback from my learning partners with identified criteria.					
Create • I can create a testable first attempt at a solution. • I can identify the strengths and weaknesses of my prototype to use as feedback/data for refining my design to create a more responsive solution to the challenge. • I can justify my decisions and process.					
Coordinate and Present • I can identify criteria for an effective presentation and use them to present my findings to an audience, keeping in mind who my audience is. • I can authentically reflect on my process and product during each phase of the design and creation process, and share what I have learned and how I plan to move forward with my learning post-graduation.					

Create and Build
Illustration 2

STUDENT BUILDS WEBSITE TO DEVELOP HER PROFILE AS AN ARTIST AND SHOWCASE HER WORK

Self-assessment and critical analysis

Throughout the *self-assessment and critical analysis* component of her capstone preparation (see pages 15–21 in the Career Education 10-12 Guide for more information about the components of capstone), the student has been very clear in her aspirations for post-graduation: to continue her work as an artist as well as pursue further learning within the Faculty of Fine Arts.

Process and representation

Long-term learning focus: Further her career-life plans as an artist

Immediate focus: Design website to create a public profile and to share her work more broadly

Context

The student is a committed visual artist and is currently learning through IB Art coursework as well as community-based art lessons. She is already well on her way as an artist, has participated in several group shows at a local gallery, and has sold several pieces. The student would like to further her career-life goals in the fine arts and has chosen to focus her capstone *process and representation* component on sharing her creative works with a wider audience, including post-secondary fine arts programs. She decides to build a website to establish a public profile as a practicing artist and to market her work.

Connections

Curricular or domain connections

Career Education – Analyzing internal and external factors to inform personal career-life choices for post-graduation; Assessing personal transferable skills, and identifying strengths and those skills that require further refinement; Creating and critiquing personal and public profiles for self-advocacy and marketing purposes, collaborating with teacher-mentor; Reflecting on learning experiences and personal development in the Core Competencies; Preparing for next steps in personal lifelong learning journey

Visual Arts – Understanding the purpose of critique and choosing when to apply suggestions; Documenting and sharing artistic works in a variety of contexts; Connecting with others on a local, national, and global scale; Roles of and relationship between artist and audience in a variety of contexts

Information and Communications Technology – Website development planning tools; Advantages/disadvantages of websites and content management systems; Technical and symbolic elements that can be used to create representations influenced by point of view, story, genre, and values

Community connections

School community
Artist communities, both local and online
Fine Arts faculties

Connections to First Peoples Principles of Learning

Learning is embedded in memory, history, and story: The student shares her personal story through her art

Core Competencies connections

Communicating – Connecting and engaging with others; Focusing on intent and purpose

Creative Thinking – Creating and innovating; Generating and incubating; Evaluating and developing

Critical and Reflective Thinking – Analyzing and critiquing; Designing and developing; Reflecting and assessing

Personal Awareness and Responsibility – Self-advocating

Create and build process

Understand and define the context

- The student planned to create a website that could act as a platform to expose her art to a wider audience. In addition, she hoped to use this platform as a portfolio to support her applications to faculties of Fine Arts and to perhaps generate some income through sales of her work in a way that was flexible and compatible with her expected busy schedule while attending post-secondary studies the following year.
- The student conducted research before and while building her website, including:
  - Analyzing websites and selling platforms used by other visual artists, taking notes on what she liked and what she thought could be improved or personalized for her own style and needs
  - Speaking with people who knew her artistic style to get a sense of what they would expect to see on a website that represented her
  - Researching the portfolio requirements for the post-secondary programs she planned to apply to
  - Analyzing and comparing several website-building platforms with e-commerce capability after receiving recommendations from people with experience building websites
  - Talking with her art teachers about the styles and pieces that would best reflect her personal style and passions
- The student designed an online survey and sent it to a wide range of people. She used the feedback to help develop the look and functionality of her website. Questions included:
  - When visiting a website with artwork, how many images do you look at before deciding if you like the artist's style?

