



Designing for Inclusion:

Examining Do-It-Yourself design activities

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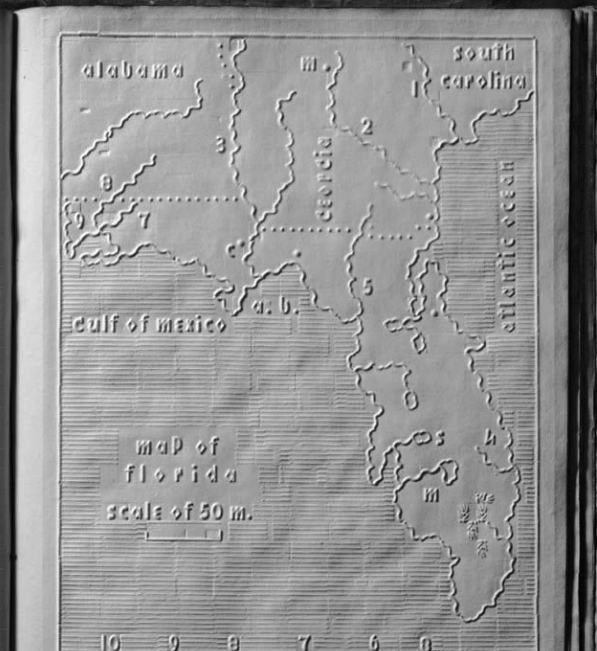
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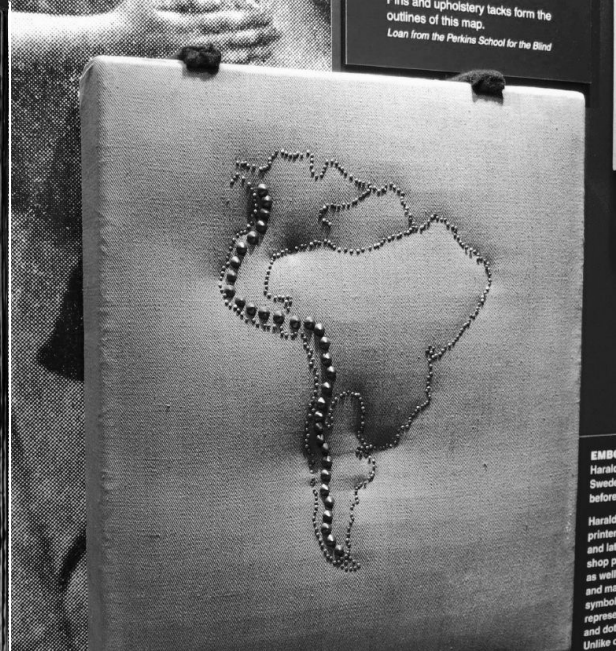
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Atlas for the blind, 1837, S.G. Howe

