DIGITAL LITTERACY

Digital learning: How to make it meaningful and fun

Today, children are surrounded by technologies that are meant to both educate and entertain them. However, their use of technology does not make them digital natives. In fact, they need our support more than ever to navigate the complexities of the digital world, which have a great impact on many aspects of their lives.

Learning to code has been identified as a key skill for the future. Previously considered in the university realm, programming basics are now taught to preschoolers. The goal of teaching digital literacy is to ensure that children understand that the digital world is a construct, built by people who have their own agency, strengths, and limitations. Ultimately, we want children to be engaged rather than passive when using digital technologies. We also hope to teach children to be safe while using them, and understand the role they have in our modern world. To do so, they require knowledge of how computer programming works, as well as the thought processes behind how codes are written, for what reason and for whom. This is called computational thinking, and is often associated with coding, but can be applied to many other subjects. It can also be taught outside digital boundaries, through unplugged activities.

Coding a computer program might look daunting for children at first: it uses unfamiliar languages and can appear as something for grown-ups. Presenting coding in a fun way — as a puzzle or a mystery to solve — is essential to grab children's interest. Like a puzzle, once completed they will have created something concrete, albeit digital.

Learning to code has been portrayed in the media as a solitary exercise for highly intelligent, nerdy, and predominantly white males. This stereotype does not accurately represent programmers today, or what we should strive for them to be. Women are one of the groups underrepresented in steam, technology, engineering, and math (STEM) fields — which includes computer science — making up only 34 percent of graduates and 23 percent of the workforce.[1] As for Black, Indigenous, and People of Colour entering STEM fields at university, they are more likely to change programs or not finish their degree. A sense of not belonging and lack of representation is theorized as a cause.[2]

The Canada Science and Technology Museum believes that everyone should be presented in STEM fields. The rich history we see in our artifacts demonstrate the power within a diversity of voices. By supporting and fostering knowledge in digital literacy — as well as creating experiences that develop their transferable skills — we hope that all children, whatever their background or gender, will grow up wanting to contribute to the digital world.

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[1] Statistics Canada data from 2016 https://www150.statcan.gc.ca/n1/pub/75-006-x/2019001/article/00006-eng.htm

[2] Why Representation In Nature Matters,: https://www.scienceworld.ca/stories/why-representation-in-nature-matters/

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Learning through playful tinkering

When planning a Rent-a-tech activity, we suggest that you also include a free-play time so that children can get acquainted with the materials or devices. Free play can either be before or after a more structured lesson. The goal of this discovery time is to spark their imagination around all the possibilities offered to them. If that sounds like chaos to you, it's because it has the potential to be! Here are some reasons why embracing a little mayhem can be a good thing, as well as some useful facilitation advice and tips to make this dedicated tinkering time constructive.

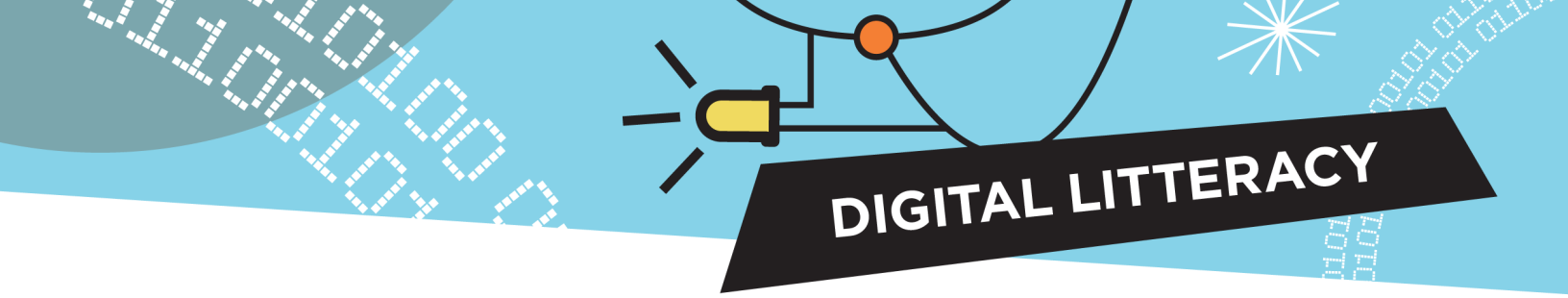
Embrace the maker mindset

The maker mindset is about experimenting, trying, and challenging yourself. Learning skills from others — and discovering through the process — are more important than the final result. Participants are makers, learners, and contributors all at once. Maker-inspired activities are often at the core of digital learning, as a way of introducing coding in a non-intimidating way. This strategy requires little knowledge to start, thus expanding the notion that anyone can be a coder, and allowing the freedom to creatively explore the possibilities that coding offers. One of the most significant aspects of any maker-inspired activity is that it gives learners agency in their own education. It engages them in a practical way in interdisciplinary projects, reframes failure as iteration, and reminds them that there is much to learn from the attempts themselves.