- Do you prefer a slideshow or gallery view of images?
- If you are familiar with my artistic style, would you say that a minimalistic black & white or a colourful palette would be a better backdrop for my website?
- Which of the following fonts best represents my style and personality?

- After doing her research, the student decided to use a site-building service that required some cost to run, but that would, in her estimation, allow her to expand the website in the future with minimal extra work. The student also chose to purchase a domain name after learning that they are portable (should she decide to change platforms in the future), and decided to learn some basic coding rather than pay for a premium website template. Overall, she deemed that her implementation costs were low and manageable.

Ideate, prototype, and test

The student created her website over several weeks after deciding which pieces she wanted to include: photos, illustrations, and other visual arts pieces that she had created over the past few years. She also developed her own font, based on her handwriting, to personalize the site further with her own brand. Over the course of the website development, the student checked in with a few peers and her art and ITC teachers to get feedback on various aspects of the design, and applied their input to improved iterations.

After researching the differences in pricing between original [physical] artwork and digital artwork, as well as the processes available for making printed copies of her pieces, the student decided to start with just a few pieces for sale online as digital copies only. However, the platform she chose would allow her to expand her offerings in the future.

Make and share

Once the website was ready for public viewing, the student focused her energies on promotion, adding a link to it on her social media accounts and creating a digital business card that linked to it as well. The student frequently shared links to her website on visual social media sites, such as Instagram and VSCO. She also planned to include the link in her post-secondary applications the following year.

At the time of completion, the student had not yet made a sale of her artwork, but she had received positive feedback about how the design was well aligned with her artistic style and highlighted her and her work in an appealing way. She felt confident that the website was a solid foundation she could continue to build on over the next few years, and she planned to expand e-commerce options after beginning her post-secondary studies.

Teaching and mentoring tips

- Creating a website presence to showcase a student's profile and/or products can include many types of work, such as music, film, fashion design, metalwork, and/or woodwork.
- Although this student was seeking a broader digital audience for her work, other students may prefer a less public platform to showcase their products. As such, they may, for example, choose to build a paper-based portfolio or one that is accessible only to a closed and invited audience.

- Collaborating with other teachers in the school can support students with specific knowledge and expertise. Connecting with her art and ITC teachers was a valuable resource to the student in this case.

Additional resources

- Code BC

Formative assessment

- At the beginning of the process, the student and her Career-Life Connections (CLC) teacher-mentor agreed on the benchmarks the student would work toward, including website design research; selection of art pieces to showcase the student's personal values and aesthetic style, while also addressing the portfolio requirements for applications to her preferred post-secondary programs; a timeline for production and publication; personal branding; and e-commerce capability.
- The student checked in with the CLC teacher-mentor weekly through online blog posts that described her progress, current challenges and recent breakthroughs, and reflections on the process so far. Her teacher-mentor responded with prompts that encouraged further thought and suggestions for moving forward.
- The student conferenced several times with the CLC teacher-mentor throughout the process. At times, she engaged in a small group discussion with classmates to ask clarifying questions, seek help and/or input, receive feedback, and benefit from diverse perspectives that could inspire further creative and reflective thinking.
- At the end of the research phase, the student compiled her research notes and created a bibliography of sources to submit to the CLC teacher-mentor as evidence of learning.
- Throughout the process, the student took screenshots of the website to document its evolution, using these later to illustrate the drafts the site went through as she sought feedback from others and to include as demonstrations of learning to share with the teacher-mentor.
- At the end of the process, the student prepared a self-assessment write-up for the teacher-mentor that summarized the events in each stage of the process, her progress related to the learning goals, her plans to apply her learning in the future, her development in the Core Competencies, and her overall feelings about how the process had an impact on her life.

Showcase and celebrate

The student prepared two versions of a presentation to share her learning. The first was an oral presentation, including visual aids, at the schoolwide Capstone Fair. The second version of the presentation was briefer and was presented in the classroom to the CLC teacher-mentor and three or four classmates as part of a sharing circle using an assessment and feedback protocol that had been previously established as a regular CLC class routine.