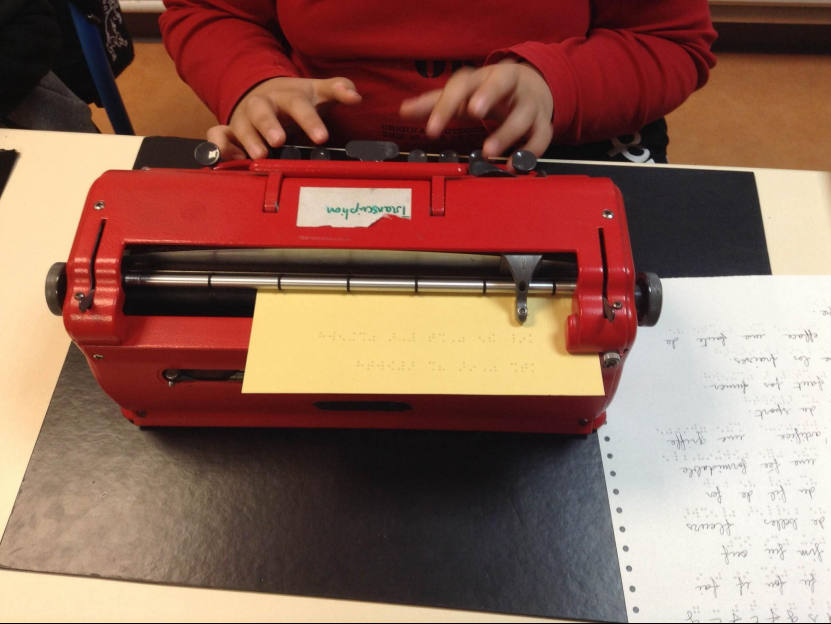


Map created with pins, 1900 - aph.org



Map production, 1977 - aph.org

Designing and producing educational tactile documents and artifacts: a long history.



A Perkins brailler

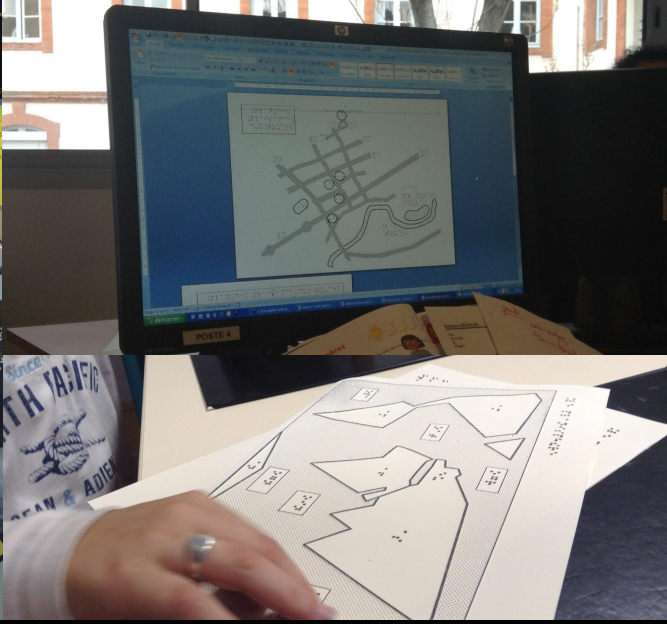


A braille computer (and MP3 player)

Since 1990, two main changes:
Integration policies (UN bill of children's rights) and digital technologies.



Matrix for a thermoformed map,
2014: Pasta and cardboard



Raised lines drawing, 2014:
Microsoft Word, (specific) swell paper



A prototype of a magnifier for the classroom
Whiteboard, 2014: Bluetooth camera, tablet

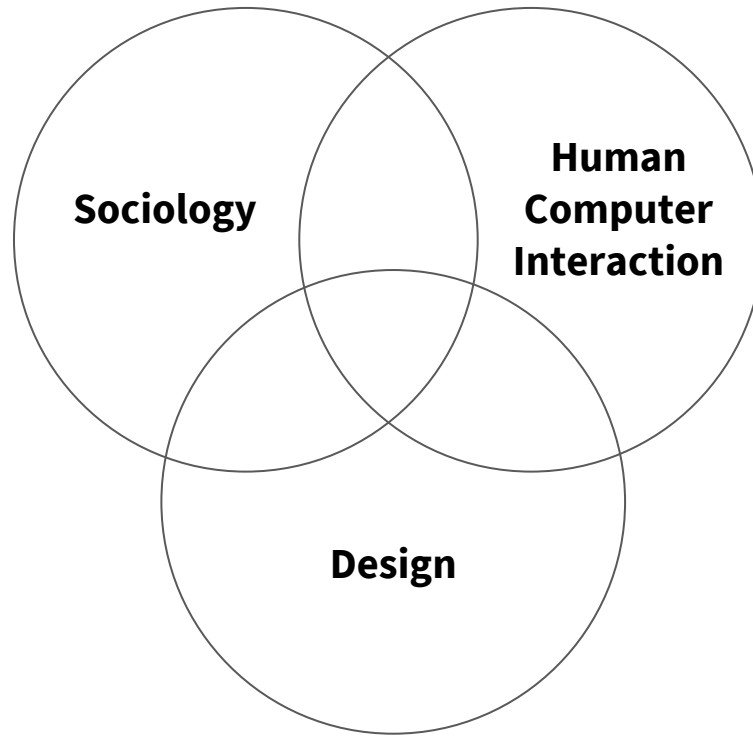
Research theme: How are adapted educational material
and tools made today?

