Tinkering: Addressing the Adults

A Theoretical and Methodological Framework

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Context

Over the last decade, Tinkering has gained international recognition as a powerful, motivational and engaging approach for developing STEM learning and building 21st Century Skills (Anzivino and Wilkinson 2012; Bevan et al. 2015; Petrich, Wilkinson, and Bevan 2013; Ryoo and Barton 2018; Vossoughi et al. 2013; Vossoughi and Bevan 2014; Wilkinson and Petrich 2014). Highly personalised, learner-centred and freed from the constraints of formal scientific language, Tinkering is increasingly being adopted by a wide-range of informal STEM learning organisations[1] to help engage diverse audiences across a range of education settings – both formal and informal (Barajas-López and Bang 2018; Barton, Tan, and Greenberg 2016; Fields et al. 2018; Lee and Worsley 2019; Martin, Dixon, and Betser 2018).

This project builds on the work of two preceding Erasmus+ funded Tinkering projects, both conceived and coordinated by the Museo Nazionale Scienza e Tecnologia "Leonardo da Vinci" in Milan:

i)   **Tinkering: Contemporary Education for Innovators of Tomorrow:** introduced Tinkering in the European context, developed and implemented new Tinkering activities to enrich the fields of formal and informal science education, and supported the development of 21st century skills for young people and adults.

ii) **Tinkering EU: Building Science Capital for All**: brought together the work of science centres and schools to support students facing disadvantage, to strengthen their STEM identity and help them develop transferable 21st century skills.

Since 2013, these projects have brought together practitioners from across the STEM education sector. So far, nine science centres and museums have trained in, developed and disseminated Tinkering pedagogy through their regions, working with school students and family groups. Inspired and informed by the work of the Tinkering Studio at the Exploratorium in San Francisco, these projects have built a European-wide community of practice, seeding regional and transnational learning ecosystems in which practitioners (museum educators and teachers) have come together to develop their practice and explore how Tinkering pedagogy could be used to develop more engaging, inclusive and equitable STEM learning experiences.

Where the first two projects focussed on young people and families, this current project specifically targets adult learners with a focus on inclusive and equitable 'Adult Learning and Education' (ALE). It will reach out to adults who may not currently identify with STEM learning, who have relatively low levels of confidence with STEM and who are less likely to choose to participate in science-related social, cultural or training opportunities. In this way, we are targeting adults who are likely to have low levels of 'science capital' (Archer, Dawson, DeWitt, Godec, et al. 2015; Archer, Dawson, DeWitt, Seakins, et al. 2015), that is, people who may feel a disconnect with STEM and who may have little or no personal experiences, relationship or interest with it.

The project emerges from the following challenges facing contemporary global society:
* Widespread **disengagement with science** for many people across Europe
* An increasing **generational skills and competencies-gap** in relation to technology and science
* Increasing **demand for highly developed 21st century skills** for individuals to participate effectively in civic and social life.
* **Low levels of science capital** amongst communities underserved and underrepresented by the informal STEM learning sector

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1 This includes museums, galleries, science centres, planetariums, science dissemination networks, hackspaces, makerspaces and libraries.

Project Overview

The work strands in this project all aim to contribute to the current European agenda of widening participation in adult education and lifelong learning. As a project consortium, we also seek to add insights relating to adult learning to the field of Making and Tinkering and strengthen the intersection between Tinkering and Adult Education and Learning (ALE) through a lens of social inclusion.

The project will extend the existing 'Tinkering EU' community of practice by developing partnerships between informal science learning organisations and the community development sector. Over three years, five internationally renowned European informal STEM learning organisations will work with and learn from local community development organisations who are experts in working with adults facing social, cultural and economic disadvantage. Following transnational training[2] and small-scale regional events, the five STEM partners will develop and deliver adult learning and education (ALE) sessions tailored to the experiences, needs and motivations of disadvantaged adults using Tinkering pedagogy to support STEM engagement and 21st century skill-development. Through a range of training and development activities the project aims to deliver:

- A suite of Tinkering activities aimed at adult learners that will be developed, piloted, delivered and subsequently integrated in the programmes of five museums and science centres.
- Regional and transnational training workshops for museum staff and other adult educators, building their knowledge and skills in Tinkering, social inclusion and lifelong learning.
- Dissemination of project information, activities, insights and documentation at local, national and European level.

2 This includes a three-day training event with Tinkering experts from the Tinkering Studio of the Exploratorium in San Francisco who are serving as special advisors to the project.

Document overview

This document details the methodological framework for the project and comprises a critical review of the relationship between Tinkering, adult engagement with STEM, development of 21st Century skills, lifelong learning and social inclusion. By exploring the relationship between these areas, this document outlines:

1) how and why Tinkering can be used as an inclusive teaching approach for Adult Learning and Education (ALE) in an informal learning setting;
2) the ways in which the project will help to develop sector knowledge around inclusive practice for working with vulnerable, underserved, disadvantaged or marginalised adults with relatively low participation rates in ALE and STEM learning.

Section 1 - Defining Adult Learning and Education (ALE)

The first section provides a brief overview of the history and context of adult learning in Europe. It locates the project within a social justice agenda for supporting engagement with ALE for non-participating or underserved groups.

Section 2 - Participation in ALE: opportunities and challenges

Section 2 provides an overview of current adult participation in ALE in Europe, discusses challenges for measuring trends in adult participation and explains the current European focus on widening participation in ALE. Evidence suggests that some of the most vulnerable and marginalised groups are being left behind and that, to a large extent, current ALE provision is serving to accumulate advantage for people with higher incomes and higher levels of education.

Section 3 - Learning, equity and inclusion in Informal Learning Institutions (IFLIs)

This section summarises research around adult learning in IFLIs and introduces the current movement to widen the role of IFLIs in the area of social justice. This section

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provides a critical review of current issues in participation in IFLIs and situates the project within a community-based, partnership framework to help establish and develop two-way learning partnership between IFLIs and the target adult group.

Section 4 – Tinkering as an inclusive approach for 'STEM-rich, skills rich' ALE

Section 4 looks specifically at Tinkering as an inclusive pedagogical approach, drawing on learning and insights gained from the preceding two Tinkering projects.

Section 5 - Project Methods Overview

The final section provides a summary of the main methods that will be used over the next three years to develop a programme of inclusive STEM ALE with a broad range of underserved, marginalised or vulnerable adult groups. The overarching methods relevant to all the partners are discussed first, followed by a summary of each regional project and how partners are responding to their local situation and need.

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Section 1:
Defining Adult Learning and Education (ALE)

1.1
Historical context: the emergence of adult education in Europe

'Adult Education' as a term in Europe likely emerged from late 17th century adult literacy education, accelerated by church efforts to increase direct reading of the bible (Smith 2004). It became more formalised and widespread with the dawn of the industrial revolution which brought the need for a large supply of capable, technical, and skilled labour (Federighi, Bax, and Bosselaers 1999).

