Tinkering EU: Addressing the Adults

Exploring Tinkering with adult learners: What we learned

A guide for museums and other informal learning and science engagement organizations

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The project

Tinkering EU: Addressing the Adults explores the potential of the Tinkering approach when working *with* and *for* adults in vulnerable situations. It aims to increase engagement with science, especially amongst those who believe that "Science is not for me"; and to build on the Science Capital and the 21st century skills of adult learners. To do so, the project focuses on *Equity and Inclusion* and uses Tinkering as an inclusive learning approach to STEM engagement. We have embraced the concept of 'allyship' whereby partners sought to create meaningful experiences with and for the participants. A key part was working in partnership with local community development organisations who helped us actively listen to, learn from, and become more representative of the participants, increasing the potential impact of each local project in relation to social inclusion. Tinkering activity design and facilitation methods were tweaked to create personally meaningful, inspiring and engaging learning experiences to help develop individuals' engagement and confidence with STEM.
http://www.museoscienza.it/tinkering-eu3/

Tinkering with tinkering

This project has come a long way, it is the third in a row: we started with **Tinkering: Contemporary Education for Innovators of Tomorrow** (2014-2017) by exploring Tinkering as pedagogy to discover the power of "becoming one with what I am doing"[1]; moved on **Tinkering EU: Building Science Capital for ALL** (2017-2020) that connected Tinkering with Science Capital as a way to address and engage all learners; while **Tinkering EU: Addressing the adults**, being true to the pedagogy, wants to support adults to develop a tinkering mindset – both learners and those who are responsible for someone else's thinking and learning experience. We often found ourselves exploring and reflecting on the intersection of 'Tinkering' (with capital T) – that is, the set of activities designed by the Tinkering Studio and the first Tinkering EU project, which built on the Learning Dimensions – and 'tinkering' as an attitude characterizing a whole range of experiences that promote open-ended creative explorations as a way to create what Edith Ackermann called "a conversation with the material"[2], to build one's own relationship to learning itself, and one's own meaning from the engagement with STEM.

The resource: what it is and how to navigate

This document gathers the ultimate reflections from the project partners. It comprises an agile tool for those interested in exploring the potential of Tinkering for inclusive learning and engagement. It presents lessons learned about:
- co-design and development of activities with local communities as a way to create equitable and inclusive spaces and experiences
- the core elements that helped shape the relationship with the communities (from knowing each other, to co-designing, to testing and implementation)
- the contribution of the project to institutional change at wider level through the reflective cases.

The 'Map of Equity and Inclusion through Tinkering Activities' summarises the ways the activities can be considered equitable and inclusive under four themes: *Upskilling, Personal Narrative and Expression, Connections to Everyday Life* and *Approach*. Each box contains reflections on the activities designed by different partners. In addition, links to additional resources, accessible and usable independently one from the other, facilitate deeper dives into the different concepts and processes. By clicking on the partner's name, you can access reflections from the partners about creating longer term impact and institutional change; by clicking on the activity title, you can access the process undertaken by each partner for the development of the activity (from the beginning of the collaboration to production) that supports Equity and Inclusion. These materials are based on interviews carried out with the museum practitioners who tinkered with Tinkering. They summarise theoretical and practical learning emerging from each community-based project that is cascading into wider organisational practice. We hope these practical examples and reflections provide insights and inspiration for science centre and museum practitioners who are considering developing these sorts of approaches to help create more equitable STEM experiences for adult learners in their own organisations.

1   Papert, S., (2000), '*What's the big idea? Toward a pedagogy of idea power*', IBM Systems Journal, 39(3-4) 720-729.
2   Ackermann, E., (2011) 'The craftman, the trickster and the poet. Re-souling the rational mind', MIT. **https://mit.academia.edu/EdithAckermann**

Map of inclusion through Tinkering activities

Learning to program through playful exploration helped make technology more accessible.

Send a message
NEMO Science Museum

Using familiar materials to prompt the exploration of less familiar ones contributed to understanding STEM-oriented contents.

Interweaving
NEMO Science Museum

Developing skills in designing and building things made adults feel valued.

Building cardboard furniture
Copernicus Science Center

Using familiar elements (sounds and noises) contributed to strengthen self-esteem and the development of emotional intelligence.

Tinkering with sound
TRACES

Bringing one's own meaningful objects into the Tinkering process helped create a space for personal storytelling, personalise the experience and reaffirm personal identities.

Chain Reaction and **Light Play**
Museo Nazionale Scienza e Tecnologia Leonardo da Vinci

Artifacts were a way to say something about oneself (a story, a wish, a dream) and became contexts for personal expression.

Send a message
NEMO Science Museum

Wishcard
ScienceCenter-Netzwerk

Helping emerge the richness and diversity of the historical and cultural backgrounds of the participants contributed to reinforce intercultural dialogue and exchange.

Dyeing with natural materials
ScienceCenter-Netzwerk

Revising activities under the light of the current situation (pandemic, working/learning from home etc.) can increase their appeal for adult learners.

Building cardboard furniture and **Home garden**
Copernicus Science Center

Building on the language aspect of the activity contributed to the development of self-confidence in using and mastering language for not native speakers.

Wishcard and Dyeing with natural materials
ScienceCenter-Netzwerk

Exploring technology and electronic-oriented contents and using creative exploration and expression through art helped build skills potentially useful for the labour market.

Dismantling and **merging electronic toys**
TRACES

1 UPSKILLING

2 PERSONAL NARRATIVE AND EXPRESSION: creating a sense of belonging

Use and exploration of the senses contributed to developing emotional thinking.

Tinkering with sound
TRACES

Using complexification - from the "simpler" exploration to a more complex engagement with stuff - created a context of progressive confidence to address STEM-oriented contents.

Dismantling and merging electronic toys
TRACES

Learning how to program helped build self-confidence and inter-personal skills.

Send a message
NEMO Science Museum

Technology was used as a means and a context for personal expression and meaningful making.

Send a message
NEMO Science Museum

Being sensitive towards the adult learners' wishes to express themselves in writing and to create unique designs.

Wishcard
ScienceCenter-Netzwerk

Sharing and exchanging ideas and processes of work encouraged and reinforced personal identity and a sense of belonging to the group.

Send a message
NEMO Science Museum

Promoting tailor-made experiences can increase the attractivity of the activities.

Building cardboard furniture
Copernicus Science Center

Promoting equitable and inclusive engagement with science for disadvantaged adults through...

Meetings during the design and development process helped build trust and to identify participants' interests, prior knowledge and experiences.

Dyeing with natural materials
ScienceCenter-Netzwerk

Listening to the needs of adult learners helped build an authentically tailor-made activity.

Building cardboard forniture
Copernicus Science Center

Chain Reaction and Light Play
Museo Nazionale Scienza e Tecnologia Leonardo da Vinci

Engaging artists attributed an additional importance to the experience and to the work done.

Interweaving
NEMO Science Museum

Personal agency in the choice of how to approach the exploration of STEM-oriented topics helped create a more interest-driven and solid bond with contents.

Dismantling and merging electronic toys
TRACES

4 APPROACH in engaging and in facilitating new roles and collaboration

3 CONNECTIONS TO EVERYDAY LIFE

Having a low threshold increases the replicability of the activity in other contexts and encourages participants to repeat it themselves at home.

Interweaving
NEMO Science Museum

The topic was chosen with the intention to provide participants with a meaningful experience and the opportunity to 'enter' the activity with no need for pre-acquired knowledge.

Building cardboard furniture
Copernicus Science Center

The opportunity to bring and add personal objects into what participants create reinforced the links with their everyday life.

Light Play and **Chain Reaction**
Museo Nazionale Scienza e Tecnologia Leonardo da Vinci

To establish a relevant bond with the participants, it is important to acknowledge and to rely on community leaders' expertise.

Send a message Interweaving
NEMO Science Museum

Creating a situation of continuous exchange between those who participate and those who facilitate means that the usual hierarchies - facilitator vs participant/learner - are not only challenged but not applied at all.

Dyeing with natural materials
ScienceCenter-Netzwerk

Choosing a topic that resonates with the participants' experience realm can be a means to introduce STEM-oriented contents.

Dyeing with natural materials
ScienceCenter-Netzwerk

Both process and end product became the contexts for participants to integrate 'techniques' they already knew.

Dyeing with natural materials
ScienceCenter-Netzwerk

Reflections

NEMO Science Museum

NEMO science centre on building close ties with community leaders and embedding community-led practice for developing adult STEM programming

We have really been on a journey with this project and have gained so much useful experience and learning for building ties with our wider community and how to work with groups that are currently underserved by NEMO. Our initial engagement with our community groups was hard. It took a long time to connect with the right people in the organisation who could translate what we were offering and see the value it could bring. After the initial online training, we were concerned that the partners may not want to continue with us. They told us that they did not know if it could be a good fit for them. We reflected that maybe it was because the training had been online, necessitated by the pandemic. But we kept going. We knew it was not going to be an easy path and we were committed. We really wanted it to work. We worked together more to discuss tinkering, to discuss ideas. We made sure we were really giving the community groups room to talk about what they wanted and needed, and to give them room to see how seriously we were taking it. In that way we really developed together. We then did another workshop with the community group staff, which included colleagues from our Education team. In this workshop the community leaders really began

to visualise the value that tinkering could bring for the adults they worked with. But it wasn't this single workshop that made the difference. It was the whole journey – from that initial online workshop, through the many discussions we had by video call, over email and then the further workshops we ran between our staff and their staff. A further catalyst was the close relationship developed between staff members, particularly an intern at one of the organisations who was able to influence up and inspire her director to see the value. It was like all the jigsaw pieces came together as we progressed through this learning journey together.