Research questions:

How do professional caregivers identify and use existing artifacts that can suit their purposes?

When do they decide to design their own artifacts and how do they do so?

How does it modify their roles and organization?



Approach: Between sociology and the field of HCI and design.
I focus on professional caregivers.



Methods: Ethnography (a year-and-a-half) and interviews

References:

In HCI: DIY assistive technologies, 3D printing in education

Hurst, A., & Tobias, J. (2011). Empowering Individuals with Do-it-yourself Assistive Technology

Buehler, E., Comrie, N., Hofmann, M., McDonald, S., & Hurst, A. (2016). Investigating the Implications of 3D Printing in Special Education.

In sociology: sociology of usages, sociology of work

Akrich, M. (1998). Les utilisateurs, acteurs de l'innovation.

Wenger, Etienne (1998). Communities of Practice: Learning, Meaning, and Identity.

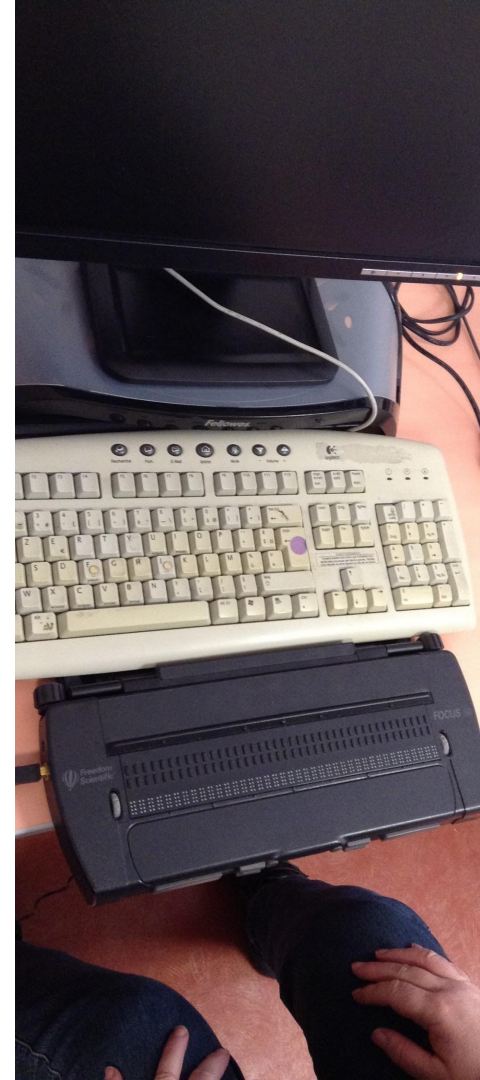
Constatations

1. Most adaptations are still done locally, on an individual basis (in France).



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2. Caregivers now deal with the making or modification of technologies.



