TinkerLib

Co-Designing Inclusive Tinkering Experiences with Adults: A resource for practitioners

2025

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Introduction

The TinkerLib project

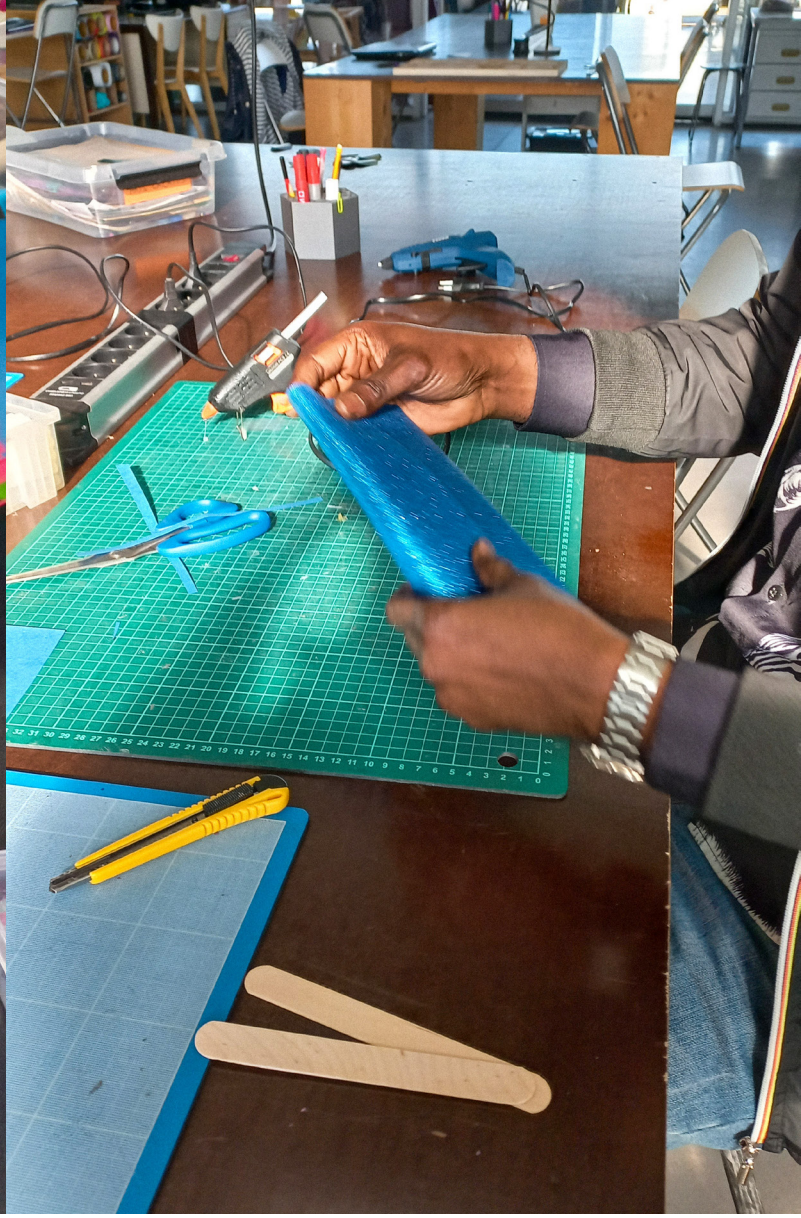
TinkerLib is funded by the Erasmus+ Programme of the European Union and aims to transform museums, science centres and libraries into (more) inclusive, participatory hubs for adult learning. By combining the learning potential of the Tinkering pedagogy with the welcoming and accessible environments of museums and libraries, TinkerLib seeks to engage adults in meaningful learning experiences, with particular attention to those from underserved communities such as migrants, individuals with disabilities or those with low literacy.

The project builds on the tradition of the three previous Erasmus+-funded projects on Tinkering initiated in 2014 with the aspiration to contribute to making STEM learning accessible to all: 1) Tinkering EU: Contemporary Education for Innovators of Tomorrow introduced the Tinkering methodology in a European context; 2) Tinkering EU: Building Science Capital for ALL explored the connection between Tinkering and Science Capital with a specific focus on teachers and students from disadvantaged communities; and 3) Tinkering EU: Addressing the Adults fostered the socio-educational and personal development of adults.

At its core, TinkerLib encouraged collaboration between the 'worlds of books' and the 'worlds of science': libraries, science museums, science centres and other informal learning settings working together locally and across Europe. The project created 5 national hubs consisting in science engagement centres and libraries working together.
This interdisciplinary synergy enabled the development of pedagogical practices rooted in Tinkering, co-design and in STEM-based learning aiming specifically to:

- enhance the skills of informal educators in co-creation and Tinkering.
- develop and test new inclusive STEM learning activities through local hubs.
- enhance the collaboration between libraries and informal science learning settings.
- promote a more inclusive model of cultural participation and lifelong learning.

This 'Methodological Kit' is one of the core deliverables of the project.
It offers a series of methodological reflections and practical guidelines to help learning designers and facilitators replicate and adapt the approach and the activities of TinkerLib in contexts involving adult learners. It has been used as a resource during the local dissemination and training events organised by the partners and is available to be shared with any interested informal education professional or organisation beyond the consortium.



Purpose of the Kit

The kit is designed to serve as both a practical and reflective tool for informal educators, librarians, museum facilitators and other community workers who wish to co-design and implement inclusive Tinkering-based learning experiences with adults. It documents the co-creation processes, the tools and the insights that emerged in the lifetime of the project, offering guidance, practical examples and adaptable methodological suggestions. It aims to help professionals develop safe, engaging and creative learning environments where all adult learners, regardless of their background, can participate, contribute and thrive.

