SECTION 7

INTENT AND CHOOSING A MAKER EXPERIENCE FOR YOUR CLASSROOM

Introduction

Taking Making into Classrooms is both a pedagogical choice and a domain to be studied.

The new Applied Design, Skills and Technologies (ADST) curriculum in British Columbia requires educators K–12 to introduce design and making K–5 in an integrated, cross curricular way, while Grades 6–12 have specific content areas for study.

Many teachers will tell you that the curriculum is already too overcrowded to add anything more. Even with the ADST curriculum, teachers feel pressure both to cover the curriculum and to address new learning opportunities. We suggest that a maker approach allows teachers and their students to uncover the richness embedded in the curriculum and work together to make meaning. Rather than attempting to cover content in a linear, scope and sequence approach, which is often termed "just-in-case learning," our experience tells us uncovering what is needed to know in time to address a learning challenge supports personalized learning and is more authentic and real! This is typically termed "just-in-time learning." It provides learning as it is needed or required rather than teaching concepts or ideas "just in case" students might need them at some point in the future (e.g. on an exam, etc.).

The introduction of makerspaces into some schools has already added pressure for many teachers. School districts have raced to create makerspaces, retrofit libraries into learning commons, and add events like Maker Faires to the already busy school year. By taking making into classrooms in an intentional way, we suggest that rather than adding another thing to the curriculum, making could become the way to uncover your curriculum in a proactive, engaged, and personal way. Making as both pedagogy and a domain of study (ADST) helps teachers to foster an intentional mindset with their students and integrate making into learning. When we take the time to unpack the name–Applied Design, Skills and Technologies we come to understand that design is the provocation for the development skills needs to complete the design and use the technologies. Making is not amateur shop class, and

Deepen Your Understanding

The Maker Movement—A Global Perspective

We all have a need to make. It stems from our curiosity with the world and our basic desire to make things and then make those things better. Our earliest ancestors led the way in making when they crafted the first hand tools in East Africa and experimented with fire. They continued to make things and make those things better as they adapted to new locations and migrated around the world.

There is a growing interest in learning how to make things rather than buying them—it is called the Do-It-Yourself (DIY) movement. People are growing tired of cheaply made, disposable goods that cannot be repaired or modified. Increasingly, people are turning to traditional ways of doing things. Many are turning away from prepackaged food items with little nutritional value or poorly made items that are expensive, complicated, and have proprietary parts that are not interchangeable and cannot be reused.

Globally, we are reclaiming our need to make and we are formalizing it into a movement. We are creating shareable workshops (makerspaces), providing hours of online instructional videos (e.g. **YouTube** and **Instructables**), and offering workshops. (From the *Toolkit for Challenging Contexts*, p. 6.)

it is an intentional way for students to create meaning using actual tools, materials and resources, informed by design thinking.

Four Learning Intentions

All classrooms in any school can support making, but teachers must consider the intent of the learning and the purpose of the making. With the recent announcement from the BC Premier's office concerning the need to introduce coding in schools, educators are additionally stressed to find ways to integrate programming, robotics, and ICT in their work. We suggest positioning coding and simple circuits with appropriate technologies within making in order to use them to add functionality to student designs. Please see Section 10 for suggestions.

We suggest four learning intentions you might consider prior to taking making into classrooms. You will probably want to modify our intentions and add nuances that are supportive of your context (e.g. physical resources, student readiness, your readiness, etc.). Table 7-1 states the learning intentions and suggests purpose, tools and materials needed, along with ease of use and cost implications.

Table 7-1: Learning Intentions

	Learning Intention	Description	Basic Tools (See Section 9 for details)	Basic Materials
Introductory, Inexpensive, Simple ↓ Advanced, Expensive, Complex	**Design and Basic Making**	Introduction of design thinking and the making of simple, tangible items to illustrate design ideas in 3D	Hand tools, including glue guns, rulers, knives, scissors, etc.)	Cardboard, recycling, simple dollar store items
	Design and Simple Prototyping	Introduction and continued use of design thinking and more elaborate prototyping of ideas to scale	Hand tools and simple power tools such as Dremel tools, electric drills, etc.	Cardboard, recycling, simple dollar store items with additional of Styrofoam, plastic pipe and fittings and other materials that can easily cut and fastened
	Design and Fabrication	Use of design thinking and introduction of fabrication to create working prototypes at scale	Hand and power tools with option for 3D printers, CNC machines, etc.	Use of authentic materials
	Design, Prototyping, Circuitry and Coding	Use of design thinking with the addition of coding and circuitry to add functionality to prototypes	Hand and power tools, soldering irons, circuits, breadboards, etc.	Use of authentic materials, including Arduino, circuits, etc. Please see *Microcomputing and Coding in Design Thinking* for suggestions (**https://issuu.com/ubcedo/docs/diy_guidebook**).