In the late 18th and early 19th century, adult schools and training establishments grew throughout Europe (Federighi et al. 1999). For example, in Britain, 'Mechanics Institutes' provided evening education for working men through lending libraries, lecture theatres, classrooms and laboratories with a mix of courses and technical training, which were later succeeded by government-funded public libraries and free museums (West 2017). At the same time in Northern Europe, the Danish Folk High School movement, founded by Nikolaj Grundtvig, was gaining momentum in response to a growing demand to provide education for the working classes to enable greater and more active participation in social and political life (Larsson 2013). 19th century adult education was thus developing on a tide of progressive, democratic and liberal social reform. Emphasis was on its emancipatory potential to help the less socially and economically advantaged become more active and engaged members of society, with the means to influence their own situation and the wider political sphere (Koulaouzides and Popović 2017). Yet, despite this liberal ideology, implementation of adult education remained largely limited to technical and mechanical training, and adult literacy lessons, until the 20th century.

1.2
Adult Education and 'Lifelong Learning'

In the 20th century, growth of large-scale industry, rapid scientific-technical advances and a widening poverty divide, all contributed to increased diversification of adult education, which also became increasingly politicised due to the growing power of the organised labour movements. For example, the highly influential British Workers Educational Association (WEA) established in 1903 between the Labour party and British universities advocated broad, universal free education for the working classes to increase social inclusion and enable greater political influence. In the years immediately after the second world war, the term 'lifelong' became associated with 'universal' provision of adult education. In a similar vein to the 19th century, 20th century political influences on adult education were largely underpinned by humanistic, liberal, emancipatory and rights-based sociological ideas that poorer and more vulnerable citizens should have the right to free education that can help them influence and shape the society in which they live and contribute to a more democratic and just society (Elfert 2018).

By the latter half of the 20th century, a new dominant discourse of 'lifelong' education was firmly established in global education policies. Where provision had previously focussed on specific training for employment, or remedial adult education to 'catch people up' on an inadequate or entirely missed childhood education, there was increasing emphasis on the importance of a flexible, learner-centred, continuing education 'throughout life' to help maximise individual and collective health, wealth and prosperity. In 1972, following the Third International Conference on Adult Education held in Tokyo, a recommendation on the development of adult education was adopted by the United Nations Educational, Scientific and Cultural Organization (UNESCO). This introduced the first international standards for adult education. UNESCO's Faure Report (Faure et al. 1972) and subsequent Delors report (Delors 1996) thus established 'learning throughout life' as a global education goal.

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1.3
A renewed global vision: inclusive Adult Learning and Education (ALE) for global sustainable development

At the European level, 1996 was designated the 'Year of Lifelong Learning' and in March 2000, the conclusions of the Lisbon European Council were that 'a move towards lifelong learning must accompany a successful transition to a knowledge-based economy and society' (European Commission 2000). Conceptions of LLL in Europe at this time were being shaped by a need to tackle unemployment and to enable Europe to compete more successfully in the global market (Groenez, Desmedt, and Nicaise 2007). Economic policies increasingly cited the importance of LLL as a means for employees to continually develop knowledge and skills, particularly in relation to rapid and ongoing technological and scientific advancement, to help grow the knowledge economy (Gouthro and Holloway 2010; World Bank 2003).

The concept of 'Lifelong Learning' (LLL) has now become widely adopted in education policy across Europe where there is a still a strong focus on continuously upskilling the workforce to remain *economically* competitive. But such neoliberal ideas around adult education have come under increasing criticism for their potential to undermine the broader, democratic principles upon which earlier models of LLL were founded – those of social equity and social mobility to help less advantaged individuals become more informed and empowered agents of positive social change. Where economic models for adult education arguably shift responsibility for learning from the state to the individual (who must constantly seek to increase or improve their knowledge and skills to remain employable), there is concern that this could serve to widen the gap for those less able to leverage learning opportunities and thus lead to increased patterns of cumulative advantage and greater social inequality in relation to participation in society and in STEM (Biesta 2016; Coffield 1999; Elfert 2015, 2018; Jarvis 2009; Kilpi-Jakonen, Vono de Vilhena, and Blossfeld 2015; Koulaouzides and Popović 2017)

Reaching beyond the purely economic potential of LLL, the wider role of LLL for supporting active citizenship, social inclusion and social cohesion is currently receiving a renewed global focus. In December 2019, UNESCO published its fourth report on Adult Learning and Education (ALE) 'Leave no one behind: participation, equity and inclusion' (UIL 2019). The report (GRALE 4) highlights the need to drill much deeper into standard measures of participation in adult learning arguing that these do not provide a clear enough picture of who is falling through the net and why. Critically, the central theme of GRALE4 is the need for countries to do more to reach underserved and vulnerable communities:

> Troublingly, in many countries, disadvantaged groups – adults with disabilities, older adults, refugees and migrants, and minority groups – participate less in

ALE. In some countries, provision for these groups is regressing. We know less about the participation of these groups than for other sections of society. Yet this information is essential if we are to develop inclusive policies for all. (UIL 2019)

GRALE 4 highlights the wide social and civic benefits of adult education including improved health, wellbeing and social cohesion and emphasises the critical role of adult education for achieving the 17 Sustainable Development Goals (SGDs) outlined in the 2030 Agenda for Sustainable Development (United Nations 2017). GRALE 4 warns that without significant increased political attention on adult education, including increased funding, better targeting of poor and vulnerable groups and improved global data collection and analysis methods, countries will not only fail to achieve the Sustainable Development Goal for Education (SDG$_4$) but they also risk undermining progress in the other 16 Sustainable Development Goals (Stanistreet 2019; UIL 2019). What is clear from this renewed global vision for ALE, is that at the start of this new decade, there is an international call-to-action for governments to address 'deep and persistent inequalities' in ALE participation, to concentrate on democratic, equitable and inclusive ALE for 'active citizenship' and to invest more in those people that are 'harder to reach' (UIL 2019).

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Project context 1: reaching the harder-to-reach and improving sector knowledge in relation to inclusive ALE

It is within this renewed vision for a democratic, equitable and inclusive approach to ALE that this project 'Tinkering: addressing the adults' is embarking on a three-year learning journey. The project will explore ways of working with diverse adult learning groups in community settings with the aim of better understanding what works and why, particularly when it comes to vulnerable, marginalized, underserved, underrepresented and excluded groups.

Using what is learned, the project will create and disseminate resources to support the wider informal learning and community development sectors to develop more inclusive and equitable practices when working in the area of ALE.