Tinkering, making, and coding does not require expensive technological tools. Start viewing recyclable materials as possibilities for any physical-based project, especially in the prototyping phase. The same notion applies to computational thinking, which doesn't require a computer to be experienced. In fact, some participants might be intimidated by the technological devices, and will refocus their energy on understanding the software and hardware instead of fully engaging with the thought process exercise. Presenting the activities as exploration games can help remove that layer of results-oriented thinking, which is often associated with achieving success through high grades. During the exploration phase, the journey is what matters; it will result in a more lasting impact than if the answers are supplied from the start.

Enhance the digital aspect with materials

Many digital learning devices, like the micro:bit, have a physical element. This enables the addition of a tangible dimension to participant projects; you can ask children to create artful casing, set designs, cardboard prototypes, maquettes, etc. This models the constructionist method, by which participants learn more when they have access to a physical object. Moreover, a material aspect will dig into participants' art, engineering, and math skills.



Facilitation advice

- Present yourself as a facilitator that will guide them in *their* projects.
- It's okay not to have all the answers.
- Make the atmosphere collaborative by avoiding competition.
- Use prompts that promote creativity and conveys a sense of iterations: Try, attempt, experiment.
- Encourage participants to share their knowledge.
- Don't focus on the final product or the initial plan. Allow participants to experiment and see their project evolve.
- If participants demonstrate knowledge in a particular area or skill, make them a resource person for their peers.
- Include reflective moments for participants to share what they have so far, either by impromptu and informal presentations or prepared questions. Encourage them to bring up issues, solutions, fixes, and to highlight their successes.
- Stay hands-off as much as possible; use questions to get them to a solution.
- Sometimes it doesn't work. Emphasize that it doesn't mean their idea isn't worthy, but execution can be complicated and time is limited.

Constructive tinkering

Below are some tried-and-tested elements from our programs, to help make the tinkering phase more valuable.

- Run through all safety rules. These may be specific rules, such as how to use a glue gun or how to avoid short circuiting a battery holder (you may want to show them what would happen, so they don't try it on their own out of curiosity), or the rules can be more general.
    - If possible, print out instructions and leave them beside the tools in question.
    - If required, place safety goggles near the tool that requires them.
    - Minimize risks, but also teach participants to become proficient and responsible with tools.
- Organize your space, whether it is a classroom or kitchen, like a makerspace. Participants should be able to collaborate and share easily. Opt for a layout that is turned toward the center instead of facing towards the teacher desk.

- Lay out supplies in an accessible way; run through them and give hints of how they could be used.
    - Split building supplies and building tools into different sections.
    - Make sure to have enough tape, or have tape alternatives such as clips, zip ties, and rubber bands (see Tinkering Supplies List).

Assessing outcomes

Tinkering and playing might seem like the same thing, but that doesn't mean learning isn't happening simultaneously. When fully engaged in an activity, the notions of it being challenging on an intellectual, conceptual, and tactile levels might be part of the appeal.

A summative assessment like a traditional exam is rarely appropriate to determine all the learning facets that occurred in a maker project.

Below is a framework developed by the Exploratorium's Tinkering Studio that highlights the different indicators of learning you might see in your participants:

- Learning Dimensions of Making and Tinkering

Evaluating a maker project is hard. We suggest that you assess throughout the project, reward risk taking, look at all failed attempts, and the progression of the participants' understanding in the various choices they made. This formative assessment process is longer, but you can involve the participants in recording documentation that will keep you in the loop. This will help you to interpret where they are in their progression, and allow you to adapt your educational strategies to help them best achieve the set goal.

Here are a few examples of documentation:

- a self-assessment questionnaire, with open-ended questions at various points of the projects
- a maker journal with their ideas and sketches, or from prompts you provide
- videos in a documentary style, or using social media such as an Instagram story
- formal or impromptu presentations through the process

Make sure participants have a chance to improve on their projects. Avoid "grading" parts of it, as you might inadvertently determine that is over and done. Instead, encourage the idea that iterations, even overhauls, are part of the participant learning process.