The kit encourages a shift in perspective: seeing participants not as recipients but as co-designers of the Tinkering activities. It supports a model of learning that is relational, flexible and rooted in the values of inclusion and the creative potential of all individuals.
We hope that the kit will be used not only as a manual but as an invitation to reflect on one's practice and will contribute to a growing community of inclusive learning spaces across Europe and beyond.

Structure of the kit

This kit is structured in three main parts, each providing an overview of the key topics explored throughout the TinkerLib project. Drawing on the experiences of the TinkerLib partnership, each section is designed to be both reflective and actionable, offering insights, strategies, and tools to support inclusive learning through Tinkering.

Part 1 outlines the broader educational, institutional, and social context of the project. It introduces Tinkering as a creative and inclusive learning approach rooted in experimentation, iteration, and personal expression. The section explores the evolving role of libraries as accessible, community-oriented spaces for informal and lifelong learning, and highlights the potential of cross-sector collaboration between libraries and science centres. It concludes by framing co-design as a participatory and equity-driven methodology, essential to fostering meaningful engagement with adult learners.

Part 2 focuses on how co-design was implemented across the TinkerLib partnership to create inclusive, community-grounded Tinkering activities. It offers guiding principles and practical strategies, drawing from previous and current project experiences. A set of guidelines supports practitioners in developing and sustaining co-creation. The section also addresses the importance of flexibility, relational work, and two-way learning, and presents three qualitative evaluation tools to assess inclusivity from both practitioner and participant perspectives.

Part 3 synthesises the project's key messages and presents practical recommendations for fostering inclusion through Tinkering. It encourages centering learners' perspectives, building on their strengths, and adapting activities to specific needs. Other key principles include acknowledging power dynamics, promoting emotional engagement, and allowing space for spontaneity.
The section highlights the value of shared ownership and community collaboration, concluding with a call to view each learner as unique and to strengthen local synergies between libraries, museums, and other learning settings.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PART 1

Context and Opportunities

1.1. Tinkering as an Inclusive Pedagogical Approach

Tinkering is a distinctive learning approach rooted in open-ended creative exploration and experimentation (Wilkinson & Petrich, 2014). It draws on several progressive educational traditions, including constructivism, constructionism, inquiry-based learning and creative play, all of which position the learner as an active, creative agent at the centre of the learning process. Rather than following step-by-step instructions or seeking a single correct answer, participants are encouraged to engage with materials, test ideas, build prototypes and adapt their approach through iterative cycles of trial and error (Wilkinson & Petrich, 2014, p. 13). Such a process-oriented approach values curiosity, personal expression and self-directed exploration. Tinkering challenges traditional notions of expertise and perfection by encouraging experimentation and "honouring failed experiments as much as successful ones" (Resnick, 2017, p. 171).

Our experience from the past Tinkering EU projects shows that Tinkering can be particularly effective as an accessible learning strategy for adults from underserved communities (Harris & Winterbottom, 2019). Migrants, adults with disabilities, individuals with low formal education, or those who have faced exclusion in traditional classrooms, carry with them a sense of disconnection or inadequacy related to formal learning environments.

Indeed, it builds on several powerful qualities:

a. The possibility to work through multiple entry points encourages participants to contribute in diverse ways, regardless of language, educational background, or technical skill. Because there is no single correct solution, learners are free to follow their own interests and intuitions, building on what they already know. This makes Tinkering particularly suitable for reaching and engaging adults with fewest opportunities in STEAM (Harris, Ghezzi, Pijer, & Xanthoudaki, 2022).

b. Failure and frustration can be powerful 'strategies', essential moments within a learning process that is iterative, reflective, and creative (Washor & Mojkowsi, 2013), and particularly important for learners who may have internalized the idea that they are "not good at science" or "not smart enough" for certain subjects. In Tinkering, every learner is invited to explore, test, make mistakes, and try again. This fosters confidence, agency, and resilience, as learners experience themselves as capable problem-solvers (Resnick & Rosenbaum, 2013). Also, as Martinez and Stager (2013, p. 70) emphasize, iteration is not synonymous with failure: it is "continuous improvement, keeping what works, and improving what doesn't", a process that is, at its core, authentic learning.

c. The collaborative and informal nature of Tinkering supports conversations among peers, with facilitators and with the materials, within an atmosphere that is intentionally welcoming, playful and

non-hierarchical, allowing for relationships of trust and mutual support to emerge (Resnick & Rosenbaum, 2013). In community-based settings such as libraries, cultural centres or museums, this creates rich opportunities to connect learning with participants' everyday lives, cultures, and aspirations.

Tinkering is more than just a method for delivering STEM-oriented content: it is a powerful tool for democratizing access to learning (Vossoughi, Escudé, & Hooper, 2016). As already discussed in the Tinkering EU3 project (Harris et al., 2019, p. 23), "Tinkering encourages learning through mistakes and failures and in turn helps to develop skills, including resilience, persistence, innovation, inventiveness, determination, creative thinking, self-motivation, problem-solving and divergent thinking. Tinkering equally encourages working with others through collaboration and sharing ideas, as well as listening to feedback and assimilating this into personal strategies for developing and achieving Tinkering project goals. Tinkering therefore provides many opportunities to develop 21st century skills." Tinkering can therefore welcome adults of all backgrounds, eventually contributing to a more fair and inclusive society.

1.2. The Evolving Potential of Libraries as Inclusive Spaces

One of the most innovative aspects of TinkerLib lies in its unique partnership between libraries and informal science education organisations, brought together in local learning hubs across five European countries. This cross-sector collaboration between institutions traditionally focused on words and community, and those focused on STEM learning and engagement opens new gateways for creating more accessible learning contexts. It also represents a significant step forward: while science learning settings often lack the ultra-local reach and social accessibility of libraries, the latter benefit from the experimental, participatory learning expertise of science educators.