Regardless of intention, *Taking Making into Classrooms* requires teachers to value their students' process over their final products. This is not to suggest that making cannot be assessed, as there will be plenty of evidence of student learning throughout the process of making: design thinking sheets, design sketches, negotiated group collaborative design sketches, models and prototypes, and reflections (see Section 4).

The challenge for teachers is to figure out ways to value the:

- learning and experience of each element of the design thinking and making process;
- time needed to gain the skills to use the technologies available;
- time spent and evidence gained through the design thinking process;
- effort needed to participate well in a group; and
- actual work, frustration, joy, and struggle of design thinking and making.

Regardless of the learning intention, *Taking Making into Classrooms* allows students with any level of experience or skill to engage in design and making. Because of the openness of the design challenge structure, students can move away from projects that have been created using a step-by-step recipe approach (just-in-case learning) and explore things that are timely and of interest (just-in-time learning).

With an appropriately equipped makerspace or mobile maker kit, teachers can keep the learning affordable and flexible so there is little need for expensive kits or prescribed lessons. Please see Section 9 for ideas.

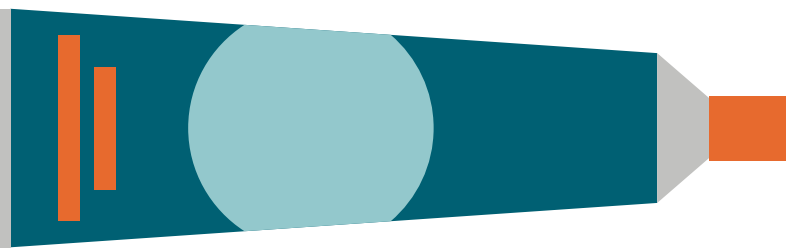
How You Might...

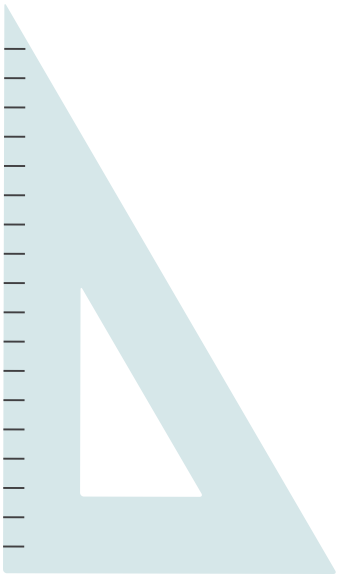
...Adapt Existing Spaces

There are numerous resources suggesting ways to create makerspaces or workspaces in existing classroom settings and school learning environments. Once you have thought through your pedagogical intent for Taking Making into Your Classroom, you might want to explore sites like **https://www.edutopia.org/discussion/2-quick-inexpensive-ways-add-collaborative-space-your-classroom**.

...Explore a Shareable Mobile Maker Configuration

It is not necessary to retrofit an entire classroom or library into a makerspace. You might want to consider creating a shareable, mobile maker configuration of tools, supplies, and resources. In Section 14, we suggest a list of tools to support a mobile maker configuration for classrooms.





SECTION 8

SAFETY ISSUES

Introduction

Taking Making into Classrooms is different from opening a school shop and periodically using the equipment without paying any mind to the potential hazards. Rather, teachers who incorporate making and design thinking into their classrooms must be aware of everything from safety equipment (i.e. eye and ear protection) to tool training changes and the most appropriate materials that are available for student use.

Linking Safety, Intent to Tools and Spaces

We take a just-in-time approach to safety issues, in order to introduce the need to be safe and maintain safe work spaces in a timely and situational manner. We know that students and teachers need to work safely, and safety issues are not something that should be taught to students in order to instill a fear of working with tools. Instead, safety should be taught to students to promote a sense of empowerment and confidence in their skills. We embrace the mantra from our colleagues and friends in Women in Trades Training (WITT), “Empowerment through power tools!”

When we can use powerful tools safely, we are empowered to do more and to try more. Empowerment is a strength-based approach to learning. Empowering both teaches and students allows them to overcome the mindset that tells them they won’t succeed due to factors like age, gender, or a lack of experience.