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Section 2:
Participation in ALE: opportunities and challenges

2.1
Formal and non-formal lifelong learning as key measures

As we have demonstrated so far, questions around what adult education is, who it is for and how and where it should happen have long been the focus of economic, social and academic debate. Over the course of the last century, ideas around 'lifelong learning' have moved to the forefront of economic and social policy. Today 'adult education' and 'lifelong learning' can refer to many different types of learning across a range of different environments and settings. Generally, these terms are used to refer to any activities undertaken by adults after their initial education (schooling). Table 1 provides an overview of three commonly differentiated categories or formats for adult learning – formal, non-formal and informal learning.

Form	Definition	Examples
Formal Learning	Learning that takes place in a structured context which includes formal primary, secondary and tertiary education (tertiary education in the case of ALE) as well as vocational training provided by formal educational institutions. It tends to follow a formal syllabus and is governed by external assessment and accreditation.	• Undergraduate and postgraduate study • Formal music qualifications • Externally examined first aid qualifications • Driving qualifications • Health and Safety training • Project Management training • Accredited correspondence and online courses
Non-formal Learning	Learning that occurs outside of formal learning systems but within some form of organisational framework, often in a community setting. It covers learning activities that do not lead to a formerly recognised qualification, but which have a very large learning component. It happens as a result of intentional effort on the part of the learner to learn an activity, or develop skills or knowledge.	• Art classes e.g. painting, photography, ceramics • Cookery skills classes • Learning circles and 'mutual aid' learning groups such as reading and discussion groups • Amateur choirs and orchestras • Correspondence and online courses (with no accreditation)
Informal Learning	Learning that takes place during daily activities in a more casual way (e.g. during leisure or family time). Informal learning takes place outside of a formal structure (such as a lesson, training or course) and is not delivered by a formal 'provider'. The participant could embark on the learning either intentionally or non-intentionally, which means that the learning may not be defined or recognised by the participants as a form of learning activity.	• Cultural activities • Sports activities • Reading and researching online • Reading books and magazines • Watching television documentaries • Visiting a museum or gallery • Practising a hobby informally (not through a provider or training establishment).

Table 1: Three common categories of ALE

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For the purposes of attempting to measure and compare ALE within and across countries, it is the intentional forms of ALE, that is those that would fall into the formal and non-formal categories outlined in table 1, that are more commonly used in international survey work, such as the *Labour* Force *Survey* (*EU*-LFS) or the Programme for the International Assessment of Adult Competencies (PIAAC) produced by the Organisation for Economic Cooperation and Development (OECD).

2.2
Participation rates: current 'state of play' in Europe

In Europe, the Education and Training Framework 2020 (ET 2020) provides common education and training objectives for EU member countries along with a set of principles and common working methods to help achieve these objectives. Among the eight key benchmarks set for 2020, is a target that, at a European level, at least 15% of adults should participate in some form of lifelong learning (measured by the share of people aged between 15 and 64 who state that they took part in some form of formal or informal education and training in the four weeks preceding the survey) where lifelong learning is defined as:

> …all learning activities undertaken throughout life with the aim of improving knowledge, skills and competences, within personal, civic, social or employment-related perspectives. The intention or aim to learn is the critical point that distinguishes these activities from non-learning activities, such as cultural or sporting activities.

> (Eurostat 2019)

The latest results for across the EU from 2018 show that:
- The participation rate in the EU was 11.1 %
- On average, the participation rate for adult learning among women was higher (12.1 %) than the rate for men (10.1 %).
- In the EU Member States, the highest rates of adult participation in learning were in Sweden (29.2 %), Finland (28.5 %) and Denmark (23.5 %). In contrast, five Member States had participation rates below 5 %: Romania (0.9 %), Bulgaria (2.5 %), Croatia (2.9 %), Slovakia (4.0 %) and Greece (4.5 %).

> (Eurostat 2019)

2.3
Challenges and Opportunities

Looking in more detail at the data for all countries surveyed, only eight of the EU member states are currently reaching or exceeding the target of 15% and there is a general trend of lower rates of participation recorded in southern and eastern Europe (Figure 1). While large-scale surveys can provide useful insights for supporting policy development, inconsistencies in data collection, for example in relation to the wording of questions, definitions of types of learning and age categories of people surveyed present challenges for determining trends in participation (Desjardins 2014). Getting beneath the surface of participation rates to understand what is happening at the individual, community or societal level is also difficult because the reasons why adults do or do not participate derive from multiple factors at multiple levels which all interplay. And even within individual surveys there is much that is

missed: for example, instances of intentional participation by adults in informal learning or participation by adults over 65 who are often not part of the survey target group for ALE participation.

Since the 1980s, research on participation in ALE has moved from a dominant focus on individual motivation and attitude, to more integrated approaches that attempt to draw together insights at different levels: from the individual, to the education providers and policy makers (Boeren 2017; Merriënboer et al. 2009). Interestingly, research using PIAAC data, which compared countries with higher participation with those with lower rates, indicates that lower participation rates do not correlate with higher numbers of individuals reporting barriers to participation and, furthermore, reducing barriers for participation does not necessarily increase demand

Adult participation in learning, 2018
(% of population aged 25-64)

Figure 1: Adult participation in Lifelong Learning in 2018, (Eurostat 2019)

for adult education. However, in both high and low rate countries, greater demand for ALE is associated with higher individual levels of education (Hovdhaugen and Opheim 2018). The implications are that irrespective of the participation rate (whether it is high or low), the challenge for policy makers is to increase interest, demand and opportunities for ALE amongst those who are not participating. These groups tend to be those with lower levels of education and adults who are in more vulnerable positions in society.

While much policy attention has been devoted to ALE, participation in ALE remains uneven and characterised by inequalities (Boeren 2016; Boyadjieva and Ilieva-Trichkova 2017; Desjardins 2014; UIL 2019). Globally, marginalised groups participate far less in ALE and the lowest participation rates are observed amongst adults with disabilities, minority groups, older adults, migrants, refugees and adults living in conflict-affected countries (UIL 2019). Accumulated advantage in ALE is also evident in the fact that adults from higher socio-economic backgrounds and adults with higher levels of education and qualifications are significantly more likely to participate in ALE than those from lower-incomes or with lower levels of education (Boeren 2016; Boyadjieva and Ilieva-Trichkova 2017; Desjardins 2014).

Project context 2: ALE targeted to marginalised and underserved adult groups

Tinkering 3 aims to work with a broad cross-section of adults who meet the criteria for low or non-participation in ALE. Working in a targeted way, each partner will develop and deliver a programme of ALE that best suits needs, motivations and experiences of the target group. As well as supporting the European agenda to widen participation in ALE by underserved groups, project teams are focussing on high quality, deep, rich learning opportunities using immersive, personalised and learner-centred approaches afforded by Tinkering methodology,

as will be discussed in section 4. Recruitment of adult participants will be carried out in a coordinated way though intermediary community partners who are already working within the target community and who can advise, support and co-develop the ALE programme in order to maximise its relevance and utility for the adults it will be serving. This community-centred, participatory mode of working is discussed in more depth in section 5.