Libraries have long stood as some of the most inclusive and democratic institutions in society (Ashraf, 2018). Unlike many educational or cultural settings that carry social or structural barriers, libraries have consistently prioritized free and equitable access to knowledge, resources and public space (Jaeger, Taylor & Gorham, 2015).
This commitment is especially visible in their historic relationship with people with disabilities: libraries in the United States, for example, were already offering accessible materials (such as Braille books and talking records) as early as the mid-1800s, long before similar rights were widely recognized in public education or policy frameworks (Jeager, Wentz & Bertot, 2015).

From early lending services for visually impaired readers to today's use of assistive digital technologies, libraries have actively worked to include people with diverse physical, sensory, cognitive and linguistic needs.

Their mission of universal access is embedded in professional standards, building design, staff training and the integration of technology (Jaeger, Taylor, & Gorham, 2015).
This deeply rooted culture of inclusion makes libraries not only legally accessible, but also socially and pedagogically inclusive, inviting for curiosity, learning and participation.

A key framework for understanding this inclusive potential can be found in the "Four Spaces Model" developed in Denmark to describe how modern libraries should be recognized for their role in:

1. inspiring, by providing emotional and aesthetic experiences to spark curiosity and motivate exploration.
2. learning, through informal and self-paced knowledge-building to enable exploration with tools and ideas.
3. becoming "third spaces" of community interaction to cultivate collaboration and mutual support.
4. enabling users to create and share their own cultural outputs to allow for sharing, storytelling, and recognition (Jochumsen, Rasmussen, & Skot-Hansen, 2012, pp. 588-594).

These four roles overlap and adapt across physical and digital formats, shaping how libraries engage diverse audiences.
Their interplay makes libraries exceptionally suited to support inclusive co-creation processes, such as those fostered by Tinkering.

Today, libraries are actively repositioning themselves as agents of social transformation. As highlighted by Ashraf (2018), libraries are increasingly taking on roles that extend far

beyond providing information. In many parts of the world, they have become community anchors that promote inclusion, equality and empowerment, particularly among disadvantaged and marginalized populations. They support literacy, lifelong learning, civic participation, health education, refugee integration and digital access (Jaeger, Taylor & Gorham, 2015). Libraries not only welcome diverse communities, but also actively design with and for them, co-creating meaningful responses to local needs.

This participatory, justice-oriented and collaborative approach, combined with an established culture of accessibility makes libraries ideal spaces for implementing both Tinkering approach and activities, especially those aimed at adult learners from underserved communities.

1.3. Building Synergies: Science Engagement Settings and Libraries as Co-Creative Spaces

In recent years, STEM education institutions such as museums and science centres have been reinforcing their role as social agents fostering more accessible, participatory and learner-oriented approaches (Crooke, 2006; Simon, 2010; Falk & Dierking, 2013). This evolution is visible in the emergence of practices such as co-curation, citizen science, participatory exhibitions, and the development of maker spaces and creative exploration labs within museum environments (Bell, Lewenstein, Shouse & Feder, 2009). It appears as a conscious effort to democratize access to science and culture, and to encourage visitors to "feel like the owners of their experiences" (Simon, 2010, p. 38).

This transformation can be seen to be well underway; nevertheless, institutions often face challenges when it comes to fully realizing this vision in practice, especially in engaging adults, and even more those from underserved communities. Structural barriers, such as language, educational background or physical constraints, can still influence participation and engagement. In this context, building authentic and sustained relationships with local communities becomes an important step toward making these spaces genuinely open and relevant to all (Crooke, 2006; Simon, 2010).
On the other hand, libraries have long embodied these principles. They are among the few cultural spaces where access is not conditional on economic means, prior education or cultural familiarity. Their openness, neutrality and non-commercial

ethos position them as trusted and familiar community anchors, particularly for people who may feel excluded from other public institutions (Jaeger, Taylor, & Gorham, 2015; Ashraf, 2018).

In addition to their long-standing commitment to accessibility and inclusion, equally important is the deep local anchoring of libraries. Embedded in the everyday life of neighbourhoods, they build trust and lasting relationships with residents and community organisations. This makes them highly effective connectors between institutions and audiences, particularly when engaging adults from underserved communities.

In this context, TinkerLib contributes to building a strong synergy among the two organisations drawing on their distinct identity and goals and exploiting their role in learning and society. By working together, the two contribute their respective experience and expertise in the development of learning experiences where experimentation, dialogue and participation can thrive, and a positive relationship with STEM can be built.

These synergies can be the starting point for a long-term effort: to evolve together into local learning hubs, shared spaces where Tinkering becomes a common language for creative exploration and co-creation. Rather than designing for communities, these partnerships encourage designing with them, inviting participants as collaborators from the beginning. This approach builds trust, fosters agency, and ensures that learning experiences are meaningful and relevant.

While models may vary across contexts, the potential is clear: libraries and STEM education institutions can co-create new forms of inclusive cultural participation, grounded in mutual learning, shared resources, and sustained community engagement.

1.4. Co-designing for learning and engagement

Co-design is a collaborative approach to developing learning experiences, during which all stakeholders - educators, cultural institutions and communities - work together to shape the process from start to finish. It moves beyond traditional top-down planning by recognizing the knowledge and lived experience of all contributors, especially those from underrepresented groups (Harris & Winterbottom, 2019).

At its core, co-design is rooted in equity, trust, participation and mutual learning (Fitzpatrick, et al., 2023). It encourages iterative development, shared ownership and responsiveness to diverse needs. Co-design embraces openness and complexity and treats each participant as a creative agent, capable of contributing meaningfully to both the content and structure of learning experiences.