If were to offer up any advice for others wanting to work in this way, it is to really invest the time in building relationships. This is hard. When we reflect on the organisations we worked with, all of them saw staff leaving regularly. Then you start all over again with building those relationships. You lose expertise inside the organisations. And, of course, community organisations work so differently. Whilst we have strict programming timings and schedules, these organisations do not and cannot work like this. So being flexible and adapting to their ways of working is a real challenge. But a necessary one. The project has really influenced our process for how we work with groups like this. We now see how much rich activity needs to happen at the front end. And it really helps now that we have these examples. When we talk to other community groups, we have had
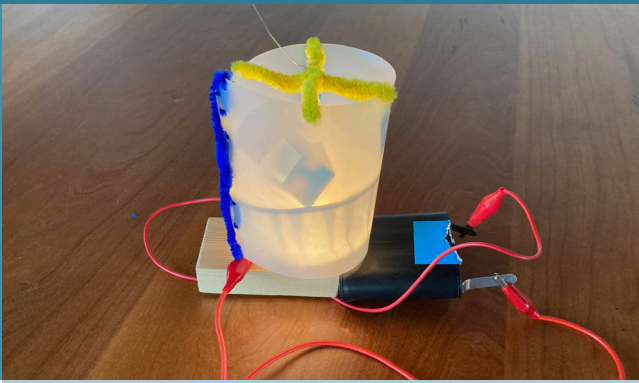
Working closely with the community leaders has taught us it really takes time to make sure you are speaking the same language. You need to take time to build the connection and the 'click' so that they understand what you want, and you understand what they want. If that is not there, there is no ground to do this kind of project.

these positive examples from three community partners with demonstrable success and real impact. This is so important for stakeholders and funders too. They want to hear from the community, not from us. And now we have these examples we can really demonstrate the impact as well as a process that works.

From the outset of the project we knew we must strive not be tokenistic. We hope we were clear from the beginning that we wanted the community organisations to benefit in ways that they needed. We have ended up putting a lot of extra effort into our work with these groups - beyond the funds of the project. We have trained their facilitators so they can run their own workshops. We are investing in the relationships so they can continue beyond TinkeringEU3. It is so important that now we have these community partners on board we keep them connected with us. We want to continue this work. Of course, it will be beneficial to the adult participants if they come for an individual workshop, but we want the impact to be sustained. We are trying to find ways to continue to support these organisations. But as a department, we are mainly funded through projects. We do not want this inclusive work to remain at the periphery because it is funded through restricted funds. It is in our museum mission and vision to reach everyone, and we are learning how to do this through projects like this. The mindset we have gained from working on this project is one we will maintain in all our future work. We are now,

in other projects trying to find ways to involve these organisations or think about ways to use this experience in different projects. Critically, we have learned that we need to advocate better internally for working with these groups. If we want to retain the relationship, we need to go on working with them beyond project. Our organisation sees working with these groups as important but given that it is on our vision and mission to be for "all" the people, we need to bring this kind of work to the core of what we do.

Now that we have this experience of working in this way, we need to become the internal organisational champions for being more equitable in what we do and how we work. The learning needs to become more embedded in our core practice. We are really trying to embed this, step by step. We need to become allies for the voices and people that are missed and missing.

Copernicus Science Centre

Copernicus on working with adult learners and their children together and the role of children as mediators in the adult learning process.

We are fortunate to be involved with many different projects here and we work with a lot of partners – some from Warsaw and others from further afield across Poland and internationally. But we are not always able to find or work with a partner who can help us to engage with audiences who do not already know us or visit us. Our work with the community leaders in this project has been very positive and successful in helping to achieve this. We were lucky to find a great partner. We had great contact and communication from the beginning. They engaged fully with the project from the outset and we had a very smooth ride with them. So much so that we are now thinking about further projects that we might work on with them and how we could develop our relationship beyond this European project.

Prior to this project, we had lots of experience of Tinkering itself – we have been programming Tinkering activities here for around a decade now. This means we have lots of experience of creating different formats for Tinkering. But our Tinkering has always been for kids or teens. We had not done anything for adults until this experience. For us this was all incredibly fresh and new. Through the pilot workshops we found out that, for the

adults in our target group, it was very important to them to feel that they were creating something meaningful. They did not want to take part just for fun, to tinker with some nice tools and simple materials to build something which was unnecessary or pointless. They wanted to produce something very practical. This created a challenge for us because building something useful and practical is not really a core principle of Tinkering methodology. It is more of a DIY (do-it-yourself)-style. So we explored this question at the start: how can we create an adult learning experience that retains the essence and learning dimensions of Tinkering with its playful, iterative processes and 'tinkerability,' but which also draws upon the DIY spirit which our target group wanted? I think we managed this through the Tinkering scenarios we developed. We got great feedback from the adults – they were not bored or disappointed. They felt that they could make something useful for their homes, and the tinkering spirit was definitely still there.

A very important part of our learning journey was around the role of the children and the family unit in all of this. We were working with a community organisation who specialises in working with families who are facing socioeconomic disadvantage. We found that bringing the children into the sessions was a very important part of the process for the adults as learners. In the initial pilots we had run the workshops for adults on their own. But when we tried it with the children coming with their

Where our adult learners worked with and alongside their children, as a team, we saw them open up more, become more playful and ultimately more creative in their Tinkering projects.

parents, we found it worked so much better. The children acted as a middleman between ourselves, as facilitators, and the adult learners. The presence of their children gave the adults a reason, or an excuse, if you like to jump straight in. It lowered the barrier. Their perception was that this was a workshop for the children or for them as a family, but we had primarily designed it for the adults. The children helped them to feel comfortable to start tinkering straight away and to enjoy the process. We saw great engagement from the adults – better than the earlier pilots with just the adults. When we invited the children with their parents, we initially planned that we would be entertaining the children while the adults were tinkering. But, during the process, we realised that the adults worked more successfully when they worked with their children to develop things together as a family unit, as a team. And when they did this, the adults were also engaged with the process as learners themselves. When we ran the workshops for just adults, the atmosphere was very serious. It seemed that they didn't want to let go or somehow could not fully open-up. The kids give them the excuse to be more playful and then they ended up having more fun, being more engaged and becoming far more creative. It was interesting to watch the different ways the family 'teams' interacted with each other and how the dynamics played out. For example, in one example a mother came with two very young boys. The mother has no previous experience with tools or tinkering. She jumped straight in because she was keen to create

shelves for toys for her children at home, and she really enjoyed it and created something she was proud of and that she would not have had the confidence to do without that motivation of her children.

This project has given us as an organisation a lot of reflect on. We have never worked in this way with adults and families before. A big insight for us is that we perhaps focus too much on kids and teens and that we don't offer enough targeted programming for the adults outside of our regular exhibitions. I think we have learned a lot about family learning which we will take this forward into our future programme design. We have some future activities planned after the summer break where we hope to be collaborating again with our community partner too.

Museo Nazionale Scienza e Tecnologia Leonardo da Vinci

Museo Nazionale Scienza e Tecnologia Leonardo da Vinci: on moving from 'needs-based' to 'assets-based' thinking for developing inclusive Tinkering programmes for adults

When Covid broke out, TinkeringEU3 was at its beginning. In the aftermath of the initial wave, the first reports[1] of the impact of the pandemic especially on those who were already disadvantaged and on the increase of cases of economic and cultural poverty[2] were released in Italy. Along with them, remarkable experts such as Emily Dawson and Barbara Streicher[3] made their voice be heard even stronger, igniting a disruptive effect on the way museums have conceived their role in contemporary society and, consequently, their very work until then. For us, at the Museum, the pandemic was a true 'no turning back point', an invitation to initiate a journey to revise our practices, programs, projects. As an organization in the Metropolitan Area of Milan, one of the most populated and culturally diverse inhabited areas in Italy, we questioned ourselves: Who do we want to visit our museum? Who do we want to be for? Who do we want to be representative of? Historically, the Museum has been an institution mainly for the middle class, tourists, and school groups. We realised that those individuals most negatively impacted by the pandemic were very likely the same ones who did not know that the 'biggest science museum in Italy' existed

a few metro stops from their boroughs. How to cope with this, especially now, at a time when social justice and community wellbeing are such increasingly and deeply felt concerns? In a historical moment of irreversible changes (i.e. increasing poverty and school drop-out rates, widening digital divide in an increasingly digitally connected world), we realized that we could not go on with our work the same way as before, and with (only) the usual, consolidated types of audiences. All this made us reframe our role in our community.

TinkeringEU3 began in that very moment. It took place while the Museum Education team was also called to work on the same topic through more projects, supported by private organisations and other EU funding programmes, all aimed at helping organisations in reframing their role in the new era. In parallel, persuaded by the importance and sensitivity of the issue, the Museum management chose to create a cross-sectoral team among the staff to participate to a professional development course around Diversity, Equity, Inclusion, Access (DEIA) with the support of a US not-profit expert organization. All this, in just few months, triggered a DEIA-oriented ecosystem of efforts, reflections and initiatives throughout our Museum.

What then of the adult learners we wanted to engage with through our Tinkering project? The Museum staff recognized the 'dual identity' of adult learners – as
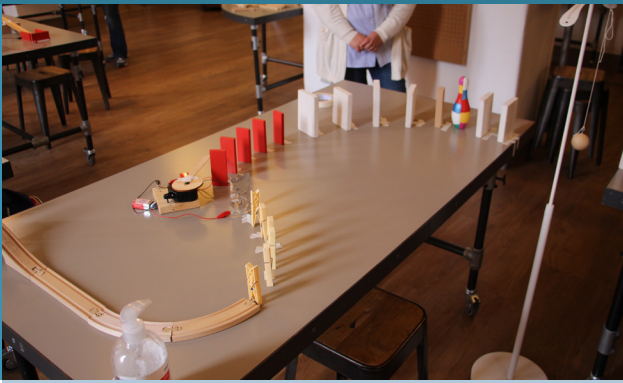
Our participation in TinkeringEU3, and the way that it necessitated approaches to working with adult audiences we had not worked with before, triggered a process of reflecting on the need to completely shift our thinking and practice.

individual learners with the right to nourish their own Science Capital; at the same time, as parents or relatives of children with a critical role to play in nurturing the next generation. Our work around DEIA aligned with our work on adult learning and Tinkering. It led us to recognize that we needed to shift our focus from a needs-based to an assets-based approach. To use an asset-based approach meant to focus on, and value the individual's own assets and potentialities rather than trying to respond to an individual or community need. Such 'needs' are so often assumed or 'guessed' by the party that retains power, and are very much determined by cultural stereotypes and biases. An assets-based approach relies on the idea of power sharing, of creating enough room for people to express themselves with integrity, rather than being seen as 'lacking' in something or, even worse, feeling 'guilty' of not being in the right disposition to do things (in this case, to engage with science). This is not to say, however, that there is no space at all for a needs-based approach. The problem arises when the identification of needs stems from assumptions, stereotypes and bias; or when an organization is moved by a patronizing, crusade-like motivation to 'help' communities ("I am here to solve all your problems"). Assets-based and needs-based approaches might indeed become complementary if both are community-driven and part of a joint reflection.