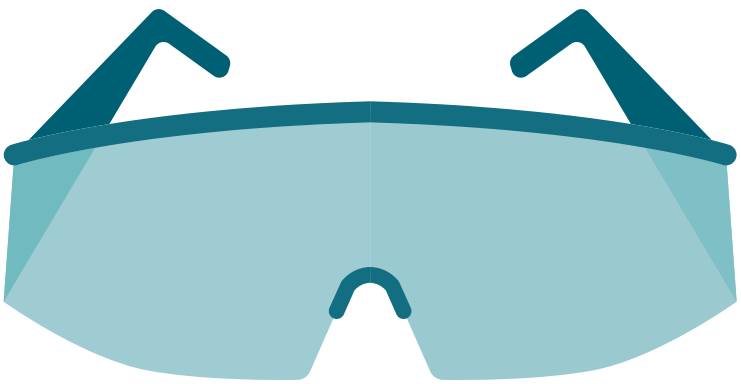


Table 8-1: Mapping Learning Intentions, Tools, and Safety

	Learning Intention	Basic Tools (See Section 9 for details)	Initial Safety Concerns
Introductory, Inexpensive, Simple ↑	**Design and Basic Making**	Hand tools, including glue guns, rulers, knives, scissors, etc.)	Emphasis is on accurate measuring, safe cutting, and careful assembly. • Use of ruler both for measuring and as a straight edge to cut against • Safe ways to walk holding sharp objects • Safe ways to use hot elements like glue guns and hot glue • Ways to help your group members—where to stand, how to hold things, use of tools with and among other people
	Design and Simple Prototyping	Hand tools and simple power tools such as Dremel tools, electric drills, etc.	Focus is on accurate measuring, safe cutting, and careful assembly; emphasis is on the selection of the appropriate tool for the task. • See above • Use of v-blocks and clamps to hold materials prior to drilling, cutting or shaping • Use of eye and ear protection for user and those immediately around them • Use of gloves where appropriate • Use of drill bits and Dremel attachments • Use of extension cords, cables, power bars, etc.
	Design and Fabrication	Hand and power tools with option for 3D printers, CNC machines, etc.	Focus is on accurate measuring, safe cutting, and careful assembly; emphasis is on the selection of the appropriate tool for the task. • See above • See safety concerns specified by specific tool to be used • Address issues of ventilation and air quality
Advanced, Expensive, Complex ↓	**Design, Prototyping, Circuitry and Coding**	Hand and power tools, soldering irons, circuits, breadboards, etc.	Focus is on accurate measuring, safe cutting, and careful assembly, and the selection of the appropriate tool for the task; emphasis is on the addition of functionality to the design through the inclusion of circuits and coding. • See above • Address issues of ventilation and air quality, especially when soldering

How You Might...

...Create a Safety Station

Consider ways in which you might create a safety station where students can be shown the proper way to use the available tools and materials available.

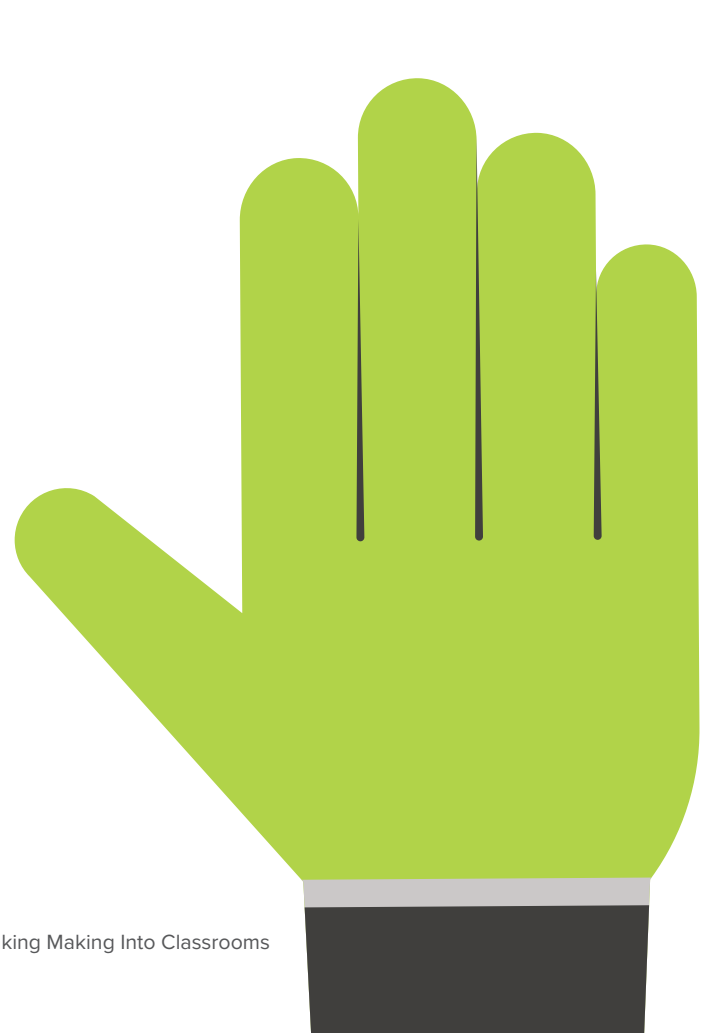
Is there expertise you can draw on—colleagues who have Red Seal certification, knowledgeable colleagues who are makers, parents, or community members who can help you to hone your skills? Do you know someone who could help with the set up and introduction of your Safety Station, etc.?