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Section 3:
Learning, equity and inclusion in Informal Learning Institutions (IFLIs)

3.1
The Learning Power of IFLIs

Informal Learning institutions (IFLIs)[3] are the focus of a large body of research around why, what and how people learn in informal settings. IFLIs are places of learning that enable personalised learning journeys for visitors, who can explore at their own pace and construct meaning that builds on personal experiences, knowledge and interests (Dierking, Ellenbogen, and Falk 2004; Dierking and Falk 1994; Falk and Dierking 2000; Falk and Storksdieck 2005; Rennie and Johnston 2004; Silverman 1995). Research has demonstrated that IFLIs are places where families learn together in intergenerational groups (Borun, Chambers, and Cleghorn 1996; Borun, Cleghorn, and Garfield 1995; Dierking and Falk 1994; Ellenbogen, Luke, and Dierking 2004; Falk 1991; Zimmerman, Reeve, and Bell 2008) and that rich learning conversations are sparked and sustained between people visiting in groups (Harris and Winterbottom 2018; Leinhardt and Knutson 2004; Palmquist and Crowley 2007; Szechter and Carey 2009; Tunnicliffe 2000; Zimmerman, Reeve, and Bell 2010). Scientific IFLIs, in particular, represent champions in the sector for developing engaging, immersive, interactive, hands-on and experiential programming (exhibits, activities, tours, events etc.) that support learning in very broad ways (content knowledge, skills development, behaviour change, social and emotional learning) and for diverse groups ranging in age, needs, motivations, skills and experiences (Borun et al. 1997, 1996; DCMS and DfEE 2000; Dierking and Falk 1994; Falk, Moussouri, and Coulson 1998; Gutwill and Allen 2010; Povis and Crowley 2015).

3.2
Equity and Inclusion: the new order for IFLIs

As outlined above, the learning power of IFLIs for different types of audiences has a wide and well-established literature. And within the professional sector, 'audience development' (focussing on what makes a 'good' visit for different types of audiences) has long been a critical part of strategic planning for financial sustainability and prosperity. The role of the sector in supporting diversity and social inclusion, however, is a more complex issue. Over the last 10 years, IFLIs have come under increasing scrutiny from public and private funding bodies to reach new and more diverse audiences: those that are deemed 'harder-to-reach' and often defined by their lack of participation.

A commonly adopted and still dominant approach for reaching non-visiting audiences is to focus on reducing barriers to access for non-visiting groups, often in the form of targeted outreach or education projects devised to help overcome specific barriers at different levels, 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 IFLIs; 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; judgemental attitudes or behaviours; failure to engage communities as partners; lack of collaboration or personalisation.

While a barriers-based approach can serve to support a widening access agenda, it has been criticised for two main reasons:

i) First, because interventions that focus on barriers can underestimate the complex interplay of factors

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3 The term Informal Learning Institutions refers to a broad range of sector institutions including museums, science centres, makerspaces, planetariums, galleries, botanical gardens, zoos and aquariums.

that lead to exclusion, and therefore fail to create sustained and long-term change in participation.

ii) Secondly, because in a barrier-based approach, there is a tendency to externalise non-participation and inadvertently promote a deficit way of thinking, in which non-participating audiences are understood as lacking interest or ability to participate, as opposed to considering how the culture and practices of the IFLIs themselves are responsible for and reinforce the lack of participation (Dawson 2014a, 2014b; Taylor 2017; Tlili 2008).

What this means in practice is that because an emphasis on barriers can inadvertently lead to deficit thinking, this can serve to perpetuate incorrect assumptions about the reasons for non-participation and thus shift responsibility away from the IFLI itself. Or put more succinctly, 'the people who experience the problem, become the problem' (Dawson 2019). Deficit thinking places blame and responsibility for non-participation on the individual. They are deemed to be lacking, for example, in desire or willingness to participate and therefore the assumption is that they need to be supported or persuaded to 'come on board' and 'reap the benefits' of what is on offer, as opposed to recognising that what is on offer, what is being represented and how it is presented is actually the root of the problem. Indeed, Dawson emphasises the pervasive tendency in the informal science learning community of framing non-participating groups in terms of having 'double deficit' whereby non-participating groups are wrongly accused of being disinterested in participating (attitudinal deficit) and of doing the 'wrong' sorts of activities (behavioural deficit) as opposed to participating in informal STEM learning (Dawson 2019). This way of thinking does not take into account the fact that, in reality, individuals may choose to participate in culturally relevant activities and practices not offered by ILFI institutions, or that what could be perceived as a lack of interest in science could actually be the result of structural inequalities preventing those people who are interested in science from participating. By asking the individual to assimilate into the status quo as opposed to reflecting on how the organisation itself needs to re-align or reimagine its practice to become more inclusive, IFLIs can serve to perpetuate dominant cultural attitudes and discourses that continue to exclude marginalised, minoritised, disadvantaged and non-dominant cultural groups. As such, there has been an increasing call for IFLIs to shift the narrative away from external barriers and to strive to be more self-reflective in relation to the internal cultures, ideas, assumptions and practices that could serve to increase or perpetuate exclusion.

Responding to these calls to better understand and break down exclusive practice and, as such, the need to better represent the communities they serve, a complex sector-wide shift is currently gaining momentum in which IFLIs are increasingly re-assessing their wider role, beyond access to culture, and towards routes to impact in relation to social justice (Dodd, Sandell, and Resource 2001; Ng, Ware, and Greenberg 2017). IFLIs are identifying ways they can diversify their workforce as well as better connect with, be informed by and respond to the communities they serve (Dodd et al. 2001; Fleming 2003; Ng et al. 2017; Sandell 2003; Taylor 2017). There are increasingly urgent calls to disrupt dominant and excluding narratives, deep-rooted misinterpretations and lack of representation in what is talked about and displayed (Clarke and Lewis 2016; Tolia-Kelly and Raymond 2020; Wajid and Minott 2019). Youth panels, disability advisory committees and community-curated exhibitions and programmes are no longer side projects or programming 'add-ons' but are starting to take centre stage in strategic planning for securing sustainable, long-term funding. Community-centred and community-led practice is becoming more widely adopted in the sector, with increasing sector awareness that IFLIs should no longer position themselves as transmitters of knowledge, but rather as partners, co-creators and collaborators with the publics that they serve. What IFLIs

are starting to respond to is the need to see inclusion as an ongoing, active process, one that requires radically re-shaping or even reinventing practice in order to disrupt organisational deficiencies that perpetuate exclusive practice and cultures. IFLIs should not be attempting a crusade or campaign to bring the (wrongly accused) uninformed or unwilling aboard the ship. Instead they need to be thinking about whether the ship is moving in the right direction of travel to warrant buy-in from potential passengers in the first place. To take this analogy one step further, IFLIs should be striving for organisational change that ensures that these passengers become part of the crew responsible for designing the structural change necessary and steering the new direction for travel.