Co-design is distinct from consultation (Harris & Winterbottom, 2019): it is not about asking for feedback on pre-made plans but about creating those plans together (Aswad, Murphy, Fernandez-Rivera, & Boland, 2022). Sutton-Long et al. (2016, p. 3) expressed this concept when referring to the community of people with disabilities by saying: "People with disabilities[1] ... don't need us to tell them what they want, they need us to provide the conditions so they can grow for themselves." This distinction is crucial when working in inclusive education settings, where standard approaches often fail to reflect the realities of marginalized communities and become barriers. In our case, Tinkering promotes open-ended exploration and learning rooted in creativity, experimentation and personal meaning making. Using co-design to develop learning experiences aims to enhance the qualities of Tinkering and ensure that learning contexts and tools are created with the adults they are meant to serve, especially those with fewer opportunities. When communities participate in the creation of learning experiences, they are more likely to engage with them, feel ownership (Aswad, Murphy, Fernandez-Rivera & Boland, 2022), and trust the institutions offering those (Fitzpatrick, et al., 2023).

Co-design can contribute to:

- more relevant and accessible activities, grounded in participants' interests and life experiences.
- stronger relationships between learners and facilitators, based on trust and mutual respect.
- empowerment of adult learners, who see their voices and expertise reflected in the process (Aswad, Murphy, Fernandez-Rivera & Boland, 2022).

For practitioners, co-design can be transformative too. It challenges assumptions, builds empathy and encourages educators to rethink their own practices and institutional norms (Harris & Winterbottom, 2019).

It can help to:

- address barriers to access, including language, cultural relevance, and lack of familiarity with institutional norms.
- share power with community partners and participants, creating shared spaces of negotiation and creativity (Fitzpatrick, et al., 2023).
- experiment with new roles: from content providers to facilitators of collaborative meaning-making.

In TinkerLib, co-design allowed for the emergence of new, context-specific Tinkering activities that would not have existed without direct input from community members. These experiences often revealed local knowledge, cultural references, or social dynamics that enriched the final learning experience. Often, co-design also brought to light specific characteristics, needs, or barriers related to the target audience which educators had not been fully aware of or had underestimated. Adopting co-design offered the opportunity to position libraries and science centres and museums even more as trusted community allies, not only places of knowledge but also places of shared authorship and agency.

Through co-design, partners were able to:

- address barriers to access, including language, cultural relevance, and lack of familiarity with institutional norms.
- share power with community partners and participants, creating shared spaces of negotiation and creativity (Fitzpatrick, et al., 2023).
- experiment with new roles: from content providers to facilitators of collaborative meaning-making.

This was a unique opportunity to reflect on the relevance of shifting practice toward co-creation and civic engagement, positioning libraries and museums as trusted community allies, not only places of knowledge but also places of shared authorship and agency (Simon, 2010).

1.The paper uses the term "people with disabilities" in alignment with its focus on service providers within the disability sector. Its language reflects the practical context of disability support services in Australia, while aiming to centre autonomy, dignity, and inclusive participation.

2.See the Activity Kit for concrete examples and insights.


HARIBO
CURE-DENT

PART 2

Co-Designing Inclusive Tinkering Experiences with Adults: Key Insights for Practice

2.1. Adopting Co-design

In TinkerLib, Tinkering and co-design have been the strategies that helped break down barriers for participation, and learn how to better empathize with, understand, and learn from, adult learners and their specific experiences and contexts.
Often with the support of community organisations , libraries, science centres and museums explored ways to support adult learning and engagement.

Partners adopted co-design processes and methods for the development of new Tinkering activities; for this, they built on the legacy of previous Tinkering EU projects, especially on "Tinkering EU3: Addressing the Adults" (2019-1-NL01-KA204-060251) which used co-design with adult learners and their communities as a basis for the development of resources for wider use.

The following guidelines and considerations integrate the results from TinkerLib with recommendations of the previous Tinkering EU projects on the process of co-creating new Tinkering-inspired activities for adult learners. They suggest a possible process of co-design as well as ways to evaluate progress and results.

A) ASK

In TinkerLib, we considered as co-designer any participant involved in such a process, that is the museum educators, the librarians and the members of the diverse communities we worked with.
Our goal was to increase confidence and engagement, to enrich knowledge of all parts, to create new and stronger professional connections, and to be there for and with members of the community through appropriate practices and attitudes.

To create a common ground, start by asking the following crucial questions:

- How can a co-design process help co-designers themselves?
- How can a co-design process help the end-users?
- How can co-design help the wider organisation and/or the wider sector?
- How can we develop deeper and more meaningful relationships with our community?
- How can we build sustainability into the programme so that it can be continued?

B) ACT (TOGETHER)

In TinkerLib, we found important guidance in the final resource of Tinkering EU3, "Adult Learning through Tinkering: a toolkit for informal science learning educators working with disadvantaged and underserved communities", which includes a series of recommendations for practitioners desiring to co-design for Tinkering.
Our experience proved them to be still valid and extremely useful (Harris & Winterbottom, 2019, pp. 21-28):

Don't be afraid to have difficult conversations within your team or organisation from the start.

Central to the success of community-focussed work that bridges informal STEM learning and working with underserved audiences is the motivation and willingness of the organisation to:

- be self-reflective about their current situation in relation to equitable working practices in STEM learning.
- create opportunities that enable a process of change of practice at different levels of the organisation – which could start from the bottom up or the top down.
- learn with and from the community sector through effective partnerships that encourage two-way learning.

Avoid deficit thinking and work from an assets-based approach.

If you are targeting an adult community that you have not worked with before and are underrepresented as visitors to your organisation, avoid making assumptions about their lack of previous participation. There might be barriers that have stood in the way. For example:

- Social barriers: limited income; lack of social support; lack of transport; unstable housing or homelessness; language or literacy barriers; personal preferences and beliefs about the necessity and value of ISLIs; physical or mental health issues or disability; day-to- day stress.
- Structural barriers: prohibitive costs; physical access issues; scheduling/timing barriers; lack of communication; hidden costs (food, extra costs for activities).
- Relational barriers: cultural insensitivity of the organisation; judgemental attitudes or behaviours; failure to engage communities as partners; lack of collaboration or personalisation.