...Explore Safety Resources

Explore the safety resources that are available and ensure you have the necessary safety equipment and expertise.

- Heads Up for Safety (**http://www.bctea.org/heads-up-for-safety/**)
- Young Workers (**https://www.worksafebc.com/en/health-safety/education-training-certification/young-new-worker/student-worksafe**)
- Heads Up—Work Smart (**http://headsupab.com**)
- For Educators (**http://www.bcpsea.bc.ca/bc-teachers/workplace-safety.aspx**)

Explore the resources shared by colleagues at the **Surrey, BC MakerSpace**.



SECTION 9

CHOOSING A MAKER CONFIGURATION FOR YOUR SETTING: IMAGINING TOOLS, RESOURCES, MOBILITY, ACCESSIBILITY ALONG A CONTINUUM OF POSSIBILITIES

Introduction

You will have noticed we used the term "maker configuration" rather than "makerspace" in the title of this section. This signals our intent (see Section 7) that making can take place in any setting—from a classroom equipped with scissors and glue (Design and Basic Making) to a classroom with circuitry, soldering irons, and 3D printers (Design, Prototyping, Circuitry and Coding and Fabrication). Even Ben Franklin, an early American inventor and maker, used the Philadelphia Library for some of his initial electrical experiments (Fallows, 2016).

We believe:

- Design is personal and driven by curiosity and challenges.
- Skill development is situational, age and stage dependent, and driven by the need to use specific tools.
- Technology use is situational, grade, age and stage dependent, and driven by the need to complete personal tasks.

Our view is consistent with the BC Applied Design, Skills and Technologies' framework that suggests "Design involves the ability to combine an empathetic understanding of the context of a problem, creativity in the generation of insights and solutions, and critical thinking to analyze and fit solutions to the context. To move design to final product or service requires skills and technology. Skills are the abilities gained through competence to do something and to do it increasingly well, and the technologies are tools that enable human capabilities" (2015, para 4 Available from **http://innovativelearningcentre.ca/wp-content/uploads/2014/09/applied-skills.pdf**).

Resources and Options

The starting point for *Taking Making into Classrooms* is the consideration of your intention—why are you doing it? As we stated in Section 3, it is the design challenge that takes making into classrooms in a meaningful way, not simply access to a space or a collection of tools. Once you have determined how you will integrate design challenges into your teaching, you can consider the appropriate access to the technologies/tools that you need.

Section 14 offers suggestions for materials, resources, and tools, as well as an initial mobile maker kit that supports design, basic making, and simply prototyping. While prices and brand names may vary, the items included in the mobile maker kit costs approximately $250 in spring 2016.

How You Might...

...Design Your Maker Configuation

Explore the resources below as they provide makerspace options you might consider.

Educational Makerspaces and Resources

http://www.makerspaceforeducation.com/
This is an amazing resource developed by Trisha Roffey, an Edmonton educator with a passion for making and making a difference in education. This site was developed as part of her Master of Education Technology at UBC.

Inclusive Makerspaces—Consideration of UDL and Accessibility

http://www.washington.edu/doit/making-makerspace-guidelines-accessibility-and-universal-design
Making a Makerspace Guidelines for Accessibility and Universal Design

Making for All: How to Build an Inclusive Makerspace

https://www.edsurge.com/news/2015-05-10-making-for-all-how-to-build-an-inclusive-makerspace

Innovations in Education

https://flipboard.com/@davehetheri51jh/innovative-education-8g0te485y

Libraries as Makerspaces

http://www.theatlantic.com/technology/archive/2016/03/everyone-is-a-maker/473286/

Makerspaces are Everywhere

http://www.spencerauthor.com/2016/04/you-dont-need-makerspace-to-have-space.html/

The Smithsonian Learning Lab

https://learninglab.si.edu/
The Smithsonian Learning Lab provides access to ideas, materials, resources, learning resources drawn from their vast collection.

Figure 9-1: Example of a Makerspace in a Converted Classroom

Image retrieved from Makerspace for Education (**http://www.makerspaceforeducation.com/**).