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Project context 3: community-focussed programming

Tinkering 3 is bringing together experienced IFLI partners from across Europe who are well-placed to develop ALE that is community-focussed, inclusive and aimed at supporting socially excluded, disadvantaged, and marginalised groups. The project is embracing a concept of 'allyship' (Ng et al. 2017) as central to its methodological process in which partners seek to create meaningful experiences with and for the participants across lines of social difference. This is discussed in more detail in section 5. A key aim is to work in partnership with, and learn from, local community development organisations at every stage of the project to help us actively listen to, learn from and become more representative of the participants we will be working with, and, in this way, increase the potential impact of each regional project in relation to social inclusion. As part of the initial training activity for partners, each partner will be asked to reflect on their current organisational situation in relation to exclusion at different levels of the organisation and to create a 'roadmap' for organisational changes that need to be made to become more

inclusive. This will be informed by the ongoing work of the Equity, Diversity and Inclusion Working Group at ECSITE (a pan-European advocacy group) who are designing a framework to assist institutions in bringing about organisational change towards equity, diversity and inclusion. Any learning about successful practice in relation to inclusive ALE in IFLIs will be shared with each other, with others in our organisations and with the wider sector. In this way we aim to enhance IFLI practitioner knowledge and skills about inclusive ALE.

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Section 4:
Tinkering as an inclusive approach for 'STEM-rich, skills rich' ALE

So far, we have looked at potential challenges around participation for disadvantaged adults who do not participate in any form of ALE and for whom complex factors can intersect to increase exclusion from ALE provision. With this in mind, we have looked at the potential of IFLIs for supporting inclusive and equitable ALE and have highlighted the critical role of partnership, working with community development organisations in order to support underserved and underrepresented adults in this project in meaningful ways. This will be discussed in more detail again below, where we outline the specific role of Tinkering as an inclusive pedagogy for developing and implementing ALE.

4.1
Tinkering, Learning, Skill Development and STEM Identity: supporting learners with low science capital

Our project advisors, the Tinkering Studio of the Exploratorium in San Francisco, have created a framework for understanding the broad learning areas and specific types of learning and skill development than can be developed using Tinkering pedagogy. This 'Learning Dimensions Framework' has been revised and refined over several years and is shown in figure 2. In the two Tinkering projects preceding this one, this framework has helped guide reflective, critical thinking amongst informal and formal practitioners around the benefits of Tinkering pedagogy and its use when working with diverse audiences and young people facing disadvantage. Importantly, as is discussed in the methodological framework for project 2 'Tinkering EU: Building Science Capital for All', the broad learning dimensions of Tinkering help to 'broaden what counts' as STEM learning in line with a 'Science Capital Teaching Approach' which focuses on using and deeply valuing the personal experiences and skills that the learner brings with them (Godec, King, and Archer 2017; Xanthoudaki, Harris, and Winterbottom 2018).

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. A summary of the opportunities that Tinkering affords for developing 21st century skills was developed as part of the first EU Tinkering project and is summarised in figure 3.

Tinkering is a hands-on, minds-on approach in which the learner takes control of their own learning and is given time, space and opportunity to think with their hands,

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LEARNING DIMENSIONS
of Making & Tinkering

Valuable learning experiences can be gained through making and tinkering.

Use this framework to notice, support, document, and reflect on how your tinkering environment, activities, and facilitation may have supported or impeded such outcomes.

Initiative & Intentionality

- Actively participating
- Setting one's own goal
- Taking intellectual & creative risks
- Adjusting goals based on physical feedback and evidence

Problem Solving & Critical Thinking

- Troubleshooting through iterations
- Dissecting the problem components
- Seeking ideas, tools, and materials to solve the problem
- Developing work-arounds

Conceptual Understanding

- Making observations and asking questions
- Testing tentative ideas
- Constructing explanations
- Applying solutions to new problems

Creativity & Self-Expression

- Playfully exploring
- Responding aesthetically to materials and phenomena
- Connecting projects to personal interests and experiences
- Using materials in novel ways

Social & Emotional Engagement

- Working in teams
- Teaching and helping one another
- Expressing pride and ownership
- Documenting / sharing ideas with others

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Figure 2: The Tinkering Studio's Learning Dimension of Tinkering, from: https://tinkering.exploratorium.edu/ learning-dimensions-making-and-tinkering

to puzzle things out, and to design and test ideas in an iterative way. While there is usually a broad goal set at the start of the experience, as the learner explores materials and ideas, they are encouraged to develop their own goals which come from their personal interests and motivations. In this way, Tinkering is a highly personal and learner-centred approach which meets the learner at their own level and pace and enables them to use their existing skills, as well as to test and try out new ones. Evaluation work from project 2 has indicated this can build motivation and confidence in disadvantaged young people who feel less confident with STEM learning. It is our hypothesis for the current project, that these intrinsically personal and motivational elements of Tinkering will translate into successful use of Tinkering with an adult audience. Tinkering should enable adult learners to pursue learning goals that are of interest and relevance to their own lived experiences within a STEM learning framework. In this way, Tinkering has the potential to help increase their STEM identity: that is, the learner's sense that STEM learning is 'for them' and relevant in their lives.

Further evidence from project 2 suggests that Tinkering can support individuals facing specific disadvantage (such as speaking a different language, having a disability or not having had as much exposure and opportunity for STEM learning) because of the way it helps 'level the playing field', therefore creating a more equitable learning space. Specific examples of how Tinkering increases equity for disadvantaged learners (highlighted by teachers participating in Tinkering 2 via an online reflection tool), include the way that Tinkering:

▶ reduces language burden because it does not require technical, scientific terminology.
▶ encourages language development through interactions between individuals and materials as they work in a hands-on way.
▶ meets learners at their own level and pace.
▶ encourages 'hidden talents' to come to the fore.

▶ provides a space and place for the learner to use and demonstrate their strengths and talents rather than imposing from the top down what those strengths should be or look like.

Project Context 4: using and further refining tried-and-tested methods

Each project partner will utilise Tinkering pedagogy as an inclusive approach for ALE workshops. The aim will be to create personally meaningful, motivational and engaging learning experiences that can help to develop individuals' confidence with STEM and/or STEM identity. Importantly, the partners will be working to tweak Tinkering activity design and facilitation methods in order to maximise their effectiveness when working with their target groups. Adult learners will be recruited through partnership work with associate community partners who will help inform the workshop design.