Know that the process involves a significant investment in time and resources.

Working in partnership with local community development organisations to co-develop programming takes time. This is because it involves forming new relationships, being open to feedback, new ideas and new ways of working. But by working collaboratively, you can really increase the impact of your work. You will learn from and with each other, helping to sustain relationships with your community partners and their clients and, in some cases, helping them to embed Tinkering methodology into the existing adult learning work of the community groups. But before you embark on a project to work in this way, be realistic about the time and resources both you and your partner can invest.

Be a responsive listener in a two-way learning process.

You need to be responsive listeners in the conversation, asking questions to gather a clearer picture of the needs and experiences of

the group. While you may need to kick-start your work by providing insights in Tinkering methodology for the community leaders, remember that your current ways of working and thinking about how to programme Tinkering may not be the best fit for this group.

Be prepared to 'Tinker' with your Tinkering methodology.

We are aware that there is an expertise that might not be part of everybody's repertoire of knowledge or skills, and this is certainly true for Tinkering. However, as we became more involved in the process of collaborating with their community partners on the activity design, we realized that we needed to be flexible and responsive to ideas that stretched beyond 'classic' Tinkering methods. Rather than tweaking existing 'tried-and-tested' Tinkering activities, several organisations found themselves developing completely new activities that they would not have envisaged doing without the input and ideas of the communities involved.

C) MAINTAIN TINKERABILITY

'Tinkerability' is a distinctive attitude of Tinkering that characterises and makes unique and highly powerful the pedagogy in focus, not only during the learners' engagement and experience but for co-design as well (Resnick & Rosenbaym, 2013).

Use the following questions as guidance while building the co-design steps (Harris et al. 2016):

- Does the process invite participants to play around with materials and /or tools as an inspiration to play and spark their curiosity and interest?
- Does the process encourage participants to be creative?
- What interesting, unusual or inspiring materials can be made available? How will they be displayed as an invitation to play'?
- What makes this a creative process?
- Is there plenty of opportunity for participants to pose problems and questions?
- Is the process open-ended with variable and potentially unexpected outcomes?
- Does the process encourage participants to follow their own interests and to create something which is interesting and personal to them?
- Does the process allow participants to try out ideas or to work in an iterative way?
- What is the importance of emotional engagement? How can it be cultivated?

2.2. Reflecting on the Co-design Experience

When stakeholders with complementary aims come together to share knowledge, perspectives, ideas and skills, there can be many mutual benefits for all involved. Co-creative or co-designed practice between informal learning institutions and community organisations allows knowledge to be shared across professional boundaries. It involves a process of mutual learning.
Through this process of mutual learning, greater understanding and respect can be achieved. Mutual learning is also important for maintaining trust in sharing information and knowledge effectively within and across the co-design team.

Co-design can impact not only the design of a specific programme to make it more inclusive for the end-users, but it can also impact working cultures and practices of the organisation more widely.
It can help informal learning institutions to become better at listening and to become more representative and responsive to values, experiences, motivations, wants and needs of underserved audiences.

- Evaluation was thus an important part of the co-design process and experience in TinkerLib aiming to:
- help reflect on the planning and delivery of the co-design process.
- determine the elements of inclusion in the planning, delivery and adaptation of Tinkering activities created with and for underserved adult communities.
- guarantee the quality and success of each activity, measured against the extent of inclusivity as perceived by the target audience.

At the same time, the specific setting of TinkerLib posed two main challenges, namely a) a high diversity of target groups, as each hub worked with a different community of underserved adults; and b) the limited sample size of the participants involved. Both facts called for qualitative evaluation tools rather than quantitative ones.
Regarding the first challenge, the main goal in the design of the evaluation tools was their versatility allowing them to be adapted to the specific context of the respective target audiences in each country.
Regarding the second, a qualitative approach helps gain deep understanding of individual reflections but allows for limited generalization of the results.

Hence, in this case we define evaluation as the process of joint reflection on the achievement of the specific goals of each activity within the context of each TinkerLib hub and respective target audience. A set of three different evaluation tools was created to obtain different perspectives on the inclusivity of the newly developed Tinkering activities and on the co-creation process as such. These perspectives included a) the TinkerLib practitioners, i.e. science educators and librarians and b) members of the specific communities.

The development of the tools has been based on a preceding analysis of existing evaluation tools, including those of the previous Tinkering EU projects. In order to make informed decisions, the "Decision Tree" for the evaluation of science communication (Impact Unit, 2021) and Reflecting on the process of co-designing Tinkering, Participant Feedback (Harris & Winterbottom, 2019) were used as guidelines and adapted to the specific TinkerLib context supported by the Equity Barometer Survey (DeWitt et al. 2024).
For any modification undertaken, the creators of each tool were contacted and asked for permission beforehand.

Tool 1: Reflecting on the co-creation process

The first tool aims to identify the impact of co-design processes on the final Tinkering activity. Adapting to TinkerLib meant that the original set of questions (Harris & Winterbottom, 2019) was shortened, and partners were given choice in the selection of 2-3 questions perceived as the most suitable for their context.
To allow for some comparability between the individual TinkerLib hubs, there was one common and obligatory question for all partners.

As to implementation of the tool, there was an at least 30 minutes reflective discussion among practitioners (in any language they prefer) and – ideally – members of the target audience. In preparation for this reflective discussion, all partners were given time to take notes individually and there was one person designated as the moderator of the discussion. Results were then summarised in 3-5 key findings and shared with the consortium.
Providing freedom of choice in the set of questions as well as the language of the discussion was essential in making this evaluation tool as accessible and easy to use as possible for everyone involved in the co-design process.