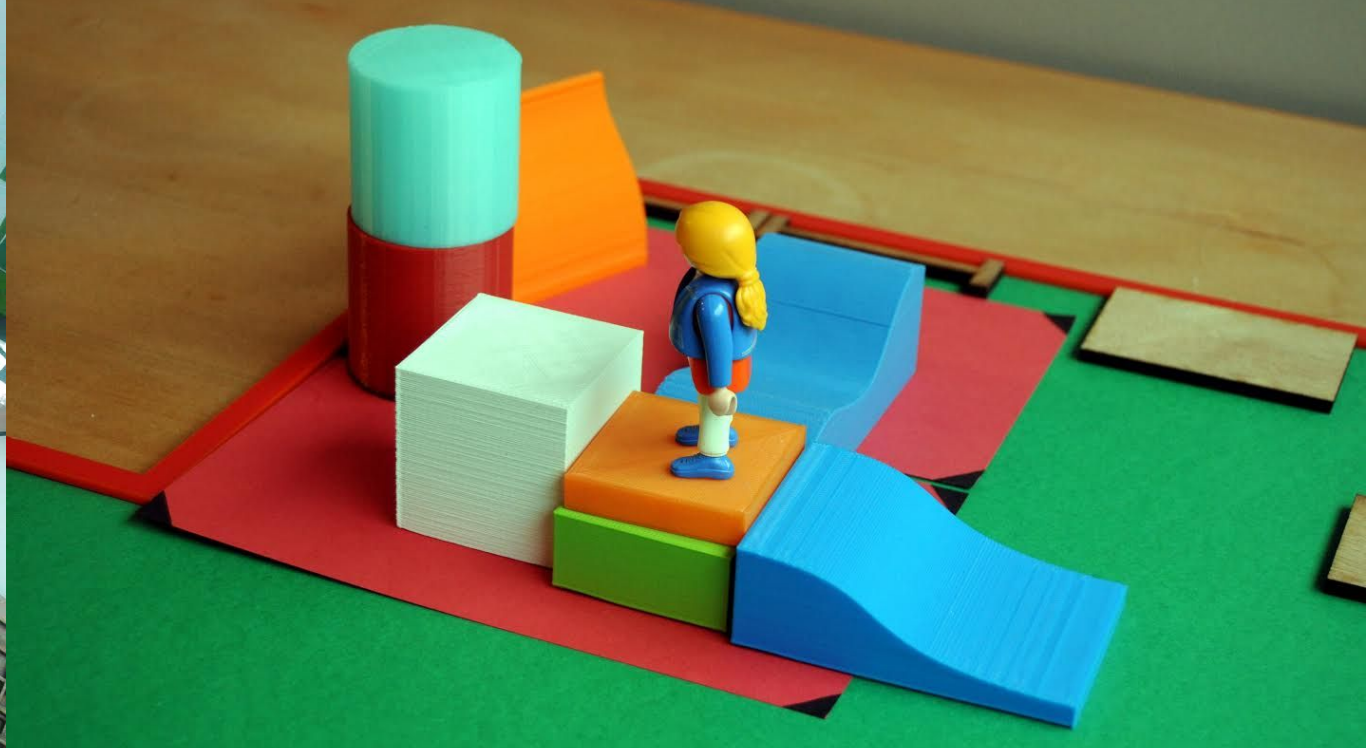
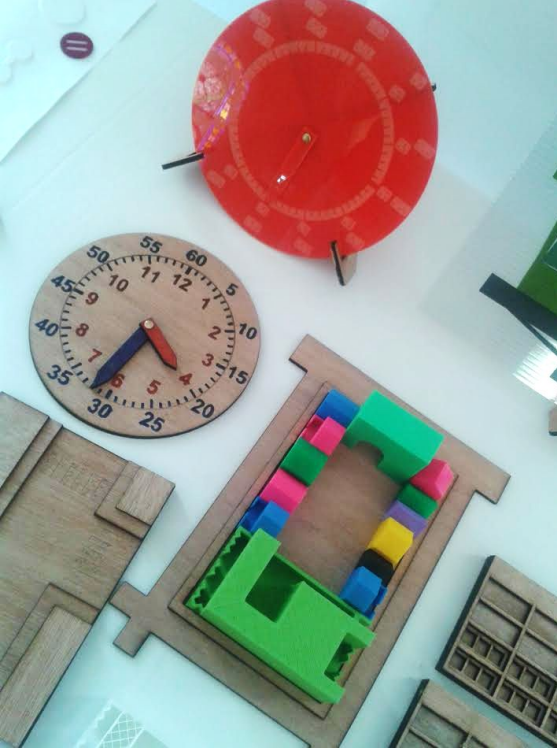
- 1.** Most adaptations are still done manually and locally (in France).
- 2.** Caregivers now deal with the making or modification of technologies.
- 3.** There used to be carpenters to make small scale models etc. This type of production was then limited, until the development of Fablabs.



