Computerized embroidery to learn ICT skills

Guest lecture by
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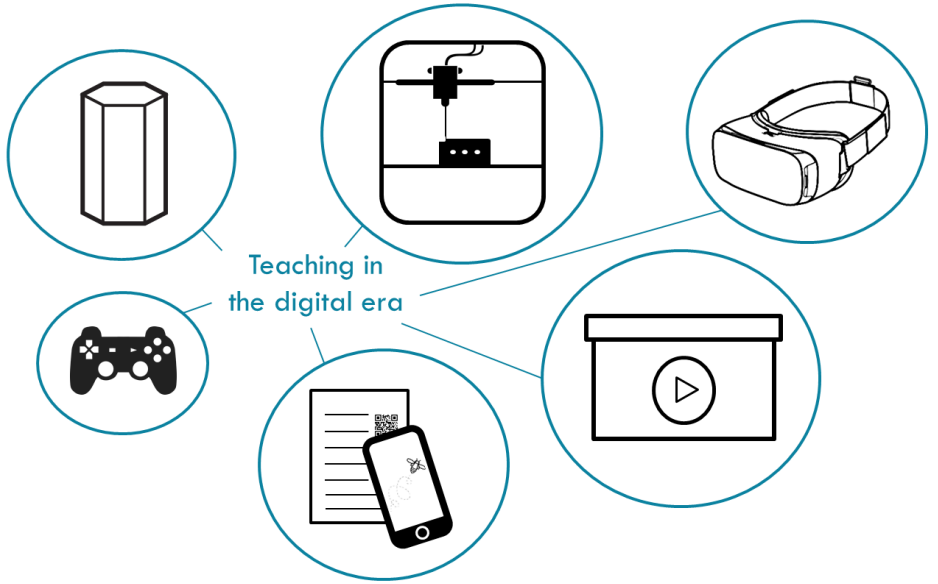


http://tecfa.unige.ch/tecfa/talks/schneide/zurich-2022

Today's menu

- Teaching ICT Skills
  - A challenge
- Digital Design and Fabrication
  - Definition
  - Use in Education
- Computerized embroidery (machine embroidery)
  - For teaching ICT
  - For teaching Computer Science principles
- Reading of the week
- Try it out: Ink/Stitch (Inkscape) and TurtleStitch
- What's for next time again?
- *If you had to do it* preparation

1. ICT Skills – a challenge for general education

ICT Skills – a challenge for general education

" […] university students, all born after the magical year 1984, do not have deep knowledge of technology, and what knowledge they do have is often limited to the possibilities and use of basic office suite skills, emailing, text messaging, Facebook®, and surfing the Internet."

"[…] there is quite a large body of evidence showing that the digital native does not exist nor that people, regardless of their age, can multitask. This corpus of research also shows that though learners in this generation have only experienced a digital connected world, they are not capable of dealing with modern technologies in the way which is often ascribed to them (i.e., that they can navigate that world for effective and efficient learning and knowledge construction)."

Kirschner, P. A., & de Bruyckere, P. (2017). The myths of the digital native and the multitasker. *Teaching and Teacher Education*, *67*, 135–142. https://doi.org/10.1016/J.TATE.2017.06.001

ICT skills must be taught ! … preferably in a motivating way.

2. Digital Design and Fabrication (“Making”) in education

“Making” = Digital design and fabrication

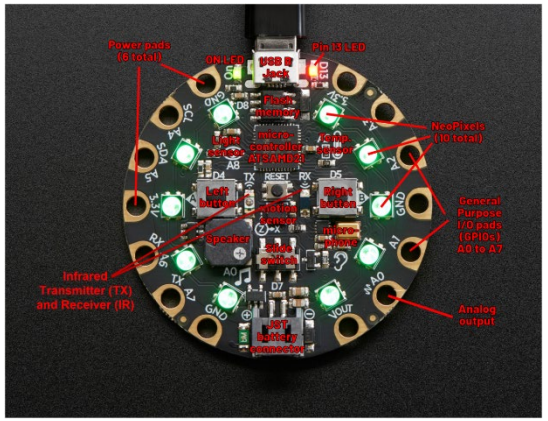
Some end-user making technology:

Computerized Embroidery:
- Medium or expensive hardware
- Very expensive or free software
- Environment friendly
- noisy

Laser cutting:
- Expensive hardware
- Free or cheap software
- Fast
- Very noisy, smelly,

3D printing
- Cheap hardware
- Free software
- Very slow
- Smelly

Electronic boards
- Cheap hardware
- Free software
- require programming

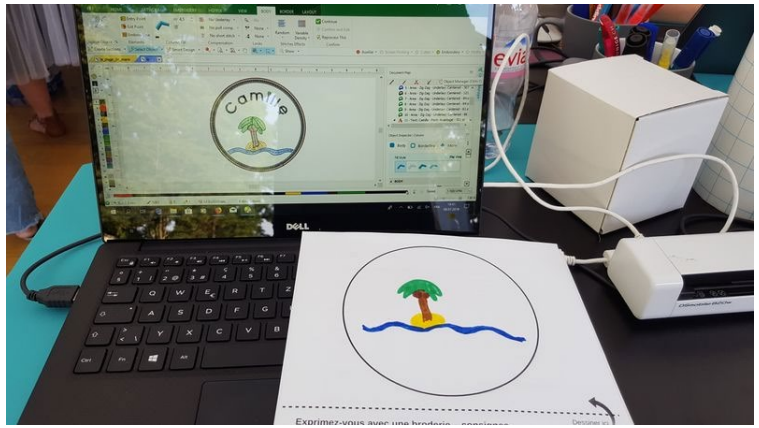


Vinyl cutting
- Very cheap hardware
- Rather cheap software
- Fast

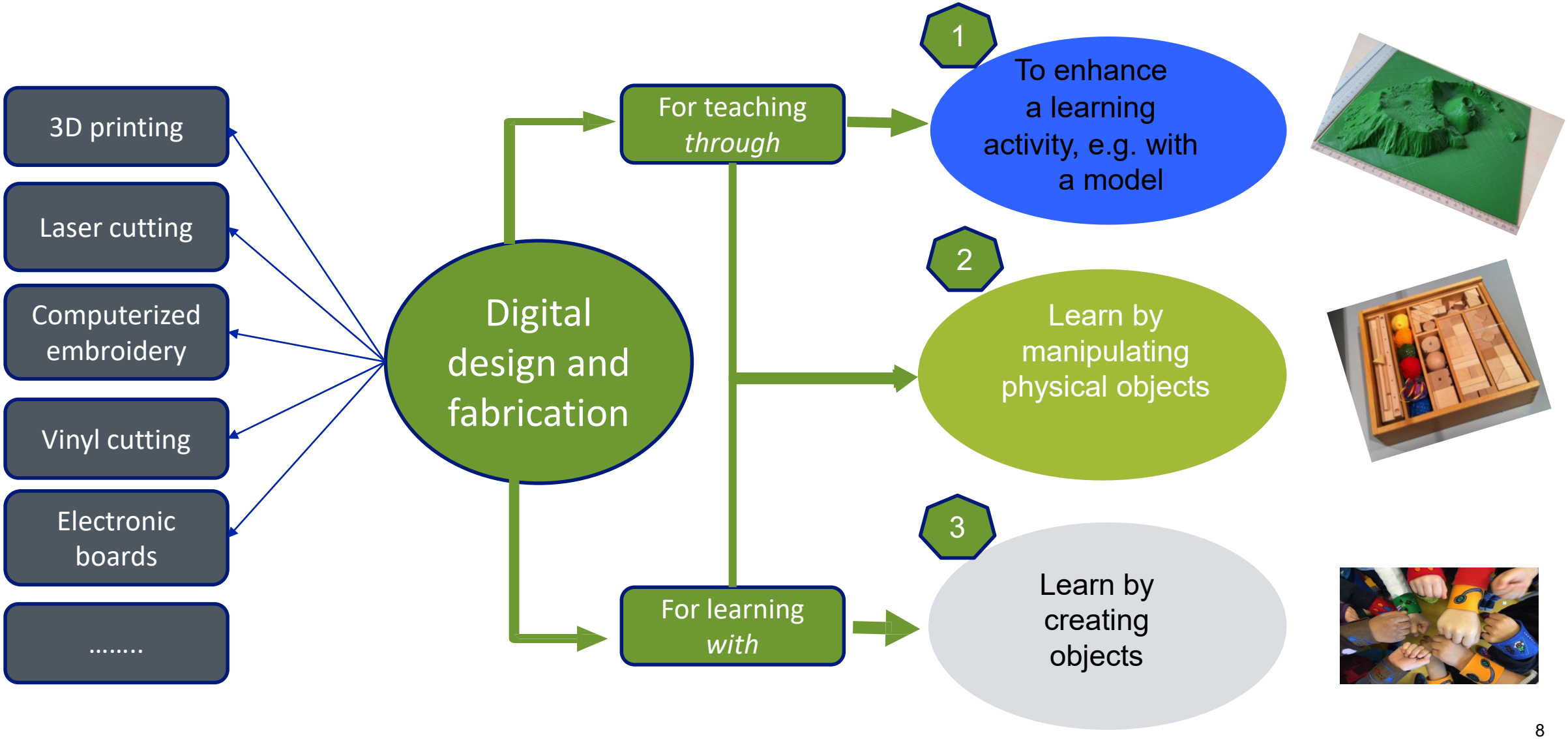
Gershenfeld (2005) «How to make almost anything » / Bowyer (2007) RepRap