As our work to engage with the local community partners progressed, we started to understand that in Tinkering using an asset-based approach meant putting our own Tinkering expertise at the service of adult learners. It meant taking a conscious step back from rigorous implementation of the 'known' methodology and being open to 'tinker' with Tinkering. Identifying approaches that respected and valued participants' assets in the context of a Tinkering activity required sensitive adaptations that responded to the situations and experiences of the participants, whilst still conserving the integral qualities and learning dimensions of the Tinkering pedagogy. This meant being open to 'unlearn' the way in which things have always been done. When we presented Tinkering to the community leaders at the start of our collaboration, we made sure to articulate its beneficial qualities, in which we believe strongly. They were particularly interested in its capacity to encourage personal expression and personalization. They felt these were crucial elements that help value the assets of the adult learners. The community leaders reported to us that the adults they work with often don't have time for 'being' individuals outside their everyday duties and to express their identities, backgrounds and personal narratives. This led us to modify existing Tinkering activities that already promote that kind of engagement, in an attempt to create a context that can encourage such thing to occur. The intuition came from the community leaders themselves who communicated the wish to let participants emerge from inside the activities. We decided upon two activities that encourage storytelling
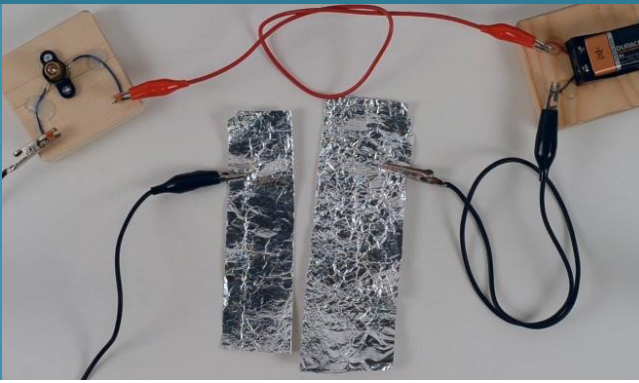
- Chain Reaction[4] and Light Play[5] . To these we added the opportunity for participants to bring and incorporate objects with personal meaning. This was (according to the community leaders and to the Museum staff) a way to create space for greater personal expression: people would have the opportunity to tell something about themselves, hopefully even more than how much Tinkering usually allows.

When we first tested the activities, we reminded participants that they could bring a personal object if they chose to, without specifying the reason. Some did, some did not. It did not matter as it was only a suggestion, and we didn't want people to feel obliged to bring something at all costs (which would have been the opposite of what we were aiming to do). The activity prompt built on that idea: "Try to build something that tells a story: if you like to, and if you have it with you, you can use your object in what you do." The results were quite unpredictable but surprising, in a good way. Some people who brought an object did not use it; but personal identity and expression emerged anyway. People were able to tell their stories with the material available. They found ways to put themselves in their Tinkering artifact. We really saw the emergence of personal narratives either way. And it was a good reminder for us that things might not go as planned, and that the journey to 'achieve' the objective it is not always linear.

The biggest challenges for us in this journey have been opening-up our practice, being ready to share power and to 'unlearn'. A powerful example is the time when one of our community leaders candidly told us that our workshop invitation leaflet for the group was not appropriate, that it might not be appealing, that it did not 'speak' to participants as it should. So she recreated it herself; and this was a good learning curve for us showing that– even if armed with the best intentions – we do not always really speak the same 'language' and that we should unlearn doing things in the way we usually do, to be open to follow other paths and to rely on other expertise.

A big part of our own learning from this experience has been around the need to overcome any fear of this being a threat to our professional expertise. In overcoming the challenges, many new opportunities have arisen. Using Tinkering as an approach impacted positively on the wellbeing of our participants and had a cascading effect - from adults to their children who often joined them on their visits to the Museum to tinker. With its power to engage, Tinkering could, in the long run, help shape a new image of the Museum: rather than being perceived as a place only for few, it could become a place of belonging for all, encouraging them in just 'being' and engaging with science.

1   AA.VV., Riscriviamo il futuro – L'impatto del Coronavirus sulla povertà educativa, Save The Children Italy, May 2020 (available at:
    https://www.savethechildren.it/cosa-facciamo/pubblicazioni/impatto-del-coronavirus-sulla-poverta-educativa)
    AA.VV. Gli italiani e la povertà educativa, a. c. di Con I Bambini e Istituto Demopolis, November 2021 (available at: https://www.conibambini.org/wp-content/uploads/2021/11/Gli-italiani-e-la-poverta-educativa-indagine-Demopolis-18-novembre-2021.pdf)
    AA.VV., Disuguaglianze digitali - Bambini e famiglie tra possibilità di accesso alla rete e dotazioni tecnologiche nelle scuole, a. c. di Openpolis e Con I Bambini, July 2020 (available at: https://www.openpolis.it/wp-content/uploads/2020/07/Disuguaglianze-digitali.pdf)
2   According to UNESCO, cultural poverty constitutes one of the faces of the multidimensional dimension of poverty. It consists in the lack of access to cultural services at wider. It is reported to be growing in the upcoming years especially in urban spaces, affecting among urban youth and other potentially disenfranchised groups. https://en.unesco.org/culture-development/transversal-approaches/poverty-reduction-and-growth
3   Dawson, E., Streicher, B. (2020), Responding to the pandemic: a social justice perspective, in 'Spokes', nr. 63 (available at: https://www.ecsite.eu/activities-and-services/news-and-publications/digital-spokes/issue-63#section=section-indepth&href=/feature/depth/responding-pandemic-social-justice-perspective)
4   https://www.exploratorium.edu/tinkering/projects/chain-reaction
5   https://www.exploratorium.edu/tinkering/projects/light-play

ScienceCenter-Netzwerk

ScienceCenter-Netzwerk on supporting adults to move from learners to facilitators of learning in Tinkering.

From the very beginning of our project, during the codesign phase, our community leaders, gave us feedback that spending a nice afternoon together with their adult learners doing a Tinkering activity and then saying goodbye was not enough. They challenged us to do better, to think harder as to how we could really help their clients in a way that was more sustainable. One of our community leaders was a Tinkerer himself. He would not have called himself that, but he shared stories of living Chicago in the 1980s doing Tinkering in a garage. The result was a toy rat that kind of worked like a yo-yo that he was able to sell on the streets and make money from. On reflection, we can see his history projected through our project. He was very close with his clients, and he suggested that they should make something product-related that they could sell if they wanted to. Making money from Tinkering was not an aim of the project but we tried to think of activities that were more product oriented. For the pilots we had the dying activity which could result in t-shirts, and we did the Wishcards which is also a product that you can take home.

Within the scope and bounds of this project, it was not easy to create repeated encounters with the adult participants. This was compounded by issues brought about by the pandemic. But we discovered that this was not necessarily a block for building constructive, meaningful STEM engagements for many of our participants. One very memorable and moving moment for us was actually when a participant, later in the project, in a Light Play workshop shared with us that, "for you this might seem like just a small workshop, but for me this is a really big thing." He went on to explain how he would have loved to have more opportunities like this in his past, and how much he had benefitted from this workshop. We realised in that moment that, for this participant, this one-off workshop really was enough. But, while we have discovered that for some participants, the one-off workshops were impactful, and 'enough', we are also very grateful that we were pushed to do more by the group leaders. That original challenge to do more, to be more sustainable, to go further led to some unexpected outcomes. In thinking how we needed to go further, we proposed the idea that some of the participants might switch roles to become part of our team. We thought that they could perhaps help us with preparing materials and hosting with us by welcoming people into the space. Perhaps some might even help facilitate the Tinkering. One of the leaders was very open to this idea. When we ran Light Play workshops with more adults from his group, two participants really stood out as being able to do more. One was quite fluent in German and was taking pictures and filming. We learned he was an Instagrammer with a big following in the Arabic community in Vienna.

We would have never thought about going deeper with our participants if our community leaders had not encouraged us in the way they encouraged us from the beginning.

He was streaming the workshop live to his YouTube channel and we thought 'wow, he would be a great facilitator!' The other participant was from Afghanistan and spoke very little German. She was amazingly creative when she did her own Light Play project. She really was an artist. The way she worked with the materials was so inspiring. We asked both if they would like to join us and work with us for the multiplier events a month later. We could not give them a contract of employment because they are refugees, but we were able to thank them in vouchers that they could use in any shop in Vienna. We also gave them certificates detailing the tasks they had undertaken. They both came and facilitated with us four times. Each time, at the end of the workshop, they reflected with us about their experience. They learned so much about facilitation. They really grew and developed new skills in supporting others. They became a link between us and the participants. They were a bridge. Having already completed the workshop as participants themselves meant they were able to explain it all from their personal perspective and that made it easier for the participants to relax and engage. What is also great is that one of the facilitators is still involved with us now. He has supported us with a regular training we now offer for people who are interested in facilitation. We have developed a sustained relationship and we have learned lot on both sides from working together.

This project has really taken us on a journey. We have learned on so many levels. At a basic level we have learned some very practical things for working more inclusively – such as how we now administer paperwork for sessions with community groups in a much more light-touch way. We had the feeling that paperwork created stress, anxiety and disconnection from the beginning. We changed the process by asking participants sign attendance sheets in the middle of the workshop when they were more relaxed. We stopped taking pictures at every workshop, reducing the need for consent forms. Instead, when participants were taking photos themselves, we asked if we could also take some pictures and then handed out the consent form at that point. And, in the end, we removed written questionnaires and collected feedback orally in an informal way. These may seem like small things, but in terms of building trust and making people feel comfortable they made a big difference. Our biggest takeaway from the project though relates to the relationships we formed and what we have learned from the process of co-design. When developing new ways of working with a new audience, you need to work hard to make sure that you are listening to and really hearing the voices of those you want to engage with.