Tool 1

Now that you have spent time working collaboratively to co-design Tinkering, it is useful to reflect on the way in which you worked with your partners. This will help you to better understand the impact of working in this way on yourselves and the target-audience. By preparing on your own first, and then jointly reflecting in a group discussion, you can clarify the benefits and challenges of working in this way, as well as identify ways the process could be improved for next time (Harris & Winterbottom, 2019, pp. 17-18).

Reflecting on co-creation

In your local hubs, schedule at least one meeting (min. duration 30') for the reflective group discussion towards the end of the process. Agree on one person to be the moderator of the discussion (if possible, a person who was not involved in the co-design process) and take notes.

Of course, you can meet more than once in your hub, for instance, if you find it relevant to reflect on the co-creation process in the middle of the process as well. This, however, is not obligatory.

Ideally, you do the group reflection together with the target group you worked with during the entire process. If that is not possible, you can do the reflective discussion only with your

hub partner. However, please try to include opinions of target group members, for example by asking them to write a short note about the co-design process. This can be done anonymously, if your partners feel more comfortable with that.
Agree on your set of questions beforehand to allow for individual preparation.

Questions

- What did you learn from each other?
- What were the benefits of making decisions jointly and sharing expertise?
- How has your professional relationship with each other evolved as the relationship has developed?
- In what ways do you think the co-design process improved the outcomes for the target audience of the Tinkering activities?
- Do you think this way of working has affected the way your organisation will work in the future? If so, how?
- If you were to do this process again, is there anything that you would do differently now in terms of the process of co-design, based on what you have learned during the process?
- What do you think have been the main challenges of working in this way? What do you think have been the main opportunities of working in this way?

Tool 2: The practitioners' perspective

The second tool was specifically designed for the context of TinkerLib and aims to evaluate the newly developed Tinkering activities with a focus on the specific context of TinkerLib, i.e. the combination of Science Centres and libraries as informal learning spaces, and on elements of inclusion in these activities. Hence, in semi-structured interviews with ScienceCenter-Network, we analysed which aspects made the specific activity inclusive – before, during and after the conduction of the activity.

In preparation for these interviews – or rather, joint reflective discussions – all hubs were invited to get together in an (optional) reflective discussion in any preferred language. To allow for this in-depth preparation, a set of guiding questions is an important part of tool 2, forming the basis for the semi-structured interviews with SCN. Results were analysed qualitatively and contrasted with the Map Guideline of Inclusive Practices (Juillard & Boniface, 2024) in order to determine aspects of inclusivity present in each Tinkering activities. These results were essential to further improve the Tinkering activities and to make them more inclusive.

Tool 2

This tool will be done in a semi-structured discussion format to share insights and talk about the Tinkering workshops.

Before the group discussion

Reflect on the questions below. If possible, try to include the perspective of your target group co-creation partners. You can also meet in your hubs and have a preparatory meeting where you discuss these questions, but you don't have to.

Questions

1. In your opinion, which aspects make the workshop inclusive?
    a. Can you describe an activity or a situation which you find a good example for inclusion?
    b. Which decisions have you made beforehand to create an inclusive setting? (e.g. regarding the materials, the physical accessibility of the room, the communication, the language, etc.)
2. If you think of the particular setting of Tinkering in libraries – is there anything you do in your workshop that is specific to this setting?
    a. If yes, can you give an example?
3. In your opinion, how successful were you in reaching your target audience and in meeting their specific needs?
    a. Which aspects of your workshop would you like to change in order to meet their needs even better?
    b. Do you have any ideas on how to do that?

Tool 3: The participants' perspective

In this tool, two pre-existing tools were combined and adapted to the context of TinkerLib, namely the "Participant feedback" (Harrisi & Winterbottom, 2019) and the "Equity Barometer Survey" (DeWitt et al. 2024).
In order to obtain the participants' perspective of the Tinkering activity and the extent to which they perceived it inclusive, the focus of tool 3 was laid on a) general feedback on the activity, as well as b) the extent to which participants felt seen, welcomed and appreciated during the activity.

Again, to cater for the heterogeneity of TinkerLib target audiences, there was a set of obligatory questions while a section on skill development was optional, for instance.

The implementation of this tool was versatile as well, since partners could use creative ways of asking these questions. Methods ranged from using colour-coded emojis, posters and sticky dots to printed questionnaires.
Results were then shared in the consortium and used as a basis to further improve the Tinkering activities.

Tool 3

This tool should help you get feedback from the participants of your Tinkering workshop. Think about the needs of your target audience and find ways to implement (parts of) this tool in an appropriate way.

Some of these questions are obligatory (marked with *) to include in your version of the tool. For all the remaining parts or individual items/questions you can decide whether they are relevant for your context or not.

PART 1 - general questions

Please indicate how much you agree with the following statements.

1. I enjoyed the workshop *

   (not at all) 1 2 3 4 5 (a lot)

2. I found the workshop interesting *

   (not at all) 1 2 3 4 5 (very much)

3. I would recommend this workshop to others *

- Yes
- No
- Maybe

PART 2 - skills

Please tick all things that you did today. You can also tick none or all of them.