Small scale model of a
Toulouse's building



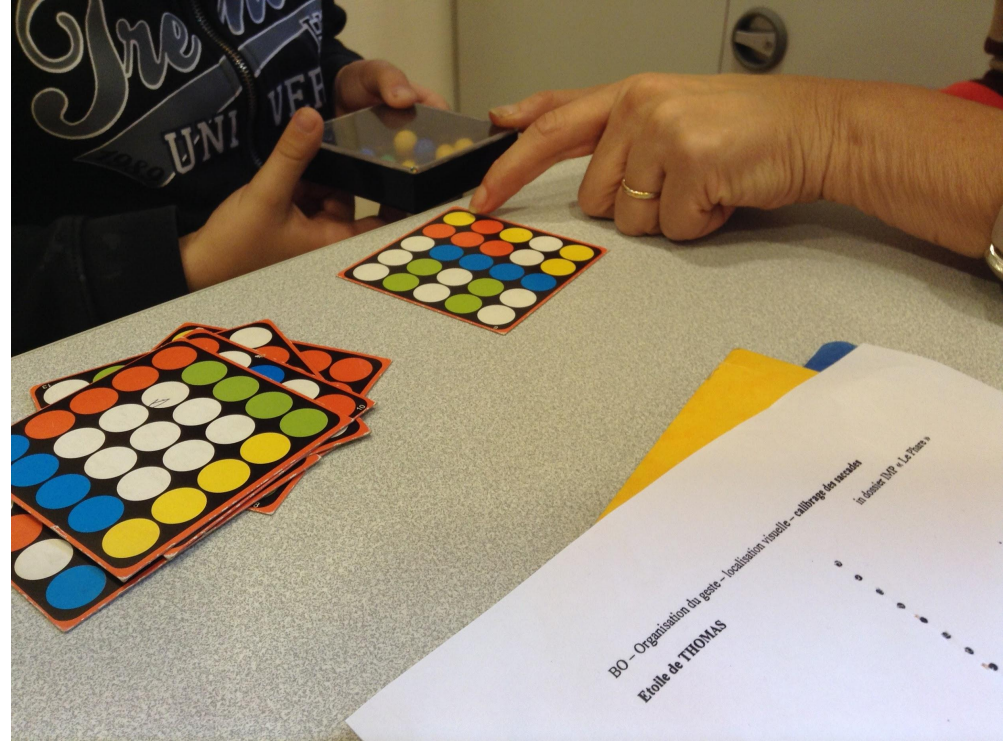
However: There are still many small scale models being used. Caregivers rely on different sources (toys etc.).



What are the types of design interventions made? (I will not cover text enlargement, braille or tactile transcription)

Four types of design interventions on artifacts (Akrich, 1998):