Workflow in “making” (simplified)

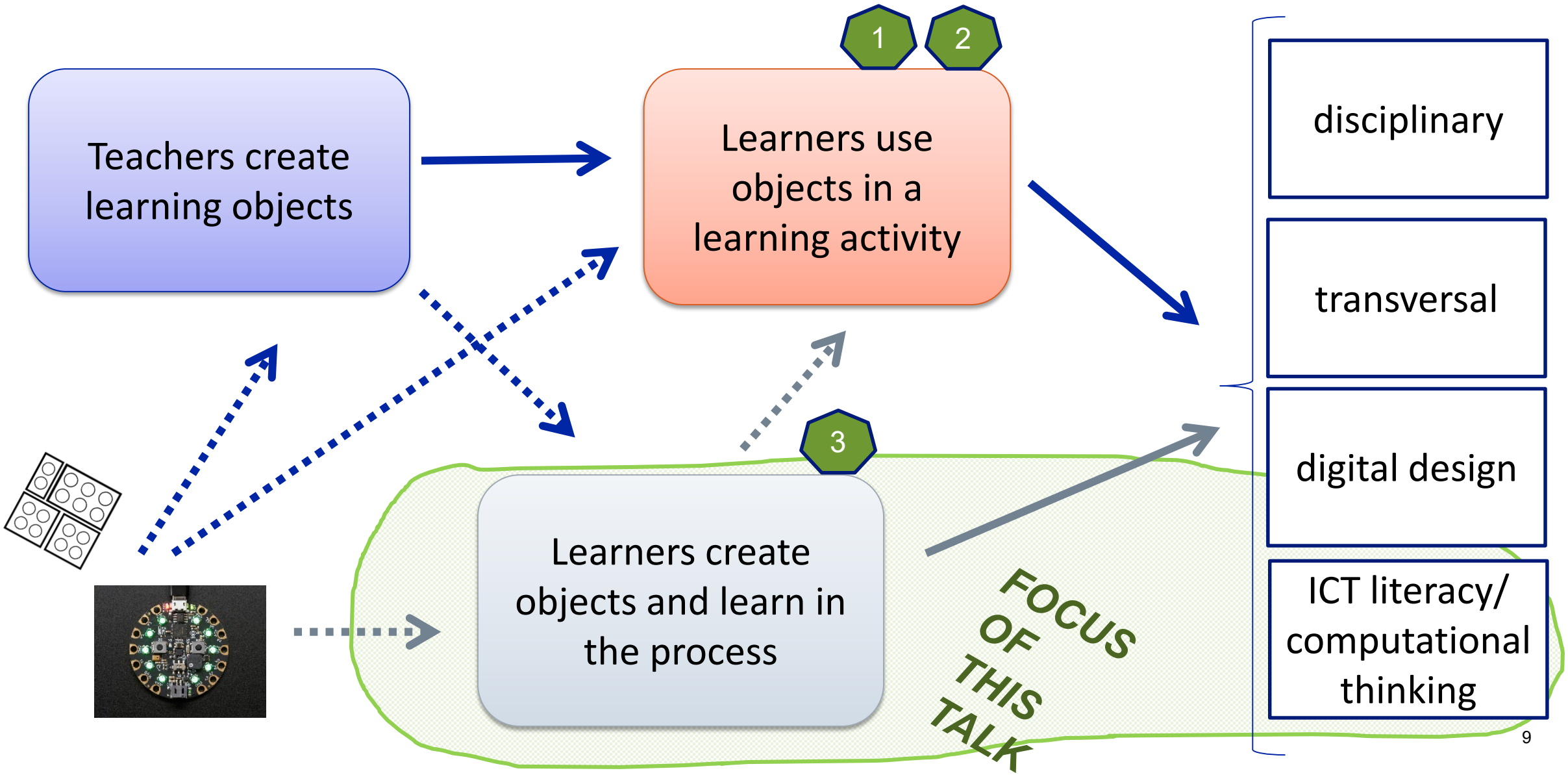
Idea → Draw or program a design → Parameterize / Create machine file → A machine fabricates → Use



“Making” in education (1)



Making in education (2)