Critical thinking and problem-solving

- I found ways to solve problems that occurred during the workshop
- I tested new ideas
- I found solutions to questions I had during the workshop

Courage, resilience, and empowerment

- I tried new things out
- I stuck with what I wanted to do, even if it did not work (at first)
- I became more confident to try new ways of working

Communication and collaboration

- I worked with others
- I told others about my ideas
- I listened to others' ideas
- I helped or supported others

Creativity and inventiveness

- I used materials in new, creative ways
- I found ways to express myself creatively
- I used personal experiences and ideas as inspiration

PART 3 - your experience during the workshop

Please indicate how you feel about the following statements. *

1. My ideas and opinions were taken seriously *

   (I fully disagree) 1 2 3 4 5 (I fully agree)

2. I felt valued for who I am *

   (I fully disagree) 1 2 3 4 5 (I fully agree)

3. I felt like I fit in here *

   (I fully disagree) 1 2 3 4 5 (I fully agree)

4. I got to use mt knowledge and skills to help others *

   (I fully disagree) 1 2 3 4 5 (I fully agree)

5. I felt safe *

   (I fully disagree) 1 2 3 4 5 (I fully agree)

6. Other participants of the workshop appreciated each other's knowledge and skills*

   (I fully disagree) 1 2 3 4 5 (I fully agree)

Please answer the following questions in keywords.

7. What would or could have made the experience better for you?

8. Is there anything else you would like to share?

PART 3

Key Messages and Guidelines

3.1 Our recommendations

The co-design process itself, the iterations with adult learners as well as the structured evaluation of the experiences across the partner countries offered a series of considerations and recommendations for the partners as well as for any practitioner interested in undergoing a similar experience. We are aware that the following guidelines stem from case studies and a qualitative evaluation of specific contexts, they cannot thus be generalized; they do nevertheless contribute to an ongoing process of reflection around approaches fostering inclusive learning contexts through Tinkering-inspired approaches.

Keep the focus on learners

Flexibility is a fundamental aspect already mentioned as an indicator of successful inclusivity (Juillard & Boniface, 2024, p. 9). Shifting the focus to the participants' own perspective is a key aspect of the process from co-design to delivery of the activity. Don't ask your adult participants to assimilate into your existing programme structure. You need to reflect on how to realign or re-imagine your practice to become more inclusive, which means deeply valuing what you can learn from the community.

Ask your community partner:

- How do you view our existing programming?
- What are we getting right and what are we getting wrong?
- In what ways do you think our existing programme (or wider organisational structure) might currently serve to exclude this group or make them feel unwelcome?
- How can we better represent the adult learners' interests, skills, and experiences?

Your community partner is a window into the adult community you wish to serve. Facilitate a two-way learning process by becoming a responsive listener throughout the co-design process. Your community partner might be able to support you to consult directly with the participants to seek their ideas, opinions or wishes on ideas that are generated for the programme.

Ask your community partner:

- What are the current lived experiences of the adult participants?
- What challenges could they see arising if you were to try your existing Tinkering approach with the participants?
- Are there particular skills that the participants would like to develop?
- What skills, interests and experiences do the participants bring with them that the session could be based around?
- What themes might most interest the group?
- What would most motivate the adult learners to come to a Tinkering workshop? What could put them off or prevent them from participating?

Finally, additional questions such as the following during the design of an activity can help address choices from the perspective of learners:

- What do I want to work on? Which focus do

I want to have?
- Which challenges do I set for myself?
- How actively do I want to participate?
- Do I want to work alone or as part of a group?
- Do I want to share my results with the group?

Build on participants' strengths, not on their perceived gaps

Inclusive learning begins with how we view the people we aim to engage. A common pitfall, known as "deficit thinking", is to assume that adults from marginalised or underrepresented communities are missing something: whether knowledge, skills, confidence, or motivation. This mindset often places the responsibility for exclusion on individuals, rather than questioning how institutional practices may unintentionally create barriers.

In contrast, building on participants' strengths means recognising and valuing the experiences, talents, and cultural knowledge that learners already bring. It shifts the focus from what people lack to what they can contribute, and invites educators to see every group as resourceful, even if their forms of knowledge differ from conventional or institutional norms.

> "We focused more on an asset-based approach, because it was essential to build trust within our team and target group. Recognising participants' existing strengths helped us design a more inclusive and empowering workshop."
>
> **Serbian Hub**

This approach also helped challenge bias and reframe expectations: educators recalled that some participants, initially perceived as learners, revealed unexpectedly high levels of skill and creativity once the space allowed them to express it. When we start from strengths, we invite mutual learninand foster respect. This requires not only a shift in activities, but often a shift in mindset and institutional posture.

Acknowledge and address asymmetries of power and expertise

Several partners stressed the importanceof recognising institutional dynamics and the roles participants are often expected (or conditioned) to play. Creating more equitable learning spaces begins with acknowledging these asymmetries and actively working to mitigate them.

> "There is an inherent asymmetry between us and the target audience because of institutionalization and power.
> To be an active listener and open to change seemed most important to counteract this."
>
> **Austrian Hub**

Equally important is the need for transparency regarding roles and intentions. Establishing a mutual understanding with new communities can significantly support trust-building.

> "It is essential to "be as clear as possible about your intentions and professional context and define together some roles (not necessarily rigid)."
>
> **Italian Hub**

Adapt activities in response to the specificities of the audience

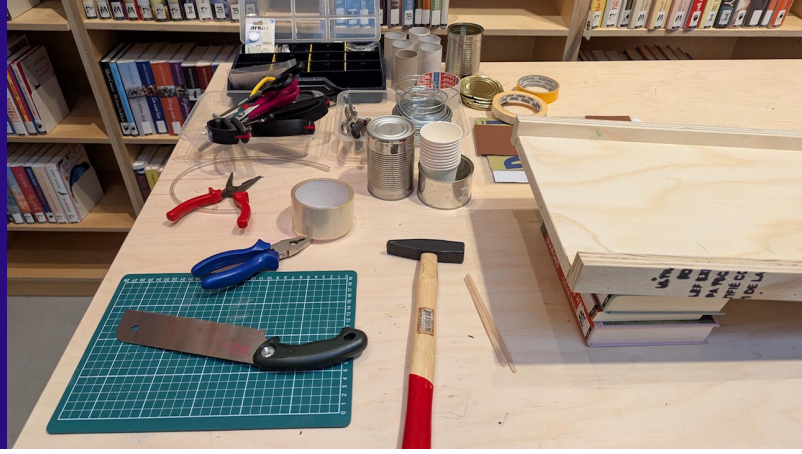
Design choices should be informed by the concrete needs, preferences, and contexts of participants.
Considerations such as language proficiency, mobility, attention span, or the need for immediate feedback often determined the success of inclusive adaptations.