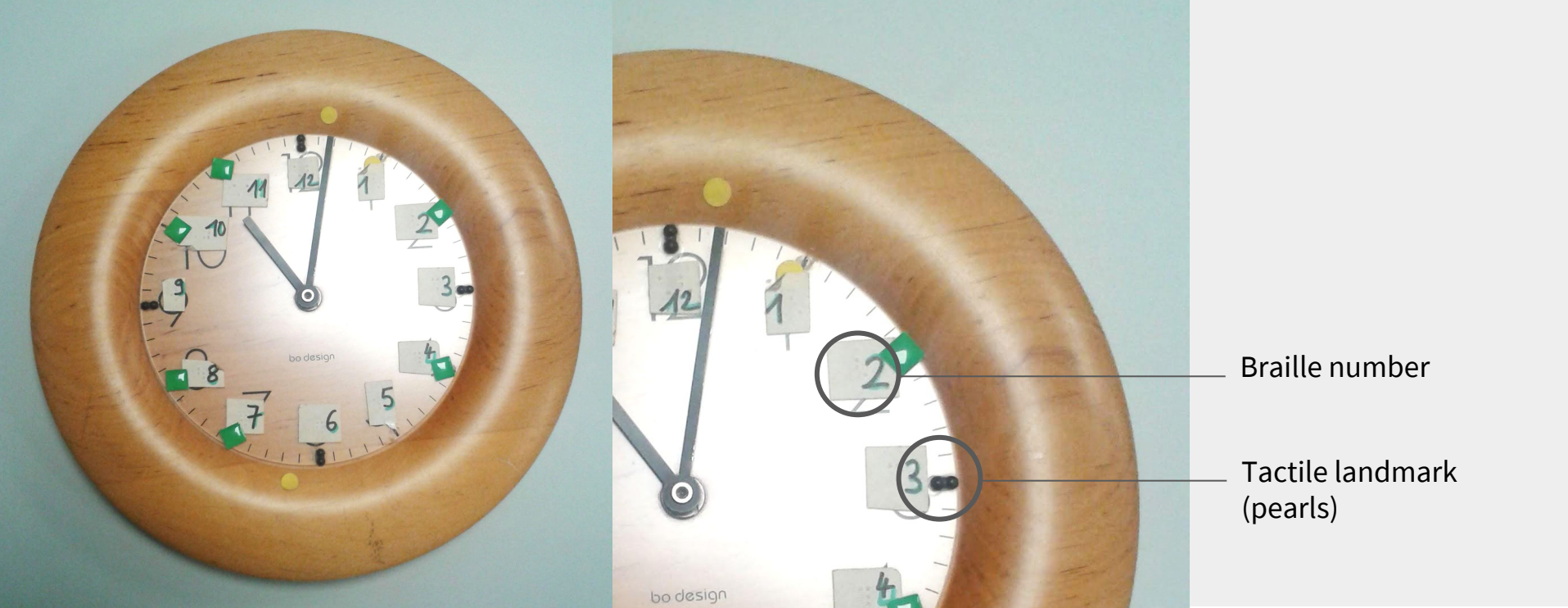
- *displacement* (i.e. modify their uses);
- *adaptation* (i.e. modifications to adapt to the user/environment but does not change the primary function);
- *extension* (i.e. associate them in a new way, to extend their functions);
- *diversion* (i.e. using them for something entirely different from the original use).



Ex: Sold as a toy, used as a therapy tool to develop fine visual coordination.

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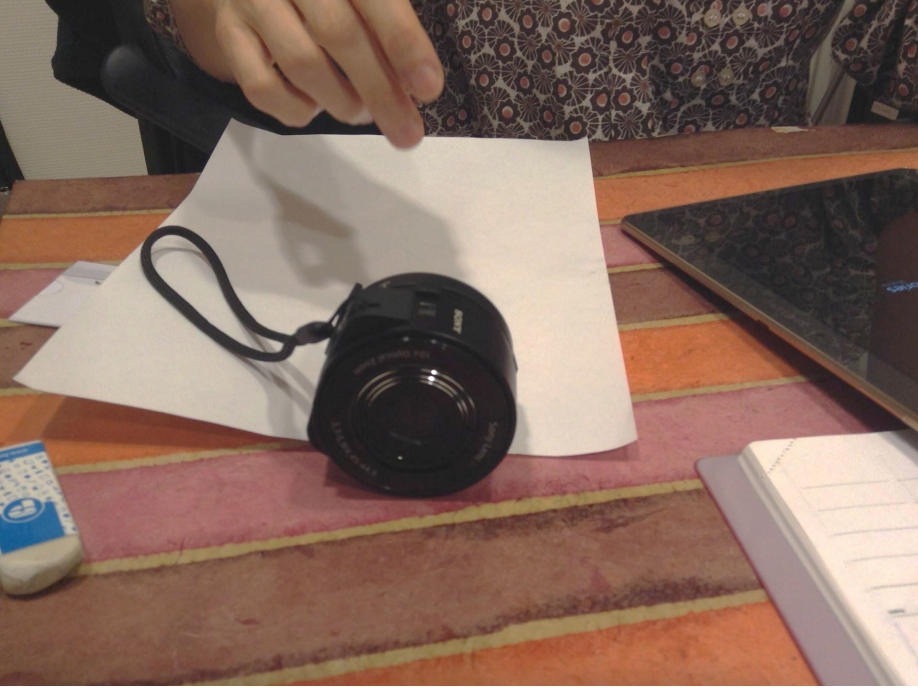
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Ex: a tactile clock, with tactile landmarks and braille numbers