Disciplinary skills

Transversal skills

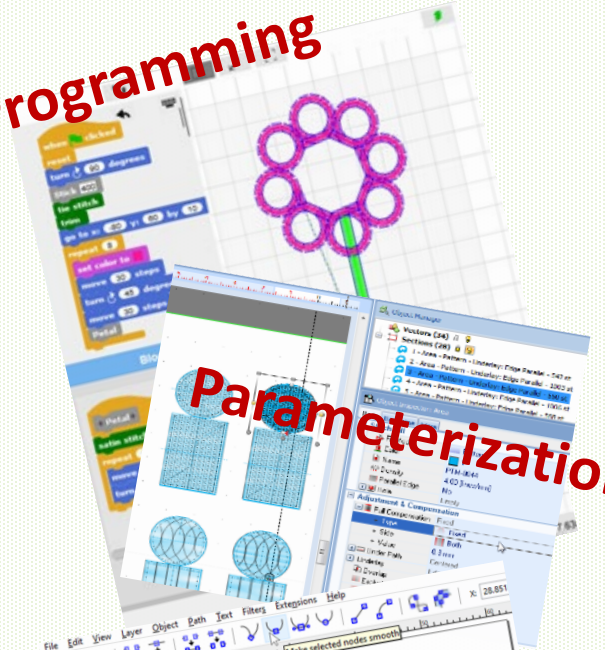
Computational thinking & ICT literacy

Digital design

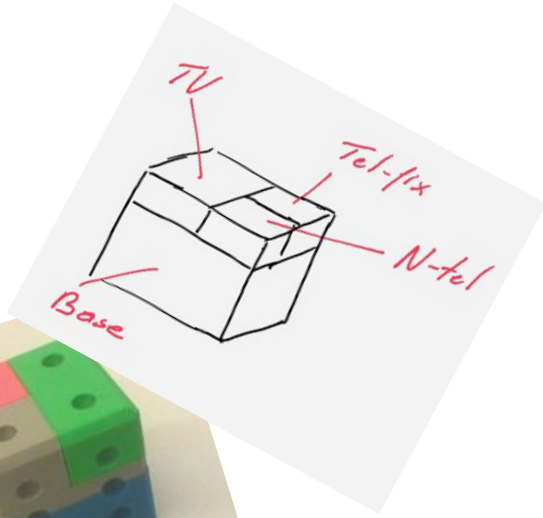
Languages

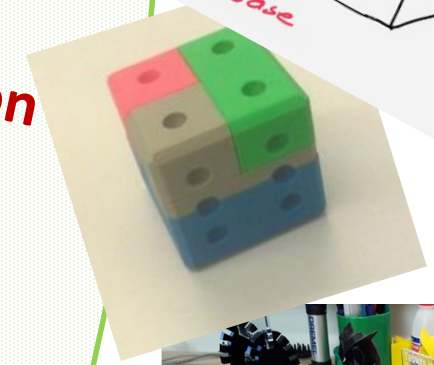
Doing projects collaboration

Programming



Parameterization

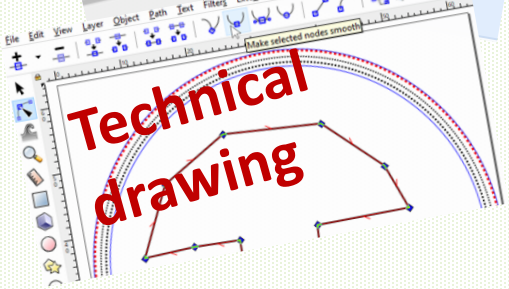




Science

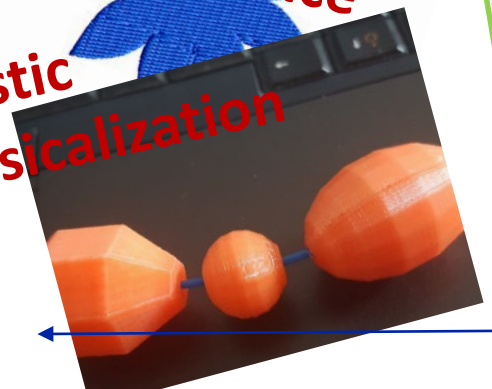
Cultural competence

Technical drawing

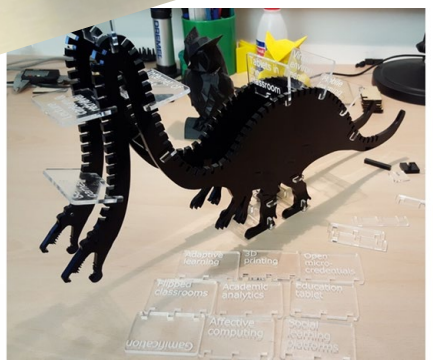


Maths

Artistic physicalization

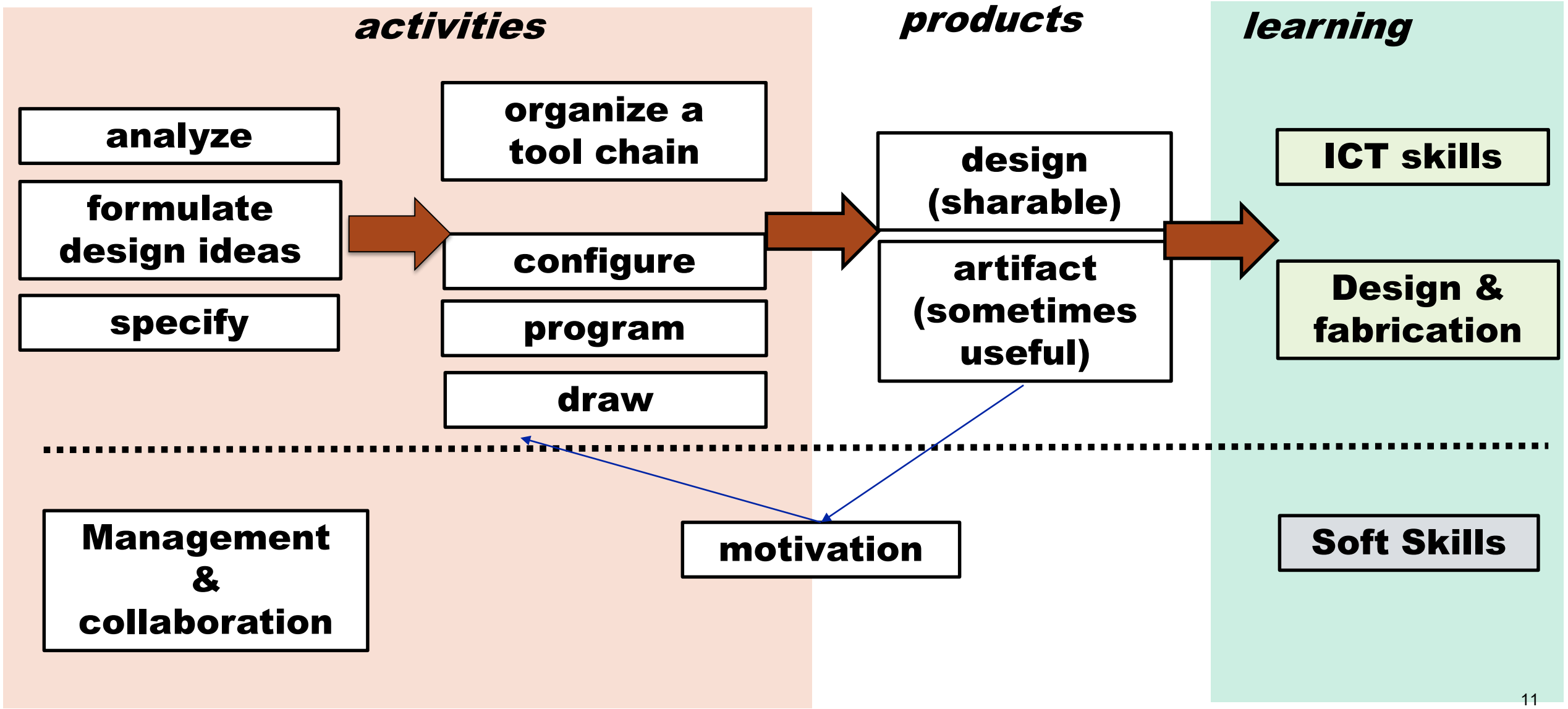


Use a system



Digicomp 2.0

Workflow, engaged know how, products and learning in “making”



Machine embroidery vs. other making tech

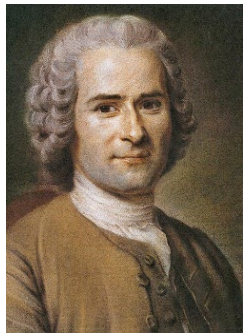
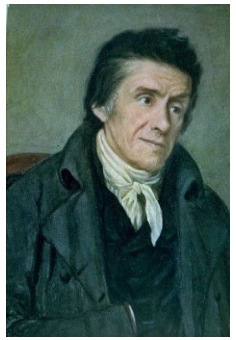
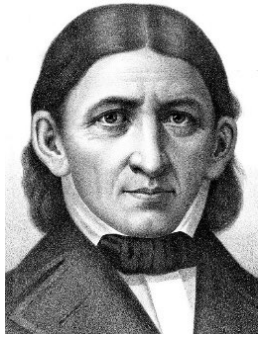
1. **(like the other) a medium with several opportunities for learning**
2. **Reliable technology** (1980,-)
3. **Does not convey an engineering image dominated by males** (although it is…)
4. **Positive connotation**, can act on other's thinking (Gell, 1998).