TRACES

WITH THE SUPPORT OF ERASMUS+
PROGRAMME OF THE EUROPEAN UNION

TRACES on developing sustained, meaningful, impactful relationships that support engagement and learning with underserved adult groups

Our work with the young adult learners within the training and integration service during our pilot phase of TinkeringEU3 was very positive. Attendance was actually very good – something that is particularly unpredictable with these young adults who are not in education, work or training. Engagement during the workshops was also much better with Tinkering than it was during more traditional learning activities. What has been a challenge, however, is sustaining the personal relationship with those individual participants over time. As the project developed and we planned our larger-scale event, we hoped that some of the original participants who had been involved in the early development workshops would come along – perhaps to even facilitate or talk to other participants about their experiences. During the pilots, they had expressed a great deal of pride in what they had achieved, and we thought they might come and share. But we found it very hard to reconnect, and they did not attend the larger event. Much of this could be explained by their life situations. The larger event was at a different location and some months after the original engagement. Many things could have changed in terms of their priorities and situations. When working with vulnerable groups, the very different situations that people are in do

make it difficult to sustain relationships over time. In the case of the prison, it was different. They simply could not come out to the larger event. But when we returned to see them, it was clear just how positive the impact of the Tinkering sessions had been. They wanted to re-engage, to reflect on what they had done, and many were keen to do more.

We have only worked with one prison so cannot know to what extend we can truly generalize, but at the beginning we assumed it would be harder than it was to work within the prison environment. We thought we would not be able to bring many materials or tools in at all, but we were very wrong – we could bring a great variety. Everything we knew about prison up to that point had been from popular culture, so there was some apprehension because we knew we did not know this audience well and what they might need. Maybe we would be able to match these needs, maybe not. Maybe the activity we were going to facilitate will be relevant, maybe not. We also did not know what to expect or what we should or shouldn't say or do. But we learned a huge amount and now, we cannot wait to go back. It was a great environment! It was a truly transformative experience for both sides. On the one hand, Tinkering had nothing to do with what we learned about working in a prison environment. We thought that prison would erase the personalities of the prisoners and that we would see people who were shy, disengaged and not wanting to
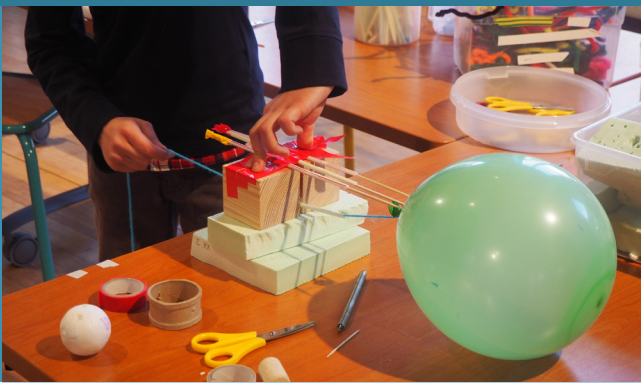
Where we started with little 'real' knowledge of what working with these groups could and would be like, we now feel allied to them. We are actively seeking funds to continue working together beyond the project because it has been such a beneficial and impactful experience for everyone involved – for ourselves, the community leaders and the adult learners.

interact. But we discovered the contrary. We discovered the biggest personalities that we ever interacted with in one group. We think we would have seen this even it if was not Tinkering. But what Tinkering gave was a space for exploration and expression. It was not an activity where we, as facilitators had to say a lot and they had to listen. It was an activity where the participants had a lot of time and space to express themselves. And they really did express themselves. In a less creative and free activity we would probably have seen their personalities a lot less. The Tinkering enabled them to really express themselves and this brought engagement and energy.

A big takeaway for us is understanding the positive impact of the codesign approach on the relationship we have developed with both the leaders and the participants. In each case, the community leaders we worked with were true allies of the participants. By allies, we mean that they were viewed by the participants as 'on their side', as people who they could trust and confide in, and as trusted to represent them. At the integration service, we did not work with the teachers who awarded the grades, but with the facilitators of other workshops. At the prison we did not work with the guards who were responsible for judging and maintaining behavior, but we with the team who were responsible for coordinating the cultural, enrichment activities. By codesigning the activities with these allies – people who had a global view of the participants' situation, perspective and

needs – this made us an ally too. We got a much better understanding of the participants and we could work together with them in more inclusive ways. The trust was built. The power relationship was more equal.

Now that the project is ending, we are actively looking for grants to continue working with each other. We have a very close relationship now and this is almost certainly because we spent so much time codesigning together during one of the lockdowns. And we all really see and understand the huge potential of doing more Tinkering with these adult learners, particularly in the prison. We have applied for three grants since the start of the year to do more. But the public funding bodies do not yet understand the value of Tinkering as a pedagogy for adult learners. It is not in the DNA of prisoner activities to be that open, free and creative. The notion of 'exploration space' is not well-known or understood. But, at some point, we know we will make this work. We are determined to do more as the benefits are so great. What we are discovering is that to work with prisons here, the best way will be to collaborate with existing providers. So we are seeking to partner to try to embed Tinkering into a more traditional existing education, integration or careers programme. Watch this space!

Creating more equitable and inclusive STEM engagement with and through Tinkering learning experiences
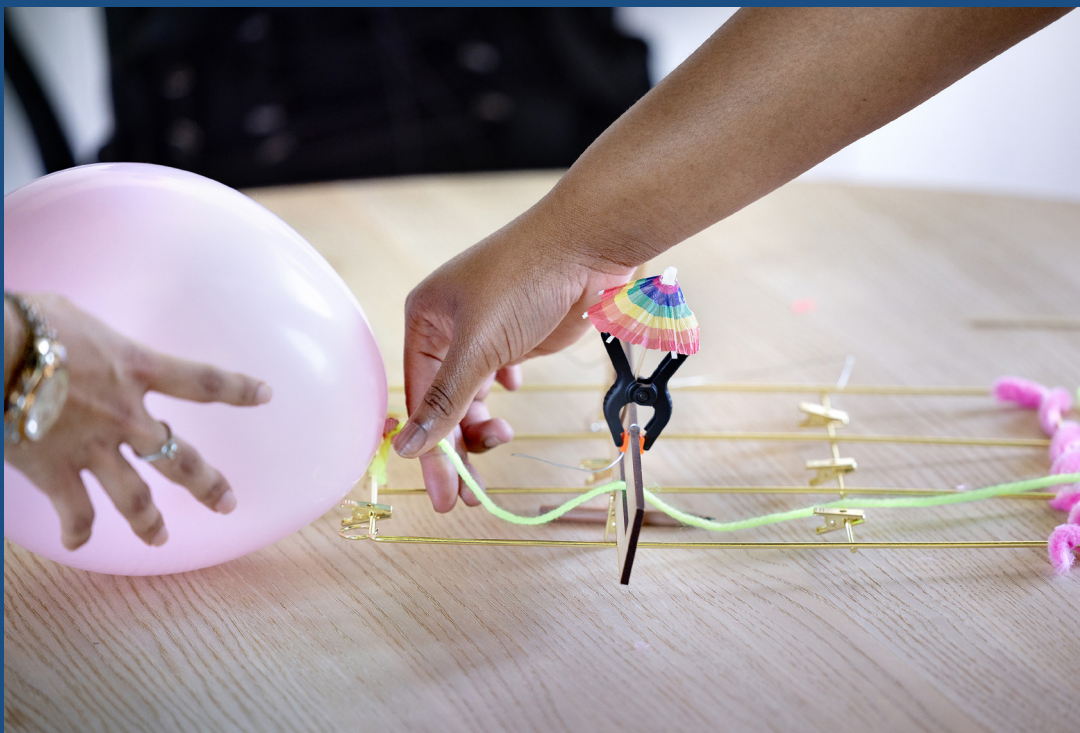
Send a message

NEMO Science Museum

| Title of the activity	Send a message IO2_Tinkering-activity-plans.pdf
Partner designing the activity	NEMO Science Museum https://www.nemosciencemuseum.nl
Associate partner involved in co-creation	Stichting Studiezalen, Amsterdam Tinkersjop, Curacao

How did you and the associated partner(s) come up with this activity? (i.e. which qualities of Tinkering did you want to exploit/enhance? Which reactions did you want to trigger in learners?)

Rather than a co-design process, the approach to activity design implemented with these two associated partners had more of a feedback structure. At the beginning, what we wanted to do and what we could do for them was not clear to the community organisations; during our joint meetings we proposed a few ideas we would have liked to explore, among which designing an activity around computational thinking, programming and Tinkering. They found it interesting especially because, even though important, these were not sufficiently taught in Curacao.

What process did you follow for the co-design and development of the activity? Which choices did you make, and which concepts does this activity rely on?

During the meetings we made proposals, among which creating an activity where tinkering and coding were merged focusing on dedicating time to progressively engage participants before the proper activity; stimulating creativity by showing and exploring diverse perspectives; encouraging the exchange of ideas.

A brief list of possible activities was taken into consideration from both parts including combining coding with little bits, micro bits or other technologies, inventing an interactive story on a virtual pet using Scratch, and creating an animation. The community leaders considered all options and eventually we agreed on the activity we later called 'Send a message with art', in which participants create an artifact incorporating a micro:bit they try to code in a very a very low threshold way to send a message, to communicate something to someone.
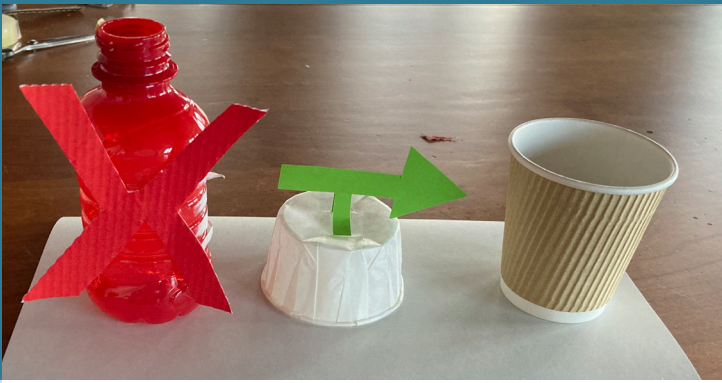
Which specific group of adults did you target?

Stichting Studiezalen is a non-profit organisation in Amsterdam. They reach children, youngsters and adults helping, through a tailor-made approach, with a combination of Life Coaching, homework support and talent development. They do programs for the youngsters as well as for their parents. We have done workshops with both the groups.

Tinkersjop is an organisation in Curaçao that works with families, schools and adults to get them acquainted with STEM and give them the opportunity to develop knowledge and skills. In this case, the target group was diverse in age, but all individuals engaged came from a low economic and social background.

In which sense is this activity inclusive?