21st century skills	Opportunities that Tinkering experiences provide for developing these skills
Creativity and divergent thinking	• Using a wide range of idea creation techniques e.g. planning, sketching, brainstorming. • Developing unique strategies, tools, objects or outcomes. • Creating new ways to use materials or tools. • Setting personal long and short-term goals and planning ways to achieve these.
Ingenuity, inventiveness, innovativeness	• Using or modifying others' ideas or strategies to create something new. • Demonstrating originality and inventiveness. • Understanding and experiencing real world limits to new ideas and goals. • Coming up with novel solutions and possibilities when faced with problems or obstacles.
Communication and collaboration	• Incorporating input and feedback from other people (e.g. peers or a facilitator) into their work. • Developing, implementing and communicating new ideas to others effectively. • Being open and responsive to new and diverse ideas.
Problem solving, critical thinking and strategic thinking	• Posing problems to solve. • Identifying emerging problems. • Coming up with solutions or methods to try to find solutions. • Elaborating, refining, analysing, testing and evaluating ideas. • Planning steps for future action.
Courage, resilience and taking informed risks	• Persisting to optimise strategies or solutions. • Viewing failure as an opportunity to learn – getting stuck and working to become unstuck. • Trying something new or never (personally) attempted before. • Trying something where there is a lack of confidence in outcome. • Becoming comfortable with a process of small successes and frequent mistakes. • Persisting toward a goal in the face of setbacks or frustration.
Lifelong learning	• Striving to understand e.g. exploring confusion and/or obstacles to build new understanding. • Connecting to prior knowledge, including STEM concepts. • Employing what has been learned during explorations. • Complexifying thinking and understanding by engaging in increasingly complicated and sophisticated work.

Figure 3: Tinkering opportunities for developing 21st century skills adapted from P21 definitions framework (Partnership for 21st Century Learning, 2015) as part of 'Tinkering: Contemporary Education for Innovators of Tomorrow'.

Section 5:
Project Methods Overview

This final section provides a summary of the methods the project partners will use to develop their regional ALE projects for adults who are under-represented or underserved by ALE in their regions. It concludes with an overview of the planned regional projects, showing the breadth of groups targeted across the consortium and the key objectives and outcomes for the individual regions.

5.1
Seeding new partnerships between IFLIs and the community development sector

Over the next three years, this project will utilise the Learning Dimensions of Tinkering as a means of supporting disadvantaged adult learners who may have relatively low levels of experience and confidence in STEM. Importantly, at the start of the project the partners will be trained by experienced practitioners from the Tinkering Studio in how best to facilitate Tinkering activities in using techniques which spark, sustain and deepen engagement and learning for wide-ranging audiences. Figure 4 shows the facilitation framework developed by the Tinkering Studio that will form the basis for training discussions which will also critically reflect on existing facilitation techniques and how this could be adapted to be made more inclusive for the target groups.

Building on the work already undertaken at the European level to use Tinkering pedagogy with diverse audiences, and again working closely with the Tinkering Studio of the Exploratorium in San Francisco, this project will train a European team of IFLI practitioners to develop and deliver Tinkering sessions with adult learners. Critically, each IFLI project partner will develop its own regional partnership with one or more community development organisations already working with disadvantaged or marginalised adult groups. Following the successful model of developing reflective practice across the formal and informal sectors used in project 2 (Xanthoudaki et al. 2018), this project will bring together practitioners from across the IFLI and community development sectors to think about and reflect on the benefits of Tinkering for skill development, learning, and STEM identity for the target participation groups. This learning will be used to tweak and refine the design of Tinkering activities to support STEM learning for the target adult groups. The target groups have been identified by each partner organisation based on existing low participation rates in ALE, in informal science learning and/or because they are facing disadvantage in relation to social, economic, political, or cultural exclusion.

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5.2
Community-centred, participatory design: using a concept of allyship to inform partnership work

In all cases, the target groups are adults who are likely to have relatively lower levels of Science Capital, that is, relatively lower science networking opportunities, and fewer opportunities to take part in science and experiences of science that would help them to identify with science and help them feel that science is 'for them'.

As already discussed, effective partnership work is critical to the success of each regional project. Each regional IFLI will partner with a community development organisation who will help guide, inform and shape the direction of the project in relation to the specific needs of the target group. Ideas for creating inclusive Tinkering activities will be generated and discussed, initially, at the C1 training events between Tinkering Studio, IFLI staff and inclusion experts. These ideas will be further modified and refined in collaboration with the community partners.

Section 2 highlighted the complex reasons for non-participation in ALE where many causal factors are in dynamic interplay and section 3 looked at the role of IFLIs for supporting a social justice agenda and creating more equitable and inclusive experiences for underserved and marginalised groups. In this project, the partners will be consciously reviewing and adapting existing working methods to help break down potential barriers for participation, as well as learning to better empathise with, understand, and learn from adult groups they will be working with. The partners will be striving to become better 'allies' for the underserved or marginalised groups that they will work with by:

- acknowledging the current practices of their own organisation which may inadvertently exclude, oppress or mispresent these groups.
- acknowledging, surfacing and disrupting potentially oppressive or excluding behaviours, and ensuring these are not inadvertently perpetuated in the ALE workshop design or facilitation.
- critically reflecting on the existing relationship between the organisation and the target group, and the ways in which the organisation can create a welcoming, representative, relevant and personally meaningful experience for the participants.
- actively listening to and learning from the participants themselves, which could be in the form of co-developed activities or through effective evaluation that informs future planning for ALE.

• ensuring that what is learned from the project is widely disseminated to colleagues, other organisations and the wider sector.

Figure 5 illustrates the community-centred, participatory design methods for the project. These will create a cycle of continuous shared learning across the IFLIs and community development sector. Working in partnership will help serve to shape and inform more inclusive practice and enhance social inclusion.

Importantly, each regional IFLI will be working with a different target group and for this reason, the specific methods they will employ, and the outcomes they will be working towards, will differ. The final section, 5.3, provides an overview of each of the five regional projects. These projects will be evaluated as case studies, as part of ongoing monitoring and evaluation where key learning will be gathered from both within and across the individual cases.