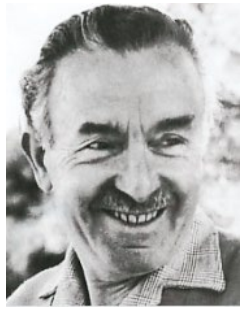
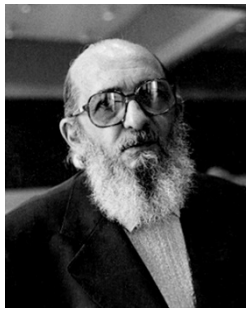
A small comparison

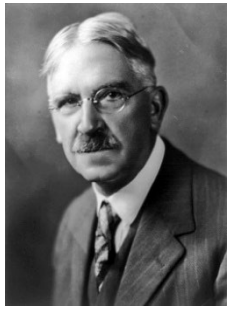
	time	Nuisances	reliability	Price	Difficulty	Artistic expression (beginners)
3D printing	slow	Little noise, smell, heaps of plastic objects	yes	weak	Somewhat to difficult	weak
Laser cutting and engraving	Fast to very fast	Strong noise, smell, rest materials	yes	high	Easy to somewhat	weak
Embroidery	fast	noise	somewhat	weak	somewhat	medium

3. Some learning theoretical foundations (quickly, sorry)

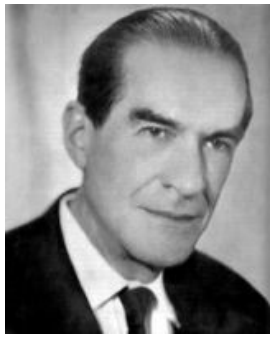
«Making» is a medium and as such it is not educational or learning theory, however ….









a. Learning by manipulating and constructing

Locke, 1632-1704
- Sensory experience

Rousseau, 1712-1788
- Romanticism

Pestalozzi, 1746-1827
- Learner autonomy and responsibility
- "head, hand and heart"

Fröbel, 1782-1852
- "Gifts" to experiment

Montessori, 1870-1952
- "Materials"

Piaget
- Constructivism

Papert, 1928-2016
- LOGO (1967)
- Constructionism
- Mindstorms (1980)

Resnick, 1956,-
- Lifelong Kindergarten
- Scratch

Key idea: Promote learning through hands-on interaction with a "kit"

1. A basic **set of elements and operations**
2. that can be **combined** (like words and sentences in a language).
3. Ready for **exploration**.

The construction kit:
- Invites using it.
- Is intuitive,
- adaptable / flexible,
- robust.
- Create larger objects from small ones

b. Activity-based learning

Karl Marx, 1818-1883 Pavlov, 1849-1936

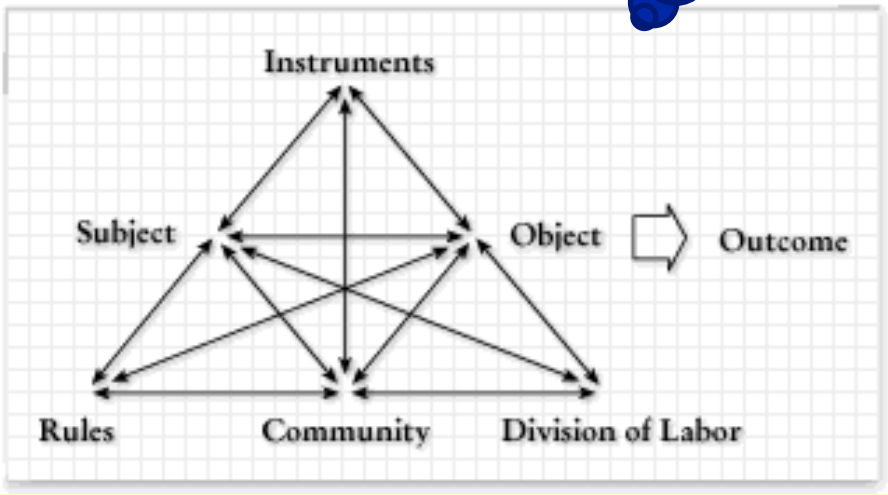
Vygotski, 1896-1934
- Socio-constructivism
- Zone of proximal development

Leontief, 1903-1979
- Activity theory (USSR)

Activity theory (Scandinavia)
- Expansive learning (Engeström, 1987)

Nardi, 1995 (use in HCI)

Key idea: Learning takes place in a social, cultural and material context



Learning happens through reflection of social knowledge.
Activities are:
- focused on objects carrying culture;
- mediated by tools carrying culture;
- Socially organized

Activities are hierarchical: activity (needs, motivation), action (goal), operation (task);

c. Hands-on, “real-world” projects

Fröbel

Herbart, 1776-1841

Dewey, 1859-1952
- Structured learning through experience (hands-on, real-world projects)
- Guided learner-centered pedagogy
- Connecting subject matters to prior knowledge and experience

Key idea: Learning through interaction with the “real world”, doing projects with some learner autonomy.

Kilpatrick, 1871-1965

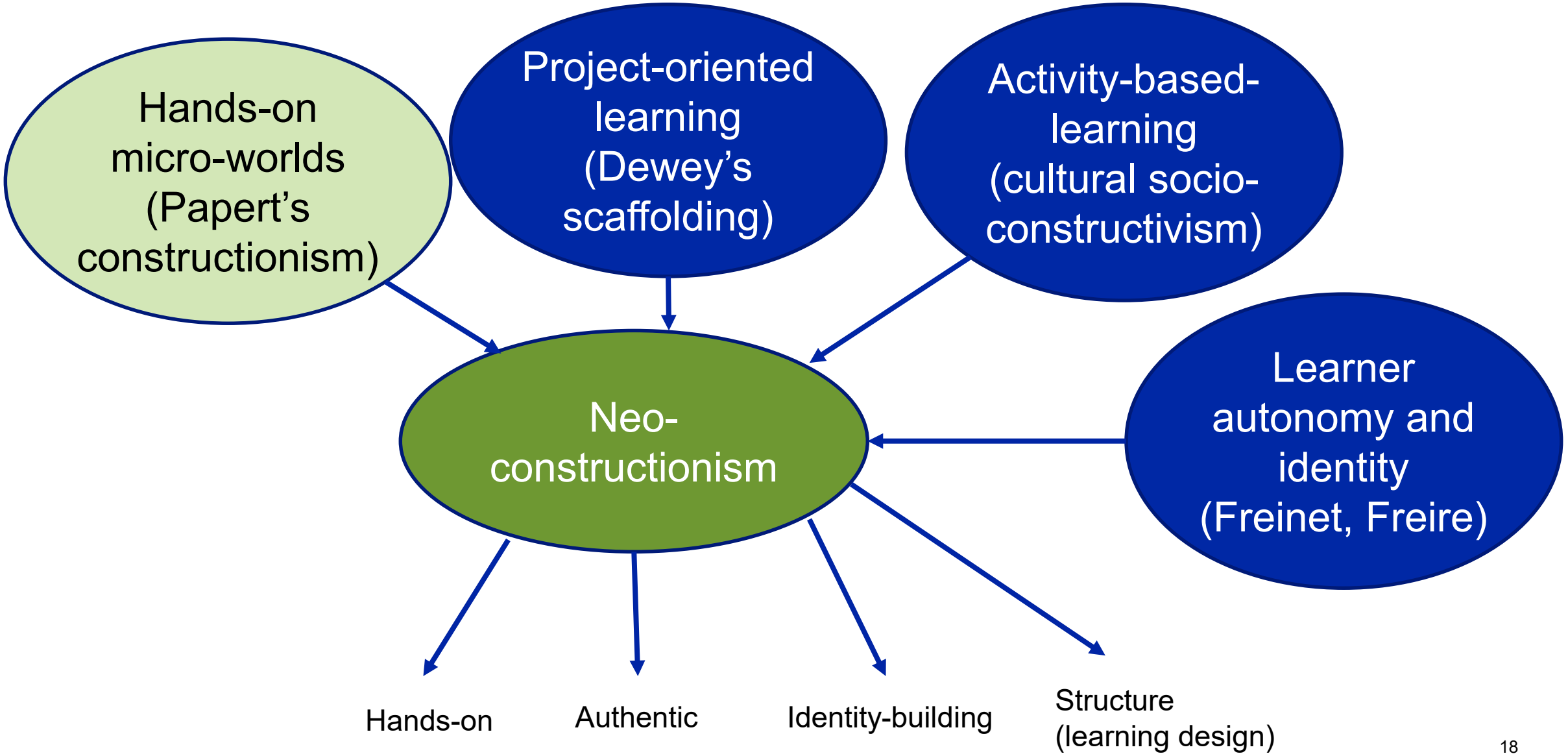
Freinet, 1896-1966
- Learner-centered inquiry-based learning
- Collaborative work, creating products
- Real-world experience (printing press, field trips, ….)
- Responsibility of the child (participation)