- It makes technology accessible in a fun and playful way: at the end of the workshop we always told participants they are now "officially computer programmers" as they learned how to program the microbit with Make.code programming blocks. Even in the cases of participants who did not know how to use the touchpad of a laptop, we ended up with a programmed Microbit.

- It makes it personal: we asked participants to create an artwork that says something about themselves, about something they want to achieve in life, think is important, or something they want to share about their cultural background.

- It empowers people: participants discover that they can program a microbit despite their fear (most of the time) of not being able to learn to do so. They also discovered that sharing something personal or about their individual sphere can be nice; other people simply discovered a new interest.

- It encourages people to share and to be proud of their artifacts: at the end of each activity we took time to discuss the objects they made and because they were 'personal' objects they also had the chance to share something personal with the rest of the group.

Interweaving

NEMO Science Museum

| Title of the activity	Interweaving **IO2_Tinkering-activity-plans.pdf**
Partner designing the activity	**NEMO Science Museum** **https://www.nemosciencemuseum.nl**
Associate partner involved in co-creation	**Vrouwen Vooruit (VV – Women forwards)**

How did you and the associated partner(s) come up with this activity? (i.g. which qualities of Tinkering did you want to exploit/enhance? Which reactions did you want to trigger in learners?)

VV joined the first part of the Tinkering training done by the Tinkering Studio of the Exploratorium[1]. After this, we created a shortlist of possible subjects for the activities. Together with VV we chose the subject and decided the activity we were going to work on. Then, we collaborated to develop ideas, helped and facilitated by the Tinkering Studio. After the trainings this idea was developed further. VV wanted the activity topic to be close to women in terms of their background, interests, and culture. That is why we chose the subject of weaving and called the activity 'interweaving'.

The aim of Vrouwen Vooruit is to empower women from the neighborhood, giving them access to a range of activities and programs. Our aims for the Tinkering activity were to introduce participants to STEM subjects making them realize that this is not necessarily complicated or difficult but has several contact points with daily life; and to invite further talks and discussions through the activity. For these reasons, we really wanted participants to enjoy the activity and to be able to discuss the techniques and which piece of science they used while tinkering with weaving after their activity. VV found that the practical side of the Tinkering activities was complementary to their activities and programs which are largely discursive. We also found that our objectives for working with the target group were complementary and aligned.

What process did you follow for the co-design and development of the activity? Which choices did you make, and which concepts does this activity rely on?

We worked quite closely together and shared every progress on the workshop development
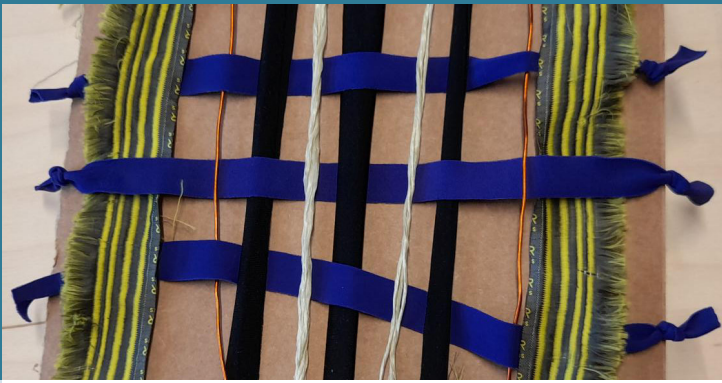
with VV. Each time a new version of the activity was made we discussed it together. We made decisions about the workshop together. We talked a lot about how to build up the workshop in a way that women could feel comfortable and enjoy the experience at its best.

When we develop a new activity at NEMO, we often test it with our colleagues in the office; we did the same in this case and we also invited VV to join this test. This was really a turning point. Until then, VV seemed to be insecure about the outcome of this project - if it would be useful for them. But after the test, the whole thing became more concrete, and they started to believe more in the project itself.

Which specific group of adults did you target?
Vrouwen Vooruit reaches out and supports women, especially immigrant women, from Amsterdam West and surroundings. They encourage them to participate more actively in society, so they can continue to make steps forward in their emancipation, integration and development process. We designed the activity specifically for these women.

In which sense is this activity inclusive?
The reasons why this activity is considerable inclusive are related to:

- **Materials used –** Many of these women are used to working with fabric or sewing, so they are familiar with the materials used and feel at ease and confident in working with them. The materials consisted of both familiar and unusual ones, such as iron wire, plastic, wood etc., which also offered the opportunity to experience working out of their comfort zone if they wanted to.
- **Including an artist –** by including an artist who works with interweaving, the participants felt they were being taking seriously as the specific artist we worked with during the testing phase worked in countries that the participants had roots in.
- **Low threshold –** At the beginning the participants were often a bit confused, wondering what we were asking them to do, what all those materials were, how to use them, and what the link was with science. After 10 minutes everybody had started, through free exploration of materials provided, people overcame frustrations and at the end they had a more concrete idea of the links to STEM.
- **The link to home -** several times participants said: 'oh nice, I want to do this with my kids at home!'. And some also did, taking some materials home. In this way, we reached even more people and the women who participated had the chance to play another role in the family setting.

1 During January 2021, a series of three online workshops held by the Tinkering Studio of The Exploratorium of San Francisco was implemented in the context of the project (C1 Joint Staff Training). These sessions were attended both by representatives of the partner organisations and the community leaders of their associated partners. The aim of the meetings was to deepen the knowledge, or introduce it to the associated partners, of the methodology of Tinkering, experience tinkering (online), learn together on how to reach out to the selected target audiences and if and how to change each organisation's practice. After the sessions, each partner run a Research and Development session with the consultants of The Tinkering Studio, along with the community leaders, to explore concrete ideas on the Tinkering activities to develop within the project.

Home garden

Copernicus Science Centre

| Title of the activity	Home garden **IO2_Tinkering-activity-plans.pdf**
Partner designing the activity	**Copernicus Science Centre** **https://www.kopernik.org.pl/**
Associate partner involved in co-creation	**Fundacja "W sercu matki"** **("In the mother's heart" Foundation)**

How did you and the associated partner(s) come up with this activity? (i.g. which qualities of Tinkering did you want to exploit/enhance? Which reactions did you want to trigger in learners?)

We started preparing our Tinkering scenarios during the pandemic when our target audience – adults with families, were forced to be at home for an extended period. This led to our community leaders suggesting the project should focus on various activities that would be closely related to being and living at home. Also, together with our associated partner we decided we wanted to prepare something meaningful for the participants. Thanks to the participation in the training with the Tinkering Studio[1], our community organisation had the opportunity to explore Tinkering first-hand and really understand what it is about. This experience for the community leaders, and our own prior experiences of Tinkering, led us to reflect together that creating Tinkering scenarios for adults is not simple. During previous workshops carried out at our museum, we had often observed that adults were reluctant to participate in the activities. Therefore, we decided that we should go beyond simple DIY/hands-on fun activities to develop something more relevant and meaningful for our participants.

During the training with the Tinkering Studio, we discussed the idea of incorporating living plants into Tinkering activities. We really wanted to follow this idea because we had never done anything like this before. The local partner also was very interested and willing to do an activity related to gardening, and this also proved to be in line with the interests of the participants (see below).

Initially, it was hard to imagine Tinkering with living plants therefore we chose to focus on inventing and creating racks, holders, stands, planters, and other objects useful to keep plants at home. We prepared seedlings of a range of plants for the workshop so that participants could decide for themselves whether they wanted to grow plants in order to clean the air, to prepare food (using
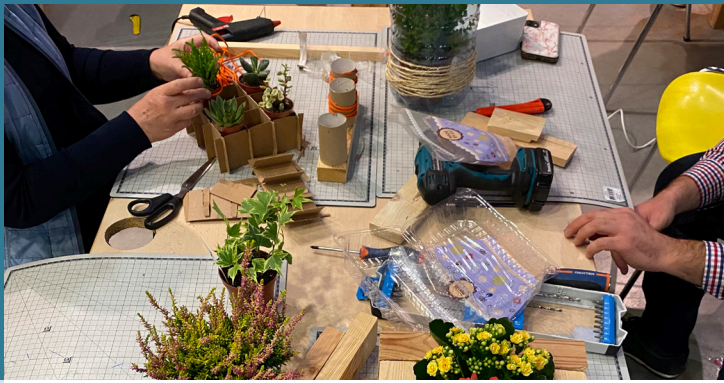
herbs, veggies, small fruits), to create nice-looking green area (e.g. a vertical garden), or to keep low-maintenance living plants (e.g., succulents). During the workshops, participants used simple materials and tools that helped simplify the creation of pots or plant holders.

The pilot testing phase revealed that, for many people, a barrier for keeping plants at home was the lack of a suitable location, a pot or the basic knowledge about plant care. It turned out that besides the typical tinkering aspect of the experience, this activity also encouraged participants to become interested in a new topic and to start an adventure with plants at home. Stimulating curiosity in another field through a Tinkering activity proved to be a very interesting outcome of this whole experience, both for us and the participants.

What process did you follow for the co-design and development of the activity? Which choices did you make, and which concepts does this activity rely on?

From the very beginning of the project, we had a very good relationship and contact with our local community organisation. The Foundation was involved in all the design and development processes that created the Tinkering scenarios. During the co-creation process, we came up with the idea of creating a survey for the Foundation's beneficiaries, to analyze their needs and goals. The survey showed that the partcipants' main areas of interest were interior design, home decorating, home gardening, arts and crafts. This informed our design processes and our decision to develop an activity involving living plants. After quite some iteration around the original idea we reached the final workshop design, which was building and Tinkering with different racks, pots, holders, stands for plants.

Which specific group of adults did you target?

The participants were people under the care of the local Foundation, a broad group that includes people with disabilities or in a difficult financial situation. The mission of this community organisation is to help develop talents and interests in adults and their families. Our main goal was to get them interested in DIY and Tinkering, to show them that Tinkering is not an activity for children, but also an interesting and valuable activity for adults.

In which sense is this activity inclusive?

This activity is inclusive because it does not require sophisticated tools and materials. It involves well-known materials. It has a low-threshold, and the participants have an opportunity to create something that is personally interesting and meaningful.