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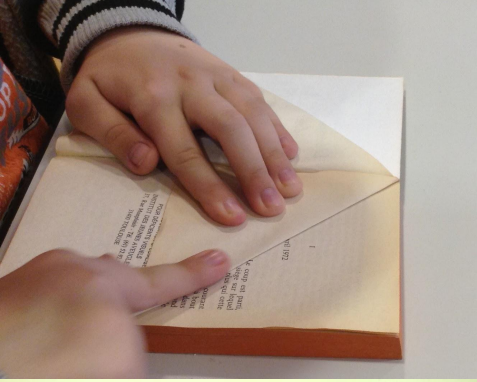
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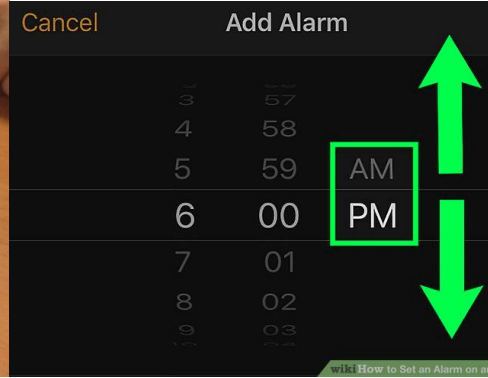
Ex: a camera usually fixed on a smartphone to improve photo quality becomes a white board magnifier when fixed in the classroom and used with the child's device.

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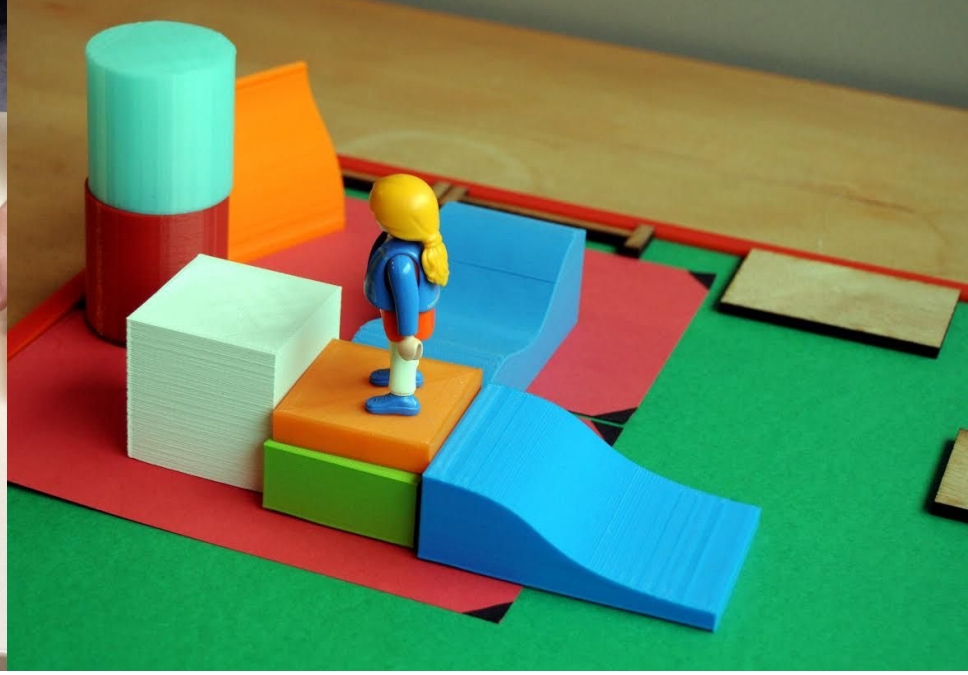
“What if we take the mechanism to choose the time on smartphones, and use it to make a conversion table?”c



Ex: a book to be folded into a tree, pastas to represent cities on a map of France, magnets to make tactile map, using interfaces' elements for a different purpose.