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Facilitation Field Guide

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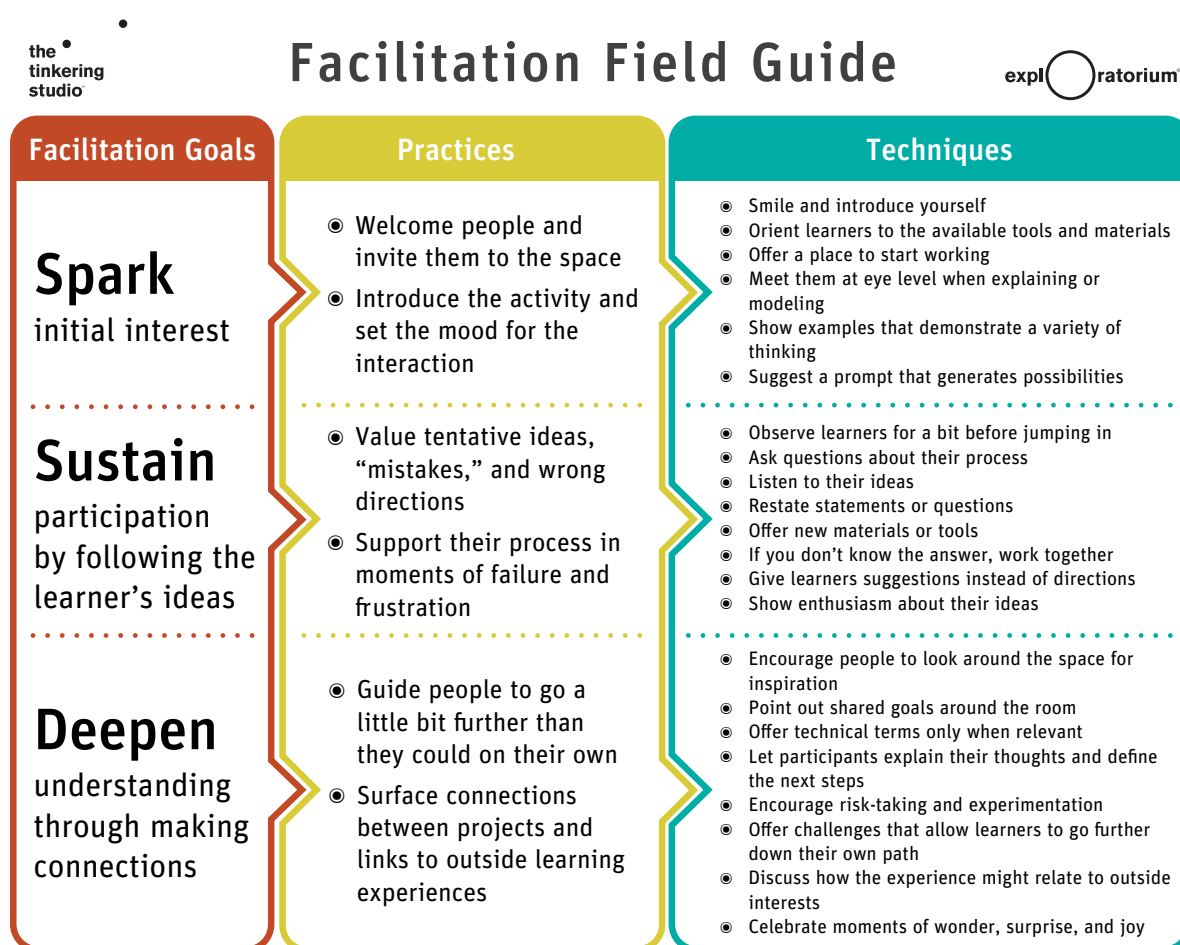| Facilitation Goals	Practices	Techniques
Spark initial interest	◉ Welcome people and invite them to the space ◉ Introduce the activity and set the mood for the interaction	◉ Smile and introduce yourself ◉ Orient learners to the available tools and materials ◉ Offer a place to start working ◉ Meet them at eye level when explaining or modeling ◉ Show examples that demonstrate a variety of thinking ◉ Suggest a prompt that generates possibilities
Sustain participation by following the learner's ideas	◉ Value tentative ideas, "mistakes," and wrong directions ◉ Support their process in moments of failure and frustration	◉ Observe learners for a bit before jumping in ◉ Ask questions about their process ◉ Listen to their ideas ◉ Restate statements or questions ◉ Offer new materials or tools ◉ If you don't know the answer, work together ◉ Give learners suggestions instead of directions ◉ Show enthusiasm about their ideas
Deepen understanding through making connections	◉ Guide people to go a little bit further than they could on their own ◉ Surface connections between projects and links to outside learning experiences	◉ Encourage people to look around the space for inspiration ◉ Point out shared goals around the room ◉ Offer technical terms only when relevant ◉ Let participants explain their thoughts and define the next steps ◉ Encourage risk-taking and experimentation ◉ Offer challenges that allow learners to go further down their own path ◉ Discuss how the experience might relate to outside interests ◉ Celebrate moments of wonder, surprise, and joy

Figure 4: Facilitation Framework for Tinkering created by the Tinkering Studio ©Tinkering Studio https://www.exploratorium.edu/tinkering/our-work/learning-and-facilitation-frameworks
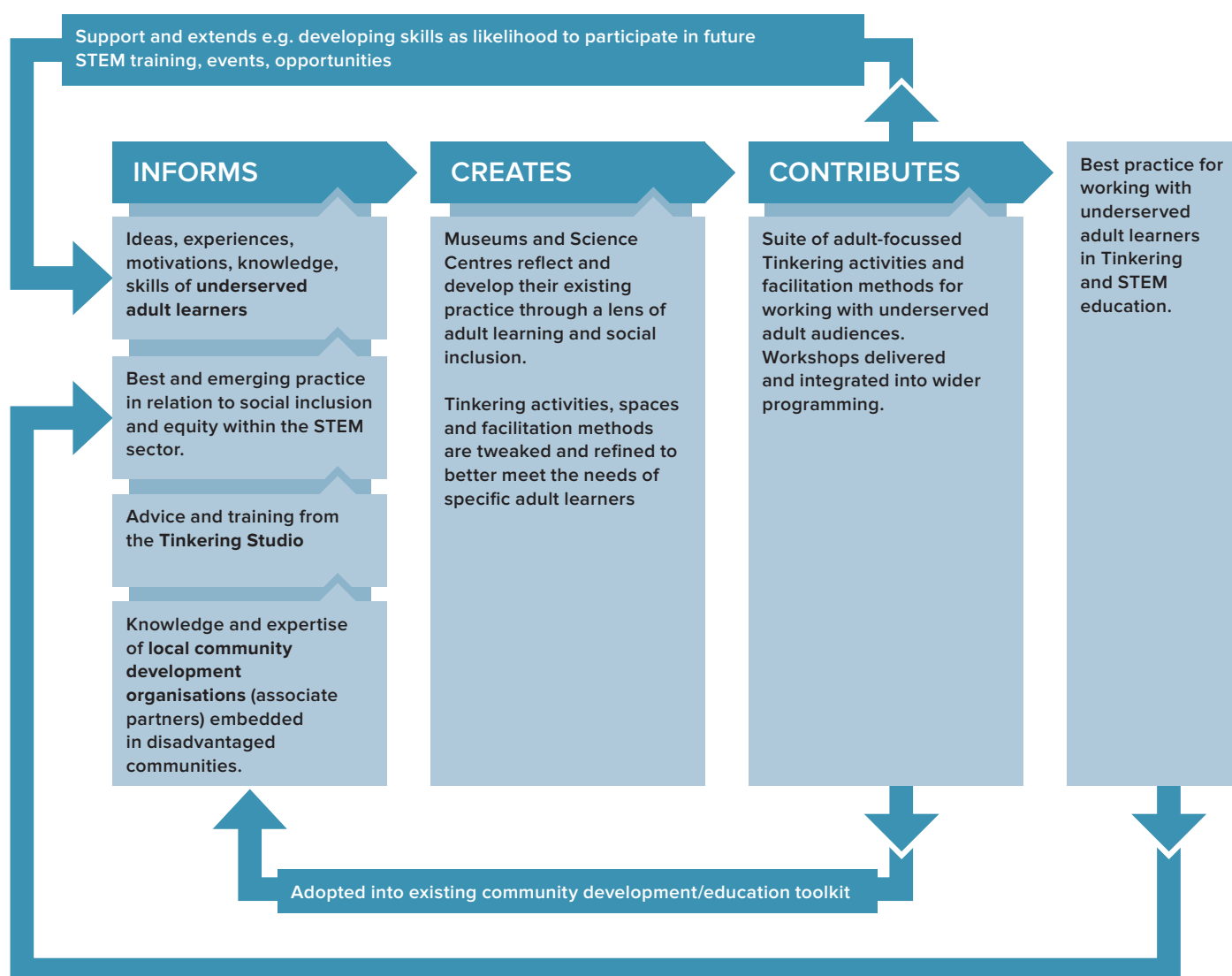
Support and extends e.g. developing skills as likelihood to participate in future STEM training, events, opportunities