Freire, 1921-1997
- Balance of action and reflection
- Dialogue, creating autonomy

- Teacher as guide
- Project-based learning
- “hands-on”
- Connect with real world
- Respect of autonomy

d. Synthesis of theory

(that is dominant in the making & education community)



ICT learning opportunities in digital making environments

1) Various ICT skills

1. System administration
2. Technical drawing
3. Image manipulation
4. Parameterization
5. Documentation & sharing
6. ……

Often, implementing constructionist thoughts:

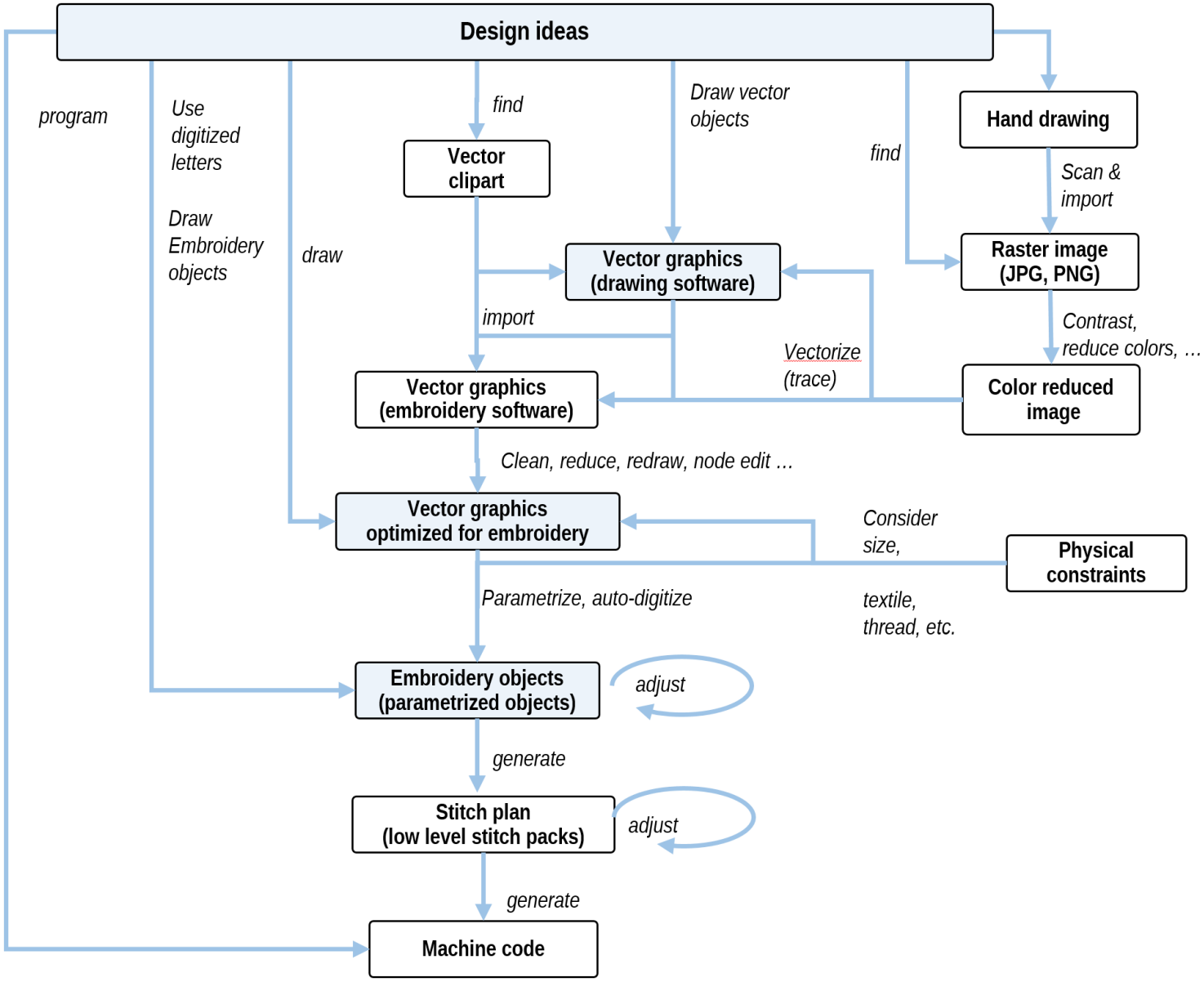
Learning is favored:
- by manipulation and discovery
- by providing structure to activities
- by inviting dialogue and sharing

2) Programming (computational making)

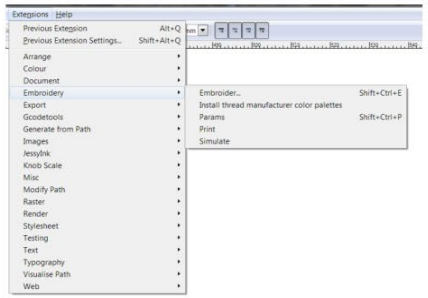
1. Visual languages that include standard elements
2. export to symbolic languages.
3. Support for sharing code.
4. Direct creation of machine-usable formats.

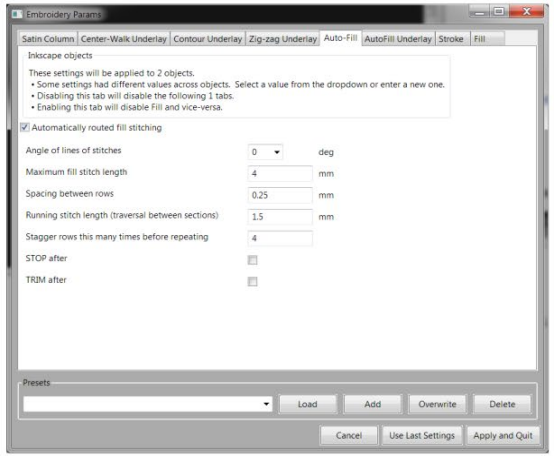
4. Computerized embroidery as a medium for teaching basic ICT skills: Some opportunities

Workflow of computational embroidery



Using the InkScape opensource drawing program + and its Ink/Stitch embroidery extension

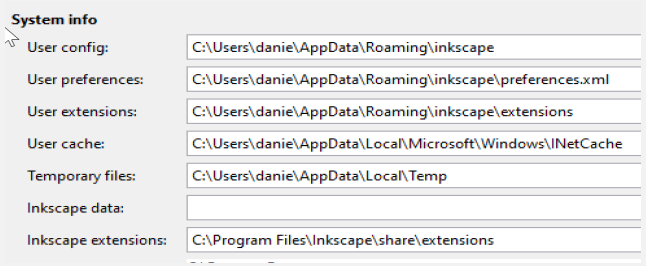




https://inkstitch.org/

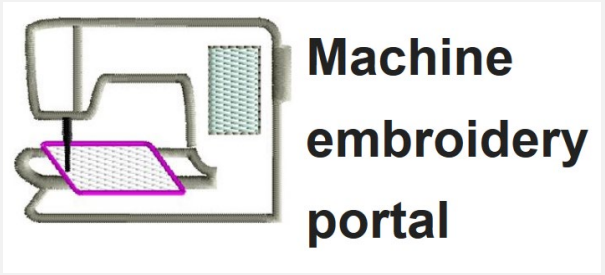
Learning about …. (a)

System administration



Installing open source software such Ink/Stitch requires understanding the file system, permissions, managing zip files, etc. and following instructions to the letter.