What to make from objects entirely designed by caregivers?



For locally made artifacts, caregivers have developed an implicit knowledge of useful **properties** (e.g. bright and contrasted colors, encourage tactile manipulation etc.)

A dialogue between a document maker and an educator:

“We could make an accessible climbing wall, like, we could use beacon we attach to the climbing grips, and it would make a sound when you pass in front of it.”

“Like, with an infrared thingy?”

“I thought the kids could have a bracelet and it could be bluetooth.”

This applies to interactive artifacts as well.

Why do caregivers build artifacts themselves?

Different and complementary motivations.

- Corresponds to a local need (e.g. map of a specific place) / or contribute to the community and can be shared and reproduced elsewhere;
- It's an interesting challenge, it participates to their training;
- It answers a specific and well-identified pedagogical need and will serve several generations of children within this organization. Contrary to Buehler et al., I've observed more applications than STEM;
- To please a specific group of children.

How do caregivers build artifacts?

- They rely on digital fabrication techniques (laser cutting and 3D printing). Caregivers make the files, the production is often at least partly outsourced;
- Enroll external help for the design and production in particular when it involves coding/electronic (family members, volunteers, PhD students observing their practices);
- They sometimes used libraries of models (e.g. Thingiverse).



What are the limits?

- Simplicity: more complex 3D models need to be outsourced;
- Costs! 5€/30 min of 3D printing means ~ 300€ for a 3D globe;
- There is much more manual post-production than it seems;
- Coding/electronic remains difficult: issues of maintenance and robustness;
- **Their vision of the benefits is not always shared by their superiors.**

Organizational implications

- Possible if, and if only, other aspects of their work is automatized (e.g., the adaptation of school books);
- Needs to be justified in measurable results (e.g. academic improvements), difficult to do if it is “only” to improve children’ experience of the classroom;
- There are attempts to make this knowledge explicit.

Knowledge management around Fablabs and technologies

- A small group of interested caregivers;
- One person, a document-maker became the treasure's guardian, and centralizes all prototypes and resources.
- No formal training to use the software, short training to use the digital fabrication tools;
- Different modalities to share this knowledge.

Different modalities to share this knowledge

- Locally, by doing Fablabs group visits, during informal discussions etc.;
- Discussion with teachers to understand sense-making processes and refine the choice of projects to be undertaken;
- Through the professional network:
 - A file that serves as a catalogue, shared with professional networks (<http://gpeaa.fr/n-243-voyage-a-travers-la-3d-juin-2017/>). It describes the **properties** of the objects;
 - By teaching to future document makers;
- Propositions to recense objects in an online library catalog.

This is a community of practice (Wenger, 1998):

- Mutual Engagement: Firstly, through participation in the community, members establish norms and build collaborative relationships; this is termed mutual engagement. These relationships are the ties that bind the members of the community together as a social entity.
- Joint Enterprise: Secondly, through their interactions, they create a shared understanding of what binds them together; this is termed the joint enterprise. The joint enterprise is (re)negotiated by its members and is sometimes referred to as the 'domain' of the community.
- Shared Repertoire: Finally, as part of its practice, the community produces a set of communal resources, which is termed their shared repertoire; this is used in the pursuit of their joint enterprise and can include both literal and symbolic meanings.

Thank you!

Any questions?

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Caregivers develop an implicit knowledge of material properties that can be used to develop adapted educational material and assistive technologies;

Digital technologies (3D printing, laser cutting) can be used in almost every school discipline for children with visual impairments;

Whereas physical properties (colors, tactile landmarks etc.) are “easy” to transfer, caregivers encounter difficulties when it comes to interactive devices, which are not solved by existing vulgarisation tools;

For now, these practices develop within a community of practice, in parallel with official organization.