1 During January 2021, a series of three online workshops held by the Tinkering Studio of The Exploratorium of San Francisco was implemented in the context of the project (C1 Joint Staff Training). These sessions were attended both by representatives of the partner organisations and the community leaders of their associated partners. The aim of the meetings was to deepen the knowledge, or introduce it to the associated partners, of the methodology of Tinkering, experience tinkering (online), learn together on how to reach out to the selected target audiences and if and how to change each organisation's practice. After the sessions, each partner run a Research and Development session with the consultants of The Tinkering Studio, along with the community leaders, to explore concrete ideas on the Tinkering activities to develop within the project.

Building cardboard furniture

Copernicus Science Centre

Tinkering EU: Addressing the adults
Creating more equitable and inclusive STEM engagement with and through Tinkering learning experiences

WITH THE SUPPORT OF ERASMUS+
PROGRAMME OF THE EUROPEAN UNION

Title of the activity	**Building cardboard furniture** **IO2_Tinkering-activity-plans.pdf**
Partner designing the activity	**Copernicus Science Centre** **https://www.kopernik.org.pl/**
Associate partner involved in co-creation	**Fundacja "W sercu matki"** **("In the mother's heart" Foundation)**

How did you and the associated partner(s) come up with this activity? (i.g. which qualities of Tinkering did you want to exploit/enhance? Which reactions did you want to trigger in learners?)

We started preparing our Tinkering scenarios during the pandemic when our target audience – adults with families, were forced to be at home for an extended period. This led to our community leaders suggesting the project should focus on various activities that would be closely related to being and living at home. Also, together with our associated partner we decided we wanted to prepare something meaningful for the participants. Thanks to the participation in the training with the Tinkering Studio[1], our community organisation had the opportunity to explore Tinkering first-hand and really understand what it is about. This experience for the community leaders, and our own prior experiences of Tinkering, led us to reflect together that creating Tinkering scenarios for adults is not simple. During previous workshops carried out at our museum, we had often observed that adults were reluctant to participate in the activities. Therefore, we decided that we should go beyond simple DIY/hands-on fun activities to develop something more relevant and meaningful for our participants.

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The creation of the activity started by exploring the materials, that is, in this case, cardboard. We have a lot of experience in working with this material because it's easy to find and to process and it is widely available. In addition, there is no need to use complex tools to cut and assemble it; the only tools needed are scissors and hot glue. This gives a low entry level so that everyone, even without specialised skills, can start building cardboard structures. On the other hand, cardboard invites the creation of a wide variety of objects, from very small to quite large structures. This makes it an ideal material for tinkering activities, in accordance with the principle: "Low threshold, wide walls and high ceiling".

Then, we started thinking which practical and useful applications could be made from cardboard that would be meaningful for our participants. As mentioned at the beginning, our purpose was to create something related to the home/everyday environment where everyone was spending a lot of time back then. This is how the idea for building small-size furniture (nightstand, small bookshelf, newspaper stand, desk organizer, lampshade, coffee table, etc.) was born. This choice also served technical and practical reasons, so as to allow each participant to build their own small piece of furniture to take home at the end of the workshop.

In addition to the practical aspects, we also wanted to show participants that they are capable themselves of constructing something useful for their own house, tailored to their needs. This activity is not just 'playing around with cardboard' – it results in creating a functioning piece of furniture.

What process did you follow for the co-design and development of the activity? Which choices did you make, and which concepts does this activity rely on?

From the very beginning of the project, we had a very good relationship and contact with our local community organisation. The Foundation was involved in all of the design and development processes aimed at creating the Tinkering scenarios for the adults. During the co-creation process, we came up with the idea of creating a survey for the Foundation's beneficiaries, to analyze their needs and goals. The survey showed that the main areas of interest of our participants were interior design, home decorating, home gardening, arts and crafts. Knowing this, as well as knowing that we wanted to do something using cardboard with a practical aspect, guided the process for designing the workshop theme, tools and processes.

Which specific group of adults did you target?

The participants were the people under the care of the local Foundation, a broad group that includes people with disabilities or in a difficult financial situation. The mission of this community organisation is to help develop talents and interests in adults and their families. Our main goal was to get them interested in DIY and Tinkering, to show them that Tinkering is not an activity for children, but also an interesting and valuable activity for adults.

In which sense is this activity inclusive?

This activity is inclusive because it does not require sophisticated tools and materials and used well-known materials that are cheap and east to get hold of. There is a low-threshold to start the activity, and all the participants have the same opportunities to create something that is personally interesting and meaningful.

Light Play

Museo Nazionale Scienza e Tecnologia Leonardo da Vinci, Milan

WITH THE SUPPORT OF ERASMUS+
PROGRAMME OF THE EUROPEAN UNION

Title of the activity	Light Play **IO2_Tinkering-activity-plans.pdf**
Partner designing the activity	**Museo Nazionale Scienza e Tecnologia Leonardo da Vinci, Milan** **https://www.museoscienza.org/it**
Associate partner involved in co-creation	**PPP – Progetto Parrocchie e Periferie** **(parish-centered association that serves a specific area of the periphery of the Metropolitan City of Milan)** **QuBì Villapizzone** **(local branch of a broader association QuBì active in different areas of Milan)**

How did you and the associated partner(s) come up with this activity? (i.e. which qualities of Tinkering did you want to exploit/enhance? Which reactions did you want to trigger in learners?)

After the initial training of the partners in the themes of the project, the MUST team connected with our associated partners to present the task and ask for feedback. We analysed the Tinkering education provision of the Museum jointly, that is, showed examples of activities usually run with school groups, in teacher training courses and with family audiences in the weekends (Paper circuits; Light play; Marbles machine; Chain reaction; Scribbling machine; Sound stories). We explored each activity in terms of the different potential learning dimensions and skills it could develop or other qualities it might have that could resonate with the participants. Our aim was to match (but not in too strict a way) one activity to one or more quality (problem solving and problem posing, construction-based, humor and whimsy, iteration, personalization, self-directed, personalization, multiple entry points) and to choose the most appropriate activity among the ones available in terms of engagement of adult learners, links with their own backgrounds and everyday lives. In this way, we hoped to increase motivation, participation, and impact[1].

The community leaders were keen on the Light Play activity. Rather than designing a new Tinkering activity, we agreed to modify an existing one to enhance those aspects that could help our purposes, that is, to integrate participants' personal context and create a dimension of personal and individual storytelling (personalization – personal expression).
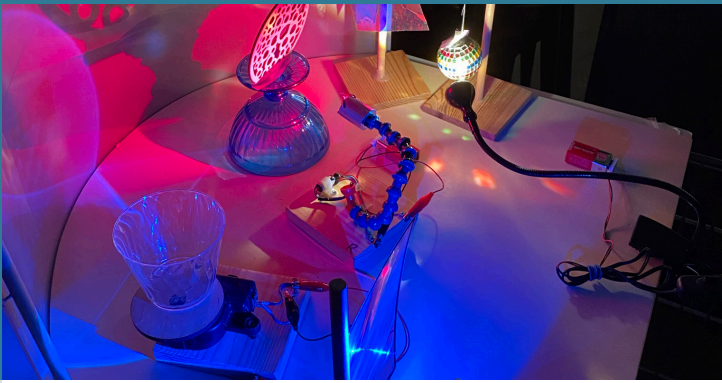
The community leaders felt that an activity run in that way could help the adults to explore storytelling and enter that space of personal creation and expression is lacking in their lives. To reinforce our purpose, we decided to introduce a variation in the activity, that is, ask participants to bring a personally meaningful and relevant object to integrate in the Light Play scenario as to increase the personalization of their experience.

What process did you follow for the co-design and development of the activity? Which choices did you make, and which concepts does this activity rely on?

As said above, the choice of Light Play emerged from the discussion with the community leaders around the impact certain qualities of Tinkering could have on the engagement of the adult learners of their community, and of how much those qualities could meet their own and adult learners' expectations.

The co-creation process ran along with the "let's get to know each other" process.

The first step for this was to set common goals among the Museum staff and community leaders:

1.   Provide the participating adults and their families with opportunities to engage with cultural events and organizations - something they are not used to being part of.
2.   Strengthen the perception of having the possibility to grow, learn and develop even though they live in a difficult context.
3.   Value adults' personal experience within an informal and friendly scenario.
4.   Encourage expression and inspire creative work, to make it personally meaningful and to help develop a sense of belonging.
5.   Tackle the sense of "it's not for me" by providing low threshold and enjoyable STEM-oriented activities.

The second step was the decision (guided by the community leaders' own understanding of the communities they work with) to focus on two elements for which Tinkering could be a real game-changer for those learners and communities: a) valuing adults' personal experience in a friendly scenario; and b) encouraging expression and creative explorations that can be personally meaningful.

The community leaders expressed to us that these adult learners (mainly people with a migratory background, facing situations of economic or social disadvantage) do not have many opportunities to express their identity or personal experiences because they are constantly focused on the needs of their children; that is, to make sure they become well integrated in a new cultural context, proficient in another language, succeed at school, establish new relationships etc. We felt that what the adults needed was a safe space to express themselves and to affirm their personal identity – and this was the starting point that brought us to the "revised" version of the Light Play.

Which specific group of adults did you target?

Both associations embedded in the network of Caritas are active in local/community contexts supporting groups of adults facing different types of disadvantage, most of them with a migratory

background (first or second generation migrants). These adults are involved in activities aiming to develop and foster active citizenship in the periphery, relying on the social function of the parish and its educators. The focus is mainly on families and young people and trying to meet their needs and/by involving them in the civic heed of the suburb.

In which sense is this activity inclusive?
The dimension of storytelling introduced in the activity allowed us to create a safe space for adults to express themselves and to personalise the experience by affirming their identities.

1 For an overview of the Tinkering activities, see here: **https://www.exploratorium.edu/tinkering/projects**

Chain Reaction

Museo Nazionale Scienza e Tecnologia Leonardo da Vinci, Milan

Title of the activity	Chain Reaction **IO2_Tinkering-activity-plans.pdf**
Partner designing the activity	**Museo Nazionale Scienza e Tecnologia Leonardo da Vinci, Milan** **https://www.museoscienza.org/it**
Associate partner involved in co-creation	**PPP – Progetto Parrocchie e Periferie** **(parish-centered association that serves a specific area of the periphery of the Metropolitan City of Milan)** **QuBì Villapizzone** **(local branch of a broader association QuBì active in different areas of Milan)**

How did you and the associated partner(s) come up with this activity? (i.e. which qualities of Tinkering did you want to exploit/enhance? Which reactions did you want to trigger in learners?)