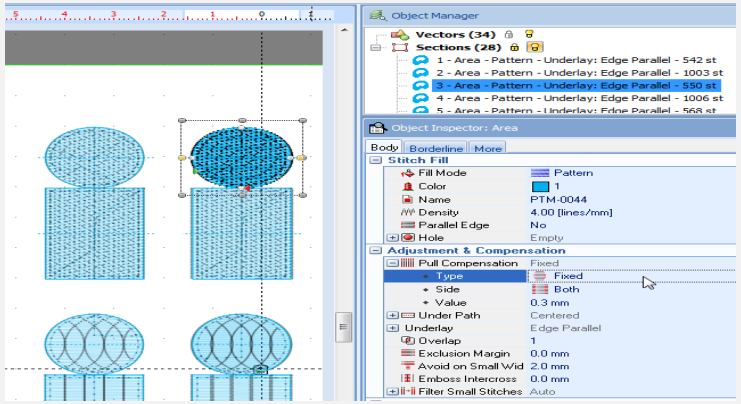
Sharing & documenting



Embroidery being a very technical field, its practice encourages sharing, peer helping and participation in online communities.

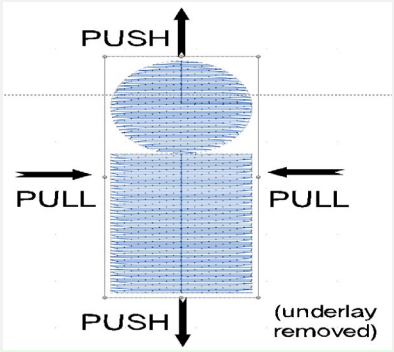
Learning about …. (b)

Parameterization



Using advanced commercial software such as Stitch Era allows training learners to look at objects that can be parametrized in many ways, and to explore menus.

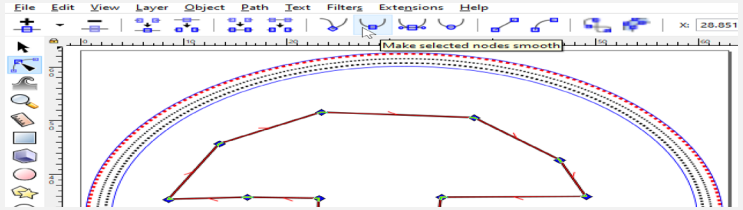
Physical constraints

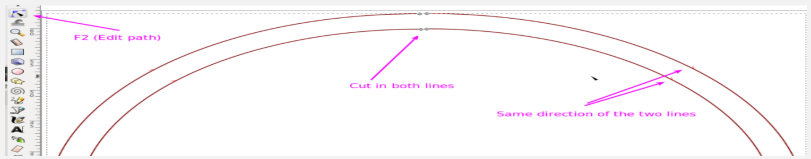


Each fabrication method must consider various physical constraints.
Students will learn that a model on the screen may not «print» as expected. Model design with any making technology has to take into account material parameters.

Learning about …. (c)

Vector manipulation





Imported or created vector “paths” must be reshaped, broken, glued, etc. This encourages learning advanced functionally of a vector drawing program or a vector drawing module.

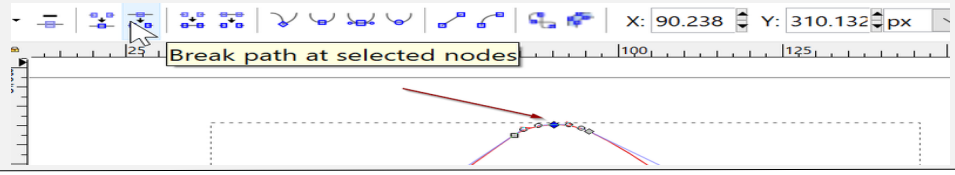
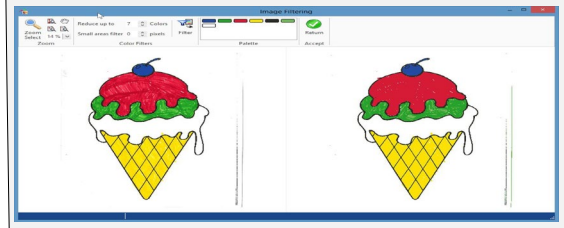
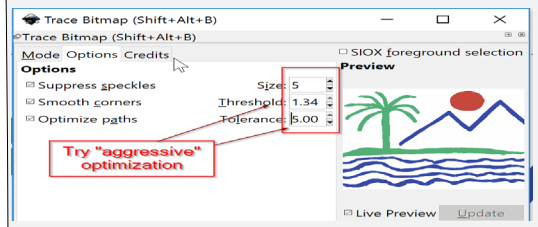


Image manipulation

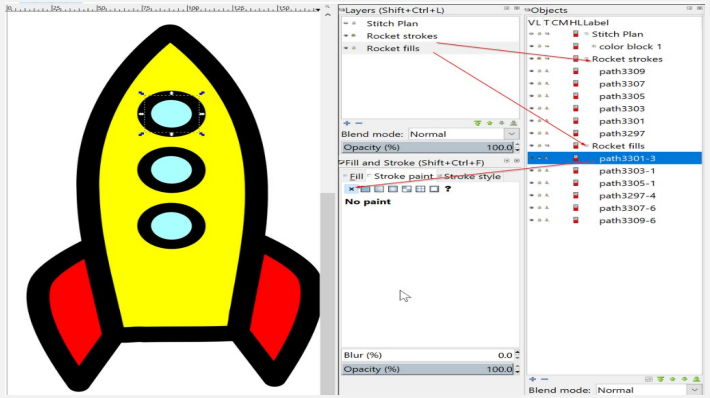




Raster images have to be simplified to be vectorized, e.g., color reduction, change contrast, remove specks are useful skills for other contexts.
Vectorizing/tracing skills are useful in many domains.

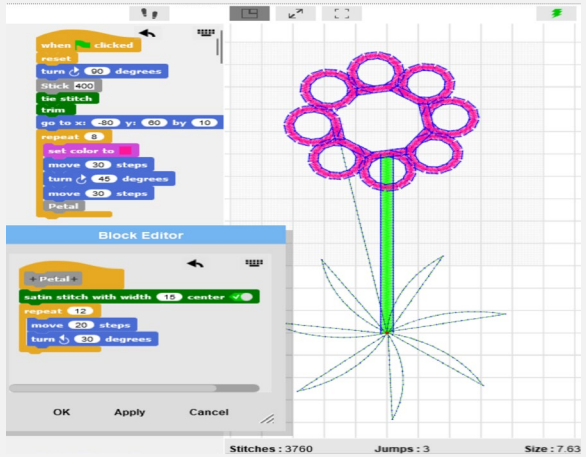
Learning about …. (d)

Vector drawing



Vector drawing is a useful ICT skill. E.g., drawings in Word or PowerPoint, illustrations in learning materials, shapes for computer animations.

Programming



http://turtlestitch.org

Quote: based on a browser-based educational programming language (Snap!) to generate patterns for embroidery machines. It is easy to use, requiring no prior knowledge in programming, yet powerful in creating novel patterns for embroidery.