Moreover, designing for autonomy and accessibility is key. Activities should allow participants to engage at their own pace, step in or out as needed, and explore different modes of interaction. This flexibility helped address a variety of learning styles and life circumstances, as observed by several partners across the consortium.

> "For accommodating our target audience (autistic adults), we needed activities with immediate feedback [...]. Also, for our target audience it was relevant to have flexible timing, so we needed activities where it was easy to step in and step out"
>
> **Italian Hub**

Be open to spontaneous developments and prioritize the process

Flexibility within the process was seen by many partners as not only necessary but deeply productive. Several described how openness to unexpected turns, whether in group dynamics, creative choices, or the direction of an activity, often led to more meaningful and engaging outcomes than originally anticipated.
This kind of responsiveness invites facilitators to prioritise the learning journey over predefined results, allowing activities to evolve in response to participants' interests, ideas, or needs.
However, this is not always easy. Many of us operate within result-oriented environments where success is measured by clear outputs or planned deliverables.



Shifting focus from outcomes to process may require a deliberate change in mindset and, at times, a tolerance for uncertainty.

"The most challenging part was staying focused on the process rather than the results. We are generally used to working in a result-oriented way, so it required a shift in mindset. However, this project really helped us develop the skill of valuing and following the process itself, which we now see as even more important than the results."

Serbian Hub

"Be prepared to let go of your expectations and be open to spontaneous changes developing in the process."

Austrian Hub

Foster a shared sense of ownership and co-responsibility

When participants' passions, interests, and perspectives are actively welcomed and integrated into the activity, engagement tends to deepen. Creating space for individuals to influence the direction and content of the experience fosters not only motivation, but also a sense of agency and belonging. Co-responsibility in shaping the process becomes a powerful catalyst for creativity.

"It was interesting to see how one participant's particular interest in trucks led him to request an illustrated book, which he then used as inspiration to build a pop-up about trucks. The possibility to include in his design his own passion was a catalyst of ideas."

Italian Hub

Fostering this kind of ownership also means being present and responsive—not imposing pre-set assumptions but allowing the activity to evolve from participants' real-time contributions. Shared ownership requires not only openness from the facilitator, but also a willingness to decentralise control and embrace a genuinely collaborative design process.

"Inclusivity means responding to current, expressed needs - not assumed ones - and shaping the process together in real time."

Serbian Hub

Value emotional engagement and moments of surprise

Encouraging a sense of joy, pride, and wonder contributes significantly to participants' motivation and sense of achievement. Emotional engagement was found to be particularly meaningful when it emerged from hands-on exploration and shared experiences—sparking not only learning, but also confidence and connection.

> "We were quite nervous about doing the Stop-Motion activity with seniors, as we were afraid they would not be able to handle iPads. We had prepared a very detailed step by step explanation, but after we handed out the tables most groups just started trying them out right away. Eventually, it was wonderful to see how proud the seniors were with the stop-motion videos they made!"
>
> **Netherlands Hub**

Emotional engagement, however, is not only about enthusiasm, it also involves emotional ease. Creating space where participants feel free to express themselves without fear of judgement, and where humour and lightness are welcome, can greatly enhance inclusion.

> "During a brainstorming session, a facilitator suggested the word "escape" to describe the world of media libraries. An inmate bounced on the word, joking that it wasn't suitable for them. The joke put us at ease and helped to play down the context. Thanks to this, the subject didn't become a taboo during the rest of the session."
>
> **French Hub**

Not taking oneself too seriously, and allowing for humour and spontaneity, can help defuse tension, humanise interactions, and foster deeper group cohesion.
Facilitators who model emotional openness and lightness often help participants feel more confident to take creative risks and bring their full selves into the process.

3.2 Concluding remarks

Consider learners as unique

"We spoke with each other in an individual way, and it helped us to adapt. We never considered them as a group, but each one as one person. We didn't adapt to one audience but to 12 different people. Of course, in one context"

(France)

"This is a rural area, we know the participants and they knew each other. We could react to their needs well. It was good that they knew each other and that the topic was related to their daily life and things familiar to them. They wanted to share their results in the end."

(Serbia)

Adhering to participants' specific needs is another important indicator of successful inclusion (Juillard & Boniface, 2024, p. 10), which means drawing attention to, and building on, each individual rather than catering for a homogeneous target group.

To address such a challenge, it could be helpful to collaborate with community partners knowing well the target audience involved in the process as well as to build connections with the participants entering to the heart of the co-design or delivery of the activity.

Foster synergies among learning settings

"The library was the space the audience already knew. They felt comfortable"

(Netherlands)

"The idea to include books came with the activity, the idea came spontaneously for some of the participants, because they had a lack of ideas and then asked if they could use the books. We think we could have that as fixed part in following workshops now"

(Italy)

Libraries offer a powerful context for reinforcing the potential of Tinkering of reaching out to adult learners, for accommodating individual agendas and repertoires of ideas, and for creating positive relationships with STEM. They are a familiar space, social and communal centre helping to build an atmosphere of trust and belonging (cf. Map of Inclusive Practices, p. 14). Also, using books as additional resources in the Tinkering activities can add a new layer of exploration to the experience.

In TinkerLib we saw how encouraging collaboration among informal learning settings that are deeply rooted into the local 'soil' can enrich experience and expertise and allow for a new focus in the valorisation of the Tinkering pedagogy to enhance learning in STEM and a sense of belonging.

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