After the initial training of the partners in the themes of the project, the MUST team connected with our associated partners to present the task and ask for feedback. We analysed the Tinkering education provision of the Museum jointly, that is, showed examples of activities usually run with school groups, in teacher training courses and with family audiences in the weekends (Paper circuits; Light play; Marbles machine; Chain reaction; Scribbling machine; Sound stories)[1]. We explored each activity in terms of the different potential learning dimensions and skills it could develop or other qualities it might have that could resonate with the participants. Our aim was to match (but not in too strict a way) one activity to one or more quality (problem solving and problem posing, construction-based, humor and whimsy, iteration, personalization, self-directed, personalization, multiple entry points) and to choose the most appropriate activity among the ones available in terms of engagement of adult learners, links with their own backgrounds and everyday lives. In this way, we hoped to increase motivation, participation, and impact.

The community leaders were keen on the Chain Reaction activity. This meant that, rather than designing a new Tinkering activity, we agreed on modifying an existing one to enhance those aspects that could help our purposes, that is, to integrate participants' personal context and create a dimension of personal and individual storytelling (personalisation – personal expression).
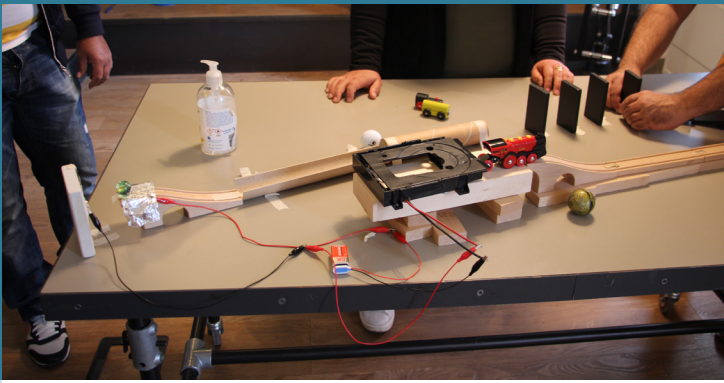
The community leaders felt that an activity run in that way could help the adults explore storytelling and enter that space of personal creation and expression that is often lacking in their lives. To reinforce our purpose, we decided to introduce a variation in the activity, that is, ask participants to bring a personally meaningful and relevant object to integrate into the Chain Reaction scenario so as to increase the personalisation of their experience.

What process did you follow for the co-design and development of the activity? Which choices did you make, and which concepts does this activity rely on?

As said above, the choice of Chain Reaction emerged from the discussion with the community leaders around the impact certain qualities of Tinkering could have on the engagement of the adult learners, of their community, and to what extent those qualities could meet their own and the adult learners' expectations.

The co-creation process ran along with the "let's get to know each other" process. The first step for this was to set common goals among the Museum staff and community leaders:

1. Provide the participating adults and their families with opportunities for engaging with cultural events and organisations - something they are not used to being part of.
2. Strengthen the perception of having the possibility to grow, learn and develop even though they live in a difficult context.
3. Value adults' personal experience within an informal and friendly scenario.
4. Encourage expression and inspire creative work, to create personally meaningful experiences to help develop a sense of belonging.
5. Tackle the sense of "it's not for me" by providing low threshold and enjoyable STEM-oriented activities.

The second step was the decision (guided by the community leaders' own understanding of the communities they work with) to focus on two elements for which Tinkering could be a real game-changer for those learners and communities: a) valuing adults' personal experience in a friendly scenario; and b) encouraging expression and creative explorations that can be personally meaningful.

The community leaders expressed to us that these adult learners (mainly people with a migratory background, facing situations of economic or social disadvantage) do not have many opportunities to express their identity or personal experiences because they are constantly focused on the needs of their children; that is, to make sure they become well integrated in a new cultural context, proficient in another language, succeed at school, establish new relationships etc. We felt that what adults needed was a safe space to express themselves and to affirm their personal identity – and this was the starting point that brought us to the "revised" version of the Chain Reaction.

Which specific group of adults did you target?

Both associations embedded in the network of Caritas are active in local/community contexts supporting groups of adults facing different types of disadvantage, most of them with a migratory background (first or second generation migrants). These adults are involved in activities aiming to

develop and foster active citizenship in the periphery, relying on the social function of the parish and its educators. The focus is mainly on families and young people, trying to meet their needs and/by involving them in the civic heed of the suburb.

In which sense is this activity inclusive?

The dimension of storytelling introduced in the activity allowed us to create a safe space for adults to express themselves and to personalize the experience by affirming their identities.

Wishcard

ScienceCenter-Netzwerk

Title of the activity	**Wishcard** **IO2_Tinkering-activity-plans.pdf**
Partner designing the activity	**ScienceCenter-Netzwerk** **https://www.science-center-net.at/**
Associate partner involved in co-creation	**Peregrina** Peregrina works with disadvantaged migrant women and offers them a variety of educational programs, amongst them German lessons and basic educational programs. **PROSA - Project School for All** PROSA offers a complete schooling program to young refugees in Vienna. Additionally, learners at Prosa are encouraged to exchange and establish connections, via a buddy-system, with local volunteers, such as students, teachers and social workers.

How did you and the associated partner(s) come up with this activity? (i.g. which qualities of Tinkering did you want to exploit/enhance? Which reactions did you want to trigger in learners?)

With both community partners, we scheduled several meetings (most of them online) to select, develop and plan the Tinkering activities, discuss the workshop outline and organize encounters with participants in advance. This was in order to build trust and introduce Tinkering and the activities selected to them.

From the very start, discussions with Peregrina involved thoughts about how to combine Tinkering with language learning & practice and focused on empowerment and building confidence. Discussions with Prosa involved thoughts about how to integrate Tinkering into the science and technology classes, how the activity could result in further discussions in classroom and how Tinkering could build confidence and foster feelings of empowerment.

Both community partners agreed that they wanted their participants to leave the workshop with some kind of product which they could then show to their family and friends or showcase in their classrooms,

in order to create a more sustainable and lasting impression of the workshop. At the same time, it was clear that we wanted to make sure that the main qualities of Tinkering, such as a low threshold to entry and the open-endedness of the process, would still be an integral part of the experience.

Following the input of these collaborative development sessions, we suggested to adapt the existing Tinkering activity 'Paper Circuits'[1]. The idea was to choose an activity that can be very well connected to everyday life and to language learning. Also, Peregrina suggested that we develop an activity with a clear technical component that could challenge the participants, e.g. inviting them to work with new tools.

Giving the existing activity Paper Circuit a twist towards "making a wish" to emphasize the language component was a joint effort during the development sessions. The idea was to create "wishcards" containing a message, e.g. "I wish you happy life". Peregrina also suggested we make a small exhibition with the created wishcards at their course venue.

What process did you follow for the co-design and development of the activity? Which choices did you make, and which concepts does this activity rely on?
In February and March 2021, we organised sessions with our community partners which resulted in the adaptation of the Tinkering activity "paper circuits" to "wishcards".

In order to build trust and motivate the participants to engage with the activities, we organized preliminary sessions at Prosa and Peregrina in preparation of the Tinkering workshops that would happen later on. Our facilitators participated in language classes at Peregrina and in a science and technology class at Prosa to introduce the project and its goals as well as the workshop outline and Tinkering activities chosen for the workshops. At the same time, they tried to learn more about the participants, their prior knowledge, interests, and language skills which then fed into the workshop design and outline.

Which specific group of adults did you target?
Both Peregrina and Prosa work with vulnerable migrant and/or refugee adult groups. While Peregrina is specifically focusing on women (with a broad age range from 20 to over 60 years), Prosa organizes a school program and leisure activities for teenagers and young adults of all genders.

In which sense is this activity inclusive?
The activity can promote the wish to express oneself in written language and create unique designs. The participants are encouraged to use a wide range of materials and tools, many of which are common in nearly every household, such as paper, scissors, buttons and tape, while others are new or unusual to some participants, such as LEDs, copper tape, coin cell batteries and a soldering station. With the material provided, some participants took the activity even further and created little three-dimensional objects such as a miniature chair which was then illuminated by integrating an electric circuit. Thus, the activity allows for flexibility and for participants to create meaningful objects that they can either send to someone they love (Wishcards) and/or take home with them as a reminder of their creative work and the time spent together in the workshop.

Our community partners were able to build on the activity in language learning classes by further elaborating the messages and wishes expressed as part of the postcards.

1 https://www.exploratorium.edu/tinkering/projects/paper-circuits

Dyeing
with natural materials

ScienceCenter-Netzwerk

WITH THE SUPPORT OF ERASMUS+
PROGRAMME OF THE EUROPEAN UNION

Title of the activity	Dyeing with natural materials **IO2_Tinkering-activity-plans.pdf**
Partner designing the activity	**ScienceCenter-Netzwerk** **https://www.science-center-net.at/**
Associate partner involved in co-creation	**Peregrina** Peregrina works with disadvantaged migrant women and offers them a variety of educational programs, amongst them German lessons and basic educational programs. **PROSA - Project School for All** PROSA offers a complete schooling program to young refugees in Vienna. Additionally, learners at Prosa are encouraged to exchange and establish connections, via a buddy-system, with local volunteers, such as students, teachers and social workers.

How did you and the associated partner(s) come up with this activity? (i.g. which qualities of Tinkering did you want to exploit/enhance? Which reactions did you want to trigger in learners?)

With both community partners, we scheduled several meetings (most of them online) to select, develop and plan the Tinkering activities, discuss the workshop outline and organize encounters with participants in advance. This was in order to build trust and introduce Tinkering and the activities selected to them.

From the very start, discussions with Peregrina involved thoughts about how to combine Tinkering with language learning & practice and focused on empowerment and building confidence. Discussions with Prosa involved thoughts about how to integrate Tinkering into the science and technology classes, how the activity could result in further discussions in classroom and how Tinkering could build confidence and foster feelings of empowerment.
Both community partners agreed that they wanted their participants to leave the workshop with some kind of product which they could then show to their family and friends or showcase in their classrooms, in order to create a more sustainable and lasting impression of the workshop. At the same time, it was clear that we wanted to make sure the main qualities of Tinkering, such as

a low threshold to entry and the open-endedness of the process, would still be an integral part of the experience.