Hands on Ink/Stitch (Inkscape extension)

- Embroidery demo
- Discussion of 2-3 use cases
  - Teach/learn what? Something else than ICT skills ? Or in addition ?
- Hand drawing to embroidery demo (if time)

For more information, see:

- http://inkstitch.org
- https://edutechwiki.unige.ch/fr/InkStitch (in French)

Save page as:
https://edutechwiki.unige.ch/fmediawiki/images/4/48/Green-apple-twemoji.svg

Research/Results

No research as far as we can tell
Some personal experience, in particular observing three facebook support groups (N>1000)

- https://www.facebook.com/groups/inkstitchfrance
- https://www.facebook.com/groups/inkstitchdeutsch
- https://www.facebook.com/groups/inkstitch

Plus my own teaching experience

- https://edutechwiki.unige.ch/fr/broderie_faclab
- https://edutechwiki.unige.ch/en/Machine_embroidery_in_education_workshop_(EdMedia2019)

Break

Please be back in ‘10 ☺

5. Computational making to teach computer science principles

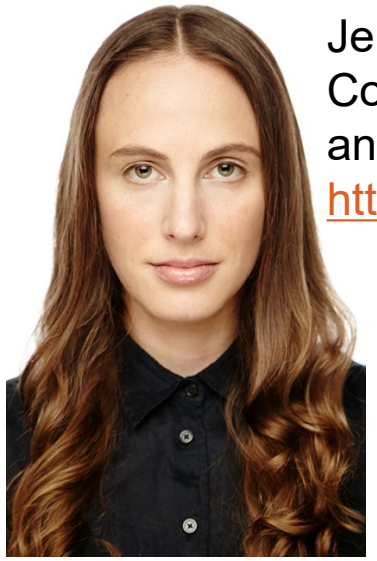
… short demo (if time left)

Leah Buechley,
Inventor, LilyPad
Computer science and making prof.
http://leahbuechley.com/

Limor Fried
Founder and CEO, Adafruit
https://www.adafruit.com/about/

Ayah Bdeir
Founder, LittleBits
https://ayahbdeir.com/

… and more
(including men)



Jennifer Jacobs
Computational fashion
and art professor
http://jenniferjacobs.mat.ucsb.edu/

Kylie Peppler
Computer & education professor
Creative coding
http://kpeppler.com/

Eva S. Katterfeldt
Computer science
education + making
Researcher

http://dimeb.informatik.uni-bremen.de/

So far, most research is theory building and UX testing (an initial search produced about 50 publications)

Feelings of engagement and empowerment fostered by these experiences indicate that computational-design tools for novices could serve as a powerful way to positively change people's understanding of the relevance and applications of programing, while fostering technological and aesthetic literacy in the process (Jacobs and Buechely, 2013)

motivation

The creation of computational artefacts as a means of expression could be an exciting way to develop computational literacy. (Chytax, Tsilingiris and Diethelm, 2019)

«Bildung»

In addition to constructionism, the interaction between body and mind, creativity and technology and self and environment.", i.e. *be-greifbarkeit*, *imagineering* and *self-efficacy* are essential requirements for learning environments for digital fabrication that facilitate *Bildung (*Katterfeldt and Dittert, 2015*)*

Self-efficacy

usefulness

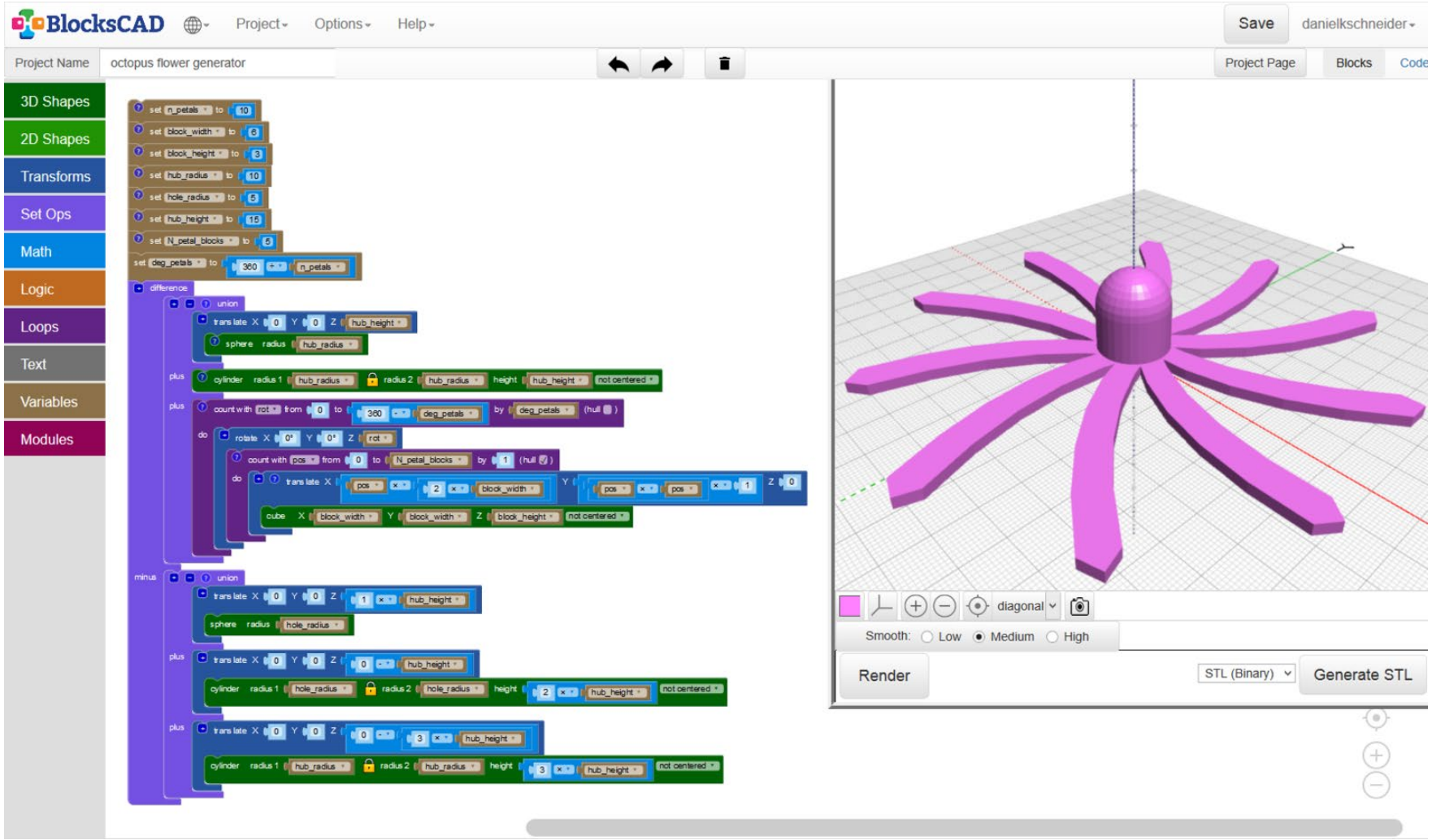
The data shows that building the projects in our structured curriculum impacts builders' technological self-efficacy, leading to in an increase in students' comfort with, enjoyment of, and interest in programming and electronics. (Qiu et al. 2013)

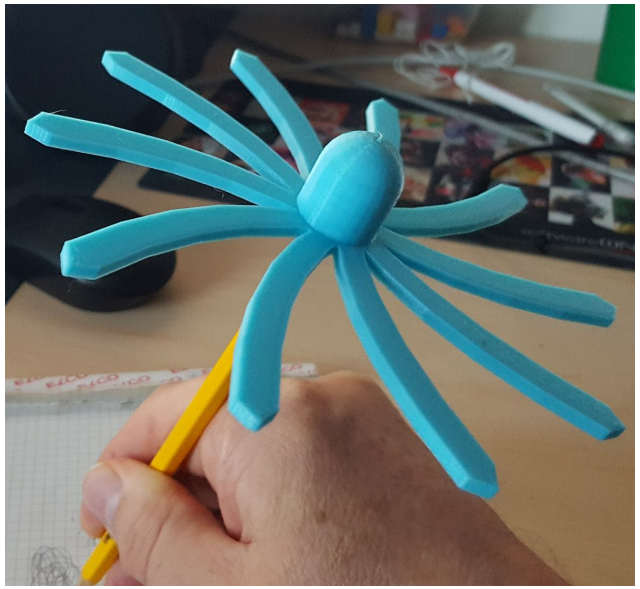
A school may purchase a 3D printer for educational purposes, only to have its student-makers print other people's models without learning to make their own. To prevent this kind of situation, educators must capitalize on the maker movement in ways that facilitate what we call computational making, which involves both meaningful cognition and the making of artifacts. (Johnson, 2017)