Following the input of these collaborative development sessions, we suggested developing a new Tinkering activity around experimenting with natural dyes as well as dyeing techniques. The idea was to invite participants to try various dying techniques like shibori, batik and tie-dye to create their own designs. As some participants would likely already be familiar with the process of dyeing fabric, it might be possible for them to include and share their own techniques. In order to incorporate elements of PH levels and colour theory, the suggestion was to use conventional dyes as well as natural dyes such as hibiscus and turmeric. This idea was very well received by our community partners who felt that an activity around dyeing would feed well into the everyday life experience of their (female) clients and as well as build on their interests, knowledge and skills.

What process did you follow for the co-design and development of the activity? Which choices did you make, and which concepts does this activity rely on?
In February and March 2021, we organized two different sessions with our community partners which resulted in the development of a new Tinkering activity: Dyeing with natural materials.

In order to build trust and motivate the participants to engage with the activities, we organized preliminary sessions at Prosa and Peregrina in preparation of the Tinkering workshops that would happen later. Our facilitators participated in language classes at Peregrina and in a science and technology class at Prosa to introduce the project and its goals as well as the workshop outline and Tinkering activities chosen for the workshops. At the same time, they tried to learn more about the participants, their prior knowledge, interests, and language skills which then fed into the workshop design and outline.

Which specific group of adults did you target?
Both Peregrina and Prosa work with vulnerable migrant and/or refugee adult groups. While Peregrina is specifically focusing on women (with a broad age range, from 20 to over 60 years), Prosa organizes a school program and leisure activities for teenagers and young adults of all genders.

In which sense is this activity inclusive?
1. **Connection with personal background and interest driven activity**: it was very easy to connect the activity with everyday experiences of participants. Many participants have tried dyeing techniques before and can share their methods and techniques within the group.
2. **Sense of belonging**: all around the world people have been dyeing fabric for thousands of years and during the workshop, this rich and diverse historical and cultural background is a great starting point to stimulate intercultural dialogue and exchange.
3. **Continuous exchange between learners and facilitators**: during the small-scale workshops, participants were working side-by-side with the workshop facilitators. Everyone was sharing and learning with and from each other, so the usual hierarchies (here the expert facilitator, there the participant learner) were not simply challenged, they were not actually applicable at all.

Dismantling and merging electronic toys

TRACES

Title of the activity	Dismantling and merging electronic toys **IO2_Tinkering-activity-plans.pdf**
Partner designing the activity	TRACES **https://www.groupe-traces.fr/**
Associate partner involved in co-creation	Probation and Integration Penitentiary Service (PIPS) of the Seine-et-Marne

How did you and the associated partner(s) come up with this activity? (i.g. which qualities of Tinkering did you want to exploit/enhance? Which reactions did you want to trigger in learners?)

The community partner in this case is an 'integration-through-work' facility that helps unemployed young adults nor currently in education or training. This is a target group that needs to better understand their own skills, who have had negative experiences with science and technology education in the past, and who do not regularly attend the activities organized by the facility. The starting point was thus the need to find an activity that could stimulate them to really engage. We thought Tinkering was a good framework to address these needs in several different pedagogical areas:

i) Relating to **skills**: in a Tinkering workshop, everyone starts from their own skills and tests them through a personal journey which can also build skills as the journey develops.

ii) Relating to the **relationship with science and technology**: the aims, objectives and environment can be adapted by the participants - they can freely decide which part of the exploration space they are going to connect with. There is no possibility of failure and no pressure for a specific, pre-defined result or outcome.

iii) Relating to **engagement**: Tinkering invites participants to engage with the activity through a personally meaningful creation which is motivating and brings enjoyment.

The community leader wished for an activity where the participants would test their creative, artistic, project management, electronic and mechanics skills so that the facility could then use those skills and exploit them within a professional orientation project. To achieve this, we adapted a Tinkering activity we had experimented with previously with similar target groups, in which the exploration includes the topics listed above: dismantling and merging parts of electronic toys[1].

Tinkering EU: Addressing the Adults

What process did you follow for the co-design and development of the activity? Which choices did you make, and which concepts does this activity rely on?
The community partners explained the needs they had identified and the questions they had. We helped them 'translate' them into a Tinkering exploration space.

We were afraid all this could be overwhelming for participants, that is, to start with a personal and lengthy project already in first workshop, without having any opportunity, firstly, to understand the framework of Tinkering. We therefore decided, with our community partner, to make the first two first workshops 'one-shot' activities (i.e., activities that standalone and finish at the end of the session):

    iv)   the first session would be on "popping balloons", a simple and accessible activity, inviting participants to explore physical mechanisms by creating a device or chain reaction which can pop a balloon.

    v)   the second session would be the Tinkering Studio's "Scribbling Machines"[2], a slightly more complex activity inviting them to experiment with electronic constructions.

The dismantling of toys project was planned to start during the third session.

We agreed with the community leaders to leave the process for ending the workshops open and not decide beforehand (options were: an exhibition of the objects; a presentation to the group; nothing; participants taking home their creations etc..). We wanted the participants to decide. We gave the participants opportunity to modify the exploration space if they wanted to - for example they could choose how we closed the workshop, they could ask for new material, and they could bring materials to the workshop themselves.

Which specific group of adults did you target?
We worked with unemployed adults who had left formal education before completing their studies. In 2022, the TRACES team also facilitated this workshop with teenagers and young adults who had left school school early without completing their studies.

In which sense is this activity inclusive?
The participants could choose and change the framework during the workshop e.g., asking for different materials, deciding how the creations will be exploited at the end of the series of workshop (presentation, concert, exhibition etc.). There was no pressure for a specific result and no failure was possible. No specific skills were needed to participate in this workshop. Each personal project started from the participant's own skills, building from there.

1 https://www.exploratorium.edu/tinkering/projects/toy-take-apart
2 https://www.exploratorium.edu/tinkering/projects/scribbling-machines

Tinkering with sound

TRACES

| Title of the activity	Tinkering with sound **IO2_Tinkering-activity-plans.pdf**
Partner designing the activity	**TRACES** **https://www.groupe-traces.fr/**
Associate partner involved in co-creation	**Probation and Integration Penitentiary Service (PIPS) of the Seine-et-Marne**

How did you and the associated partner(s) come up with this activity? (i.e. which qualities of Tinkering did you want to exploit/enhance? Which reactions did you want to trigger in learners?)

In 2020, PIPS employees participated in a facilitated Tinkering workshop in prison; then they participated in an online training. They discovered and understood the framework of Tinkering. After that, we met regularly online to co-design a custom-made series of Tinkering workshops for long-term adult inmates.

During these meetings, the community partner explained that their programs for detainees lacked in activities engaging the senses and emotional thinking. They pointed out that exploration of senses and emotion are essential for inmates, because many things that can inhibit their emotional development and understanding:

- People's senses and emotions change and even quench during incarceration. Inmates find they may understand their senses and emotions anymore and they can become be scary and difficult to explore.
- In a closed space where prisoners are locked in together, any personal and emotional expression can become intrusive for others.
- Inmates also lack self-esteem, which leads to emotional self-censorship. In the case of sex-related crime offenders, there is usually another layer of self-censorship because opening-up about one's emotions is not always viewed as a positive thing. In an all-male environment, there can also be taboos around discussing emotions and expressing sensitivity.

Thus, we decided to design a Tinkering activity that would allow the inmates to explore senses and emotional knowledge. Among the things that the PIPS employees reported, was the fact that the prison is a very loud environment so that sound and noise is something that is 'suffered' there
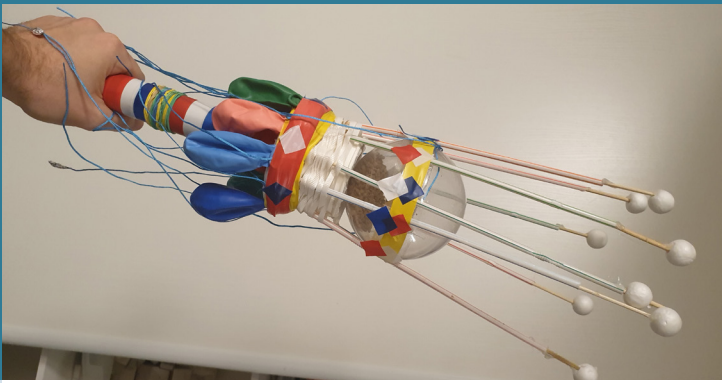
by inmates. For these reasons, we decided to explore sound production - during this workshop participants would choose and actively explore sounds instead of suffering them.

What process did you follow for the co-design and development of the activity? Which choices did you make, and which concepts does this activity rely on?

The community partners explained the needs they had identified and the questions they had. We helped them translate those into a Tinkering exploration space. We knew that for the Tinkering workshop to be more impactful, it should not be a short one-shot activity. We wanted to give the participants time to explore their creativity and emotional knowledge in a deep, rich way and to try, test and create something personally meaningful that they could be proud of. We agreed that they would need at least 6 hours to really achieve this, hence a series of 3 workshops of 2 hours each. We were afraid it could be overwhelming for the participants to directly start a personal and lengthy project from the first workshop, without having time to understand the framework. Hence, we decided with the community leaders that the first workshop would be a one-shot activity during which we would:

- Explore the Tinkering framework with the participants.
- Explore their emotional knowledge by discussing and asking them questions.

When we facilitated this session, the participants skipped this first one-shot activity. It appeared that the communication between the community leaders and the group was very efficient, and the participants had already understood the framework.

We agreed with the community leaders to not decide beforehand how to end the workshops (options were: an exhibition of the objects; a presentation to the group; nothing; participants taking home their creations etc.). We wanted participants to decide. We gave the participants the opportunity to modify the exploration space if they wanted to - for example they could choose how we closed the workshop, they could request new material and they could bring materials to the workshop themselves.

To make it more inclusive, we decided that it was essential that no preliminary skill would be needed to access the exploration space. That is why we chose not to explore music. And this is also why we chose to explore physical sounds and not electronic sounds.

Which specific group of adults did you target?

Adult male inmates in a long-term sentence.

In which sense is this activity inclusive?

It came from needs identified in the target group. The participants could choose and change the framework during the workshop: ask for different materials, decide how the creations will be exploited at the end of the series of workshop (presentation, concert, exhibition, even skipping the first part of the series of workshops that were initially planned). There was no pressure for a specific result, no failure was possible: everyone was free to explore this exploration space personally and in ways that were meaningful for them.