For the references, see: https://edutechwiki.unige.ch/en/Computational_making

Programmed 3D objects - https://www.blockscad3d.com/

Computational making environment example

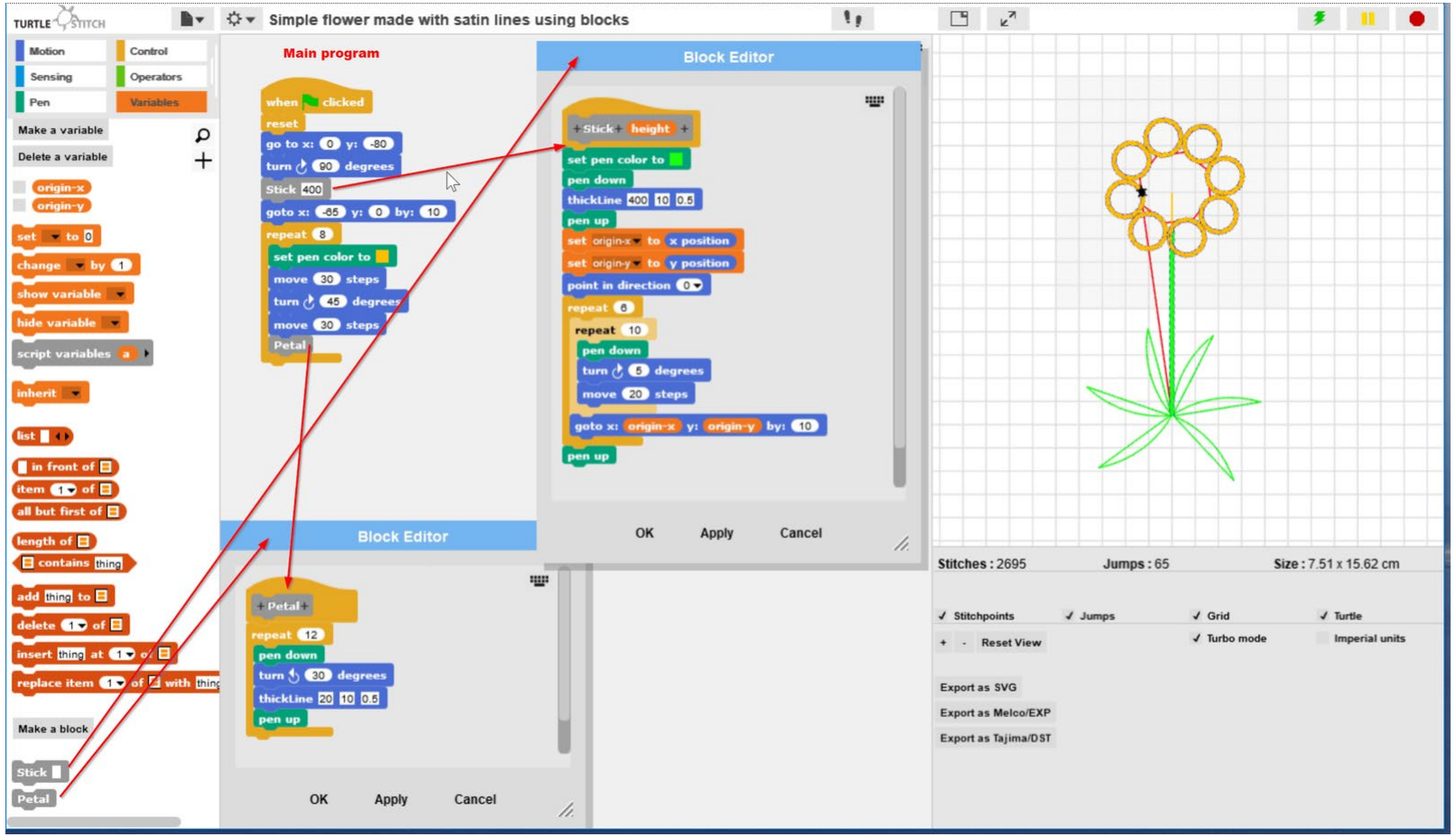




See also: https://www.tinkercad.com/learn/codeblocks

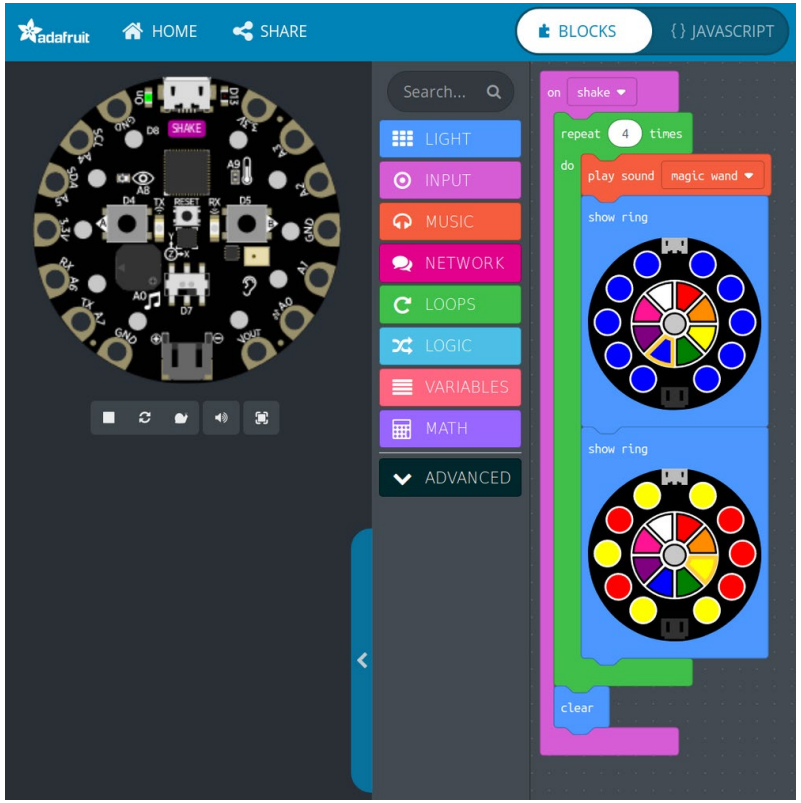
Coded embroidery - https://www.turtlestitch.org/

Computational making environment example



Digital Electronics – with Adafruit CPX https://makecode.adafruit.com/

Computational making environment example



Hands on turtle stitch

- Embroidery with turtle stitch demo
- http://turtlestitch.org

Open an example: (E.g. simple flower made with embroidery lines using blocks)
https://www.turtlestitch.org/users/dks/projects/Simple%20flower%20made%20with%20embroidery%20lines%20using%20blocks

6) Reading of the week

Kirschner, P. A., & de Bruyckere, P. (2017). The myths of the digital native and the multitasker. *Teaching and Teacher Education*, *67*, 135–142. https://doi.org/10.1016/J.TATE.2017.06.001 chapters 1-3, pages 136-138)

- What were they interested in?
  - Literature review: debunking myths about digital skills and multitasking
- Conclusions
  - Digital skills need to be taught (and not just explored)

Brady, C., Orton, K., Weintrop, D., Anton, G., Rodriguez, S., & Wilensky, U. (2016). All roads lead to computing: Making, participatory simulations, and social computing as pathways to computer science. *IEEE Transactions on Education*, *60*(1), 59-66.

- What were they interested in?
  - Literature review and Case study
  - Teaching Computer Science principles to a “difficult” population through a mix of making, participatory simulations, and Social Computing
- Results of the case study:
  - A mix of three media/approaches and formal/informal can engage historically underrepresented populations in computing.

7) What's for next time again?

- Read one or two scientific article-s

8) Group work

If you had to do it

- 2-3 slides
- Draft scenario of an activity with computational embroidery, either “learning with” (students create) or “learning through” (teacher creates a tool to enhance a learning activity)
- Not necessarily teaching/learning ICT or programming. Choose another subject area if you like.

- New activity or adapting an existing activity engaging learners with computational embroidery
- Why do you think working with textiles would be interesting (vs. another technology) ?
  - Effect on learning/ engagement/ etc.
- The activity’s description