INFORMS

Ideas, experiences, motivations, knowledge, skills of **underserved adult learners**

Best and emerging practice in relation to social inclusion and equity within the STEM sector.

Advice and training from the **Tinkering Studio**

Knowledge and expertise of **local community development organisations** (associate partners) embedded in disadvantaged communities.

CREATES

Museums and Science Centres reflect and develop their existing practice through a lens of adult learning and social inclusion.

Tinkering activities, spaces and facilitation methods are tweaked and refined to better meet the needs of specific adult learners

CONTRIBUTES

Suite of adult-focussed Tinkering activities and facilitation methods for working with underserved adult audiences. Workshops delivered and integrated into wider programming.

Best practice for working with underserved adult learners in Tinkering and STEM education.

Adopted into existing community development/education toolkit

Figure 5: Participatory project methods

5.3
Regional approaches

Wide-ranging target groups have been identified across the IFLI partners. As discussed, the reasons for non-participation in ALE amongst these groups are likely to be multiple and potentially complex. For this reason, alongside working with experienced community partners, a flexible approach to project design will be used to enable partners to develop bespoke sessions for the groups they will work with. Such sessions could take place in a variety of locations, for different duration, and across short- or longer-term (e.g. one-off versus series of workshops).

Case 1: NEMO, Amsterdam, Netherlands

Target group
Adults who face low income and social issues. Some of them are unemployed. Although they engaged in formal education, they may not have completed it. This may have been because of social, emotional and behavioural difficulties. Some of the adults will be people who have lost their jobs and would like to gain more skills to help them back into employment. The participants in our target group are likely to have relatively low levels of science capital and are most likely not familiar with STEM learning.

Associate/community partner
1. **Workfast**: a Dutch company that works for Municipalities in The Netherlands. Their core business is to coach people who are unemployed and dependent on welfare back into the job market and they strive to help them become self-supporting and independent of welfare support.
2. **Cre8**: a Dutch Social Venture offering traineeship for young people in Amsterdam, which provides them with a way into the labour market and offers them structure and guidance in an inspiring work environment.

3. **Tinkersjop**: an organisation in Curaçao working with families, schools and adults to get them acquainted with STEM and give them the opportunity to develop knowledge and skills. The target group is diverse in age, but all come from a low economic and social background.

Aims and outcomes
We are conscious that a single, standalone Tinkering workshop will not be sufficient to generate extensive skill development for each individual. However, the impact of our work is with and through the work of the associate partners. We will develop Tinkering experiences for their participants, which enhance longer programmes of development that the participants are part of with the associate partners.

Through the Tinkering experiences, we are planting a seed in the minds of the participants that this sort of STEM experience is 'for them', as opposed to being 'for other people', by creating experiences that resonate and really value their lived experiences, interests and needs. We will be giving our target group an opportunity to learn in an inviting STEM setting. By doing so, we hope that this will lead to increased self-confidence with STEM and to greater confidence to participate in similar experiences in the future. Currently our target group is not familiar with STEM learning, so the Tinkering experiences will hopefully bring about a positive change in this area.

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Case 2: ScienceCenter-Network, Vienna, Austria

Target group

Adults mainly between 18 and 29 years old who are refugees and migrants. Participants in our target group do not meet the minimum criteria for entry into the regular school system either because they are too old, because they do not have a place of residence in Vienna or because they do possess the required basic competencies in Math, English and German. These adults need to gain an educational certificate to access higher education or employment. For some it will be an important part of demonstrating integration as a part of applying for asylum. Most of the adults we will work with in this project will be applying for asylum or will have been granted asylum. Their only chance of getting an educational certificate is through special courses offered by associations like Vielmehr für alle and Peregrina (see below). Both offers are free, with a low threshold for gaining entry.

Associate/ community partner

1. **Association 'Vielmehr für alle' ('much more for everybody'):** an association supporting refugees in education, housing and participation. Their work manifests in a triangle of social work, education, social inclusion / community work. They offer:
    - **Education**: via the PROSA school (PROject School for everyone) which offers special education courses for adults, helping them complete compulsory schooling in Austria.
    - **Culture**: via Café PROSA, which is a cultural centre, offering workshops, events, a place of encounter and support and counselling.
    - **Living**: via the workstrand 'refugees welcome in Austria'. This offers to help refugees to find affordable housing within society, helping to work against isolation and segregation.

    - **Works**: via 'work:in' a project supporting young refugees to access the professional world via excursions, vocational orientation courses, CV support etc.
    - **Social Network**: their 'home' work strand which helps the young people to find their place within Austrian society to feel safe. This involves a buddy to support exchange.

2. **Association Peregrina – Bildungs-, Beratungs- und Therapiezentrum für Immigrantinnen** (Education, Counseling and Therapy Centre for Immigrants): a centre for migrant women and their families who could be refugees, asylum seekers and/or jobseekers. Peregrina offer information and advice in legal and social matters including career and education advice. They offer German language courses and special courses to complete compulsory schooling. Their multi-professional team can be contacted for psychological counselling and therapy which is free of charge and anonymous.

Aims and outcomes

Opportunities in the Austrian labour market are much greater if these adults pursue qualifications, training, or work within a STEM field. Each experience that they have in these areas can help them gain employment and useful skills. Our project aligns with the education work of our two associate partners which builds on the national curriculum for adult education and is supplemented by a range of non-curricular projects, for example, on climate protection. As well as content knowledge, 'learning how to learn´ is an important element of their education programs. This aligns well with our project approach. By engaging the students in STEM learning using Tinkering pedagogy, we are introducing them to a highly learner-centred and personalised approach that they are unlikely to have experienced before. We hope to pique their curiosity in STEM whilst also helping them capitalising on this opportunity to connect with other

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STEM networks in Vienna that might be useful for their education and training, including our pop-up science centre ('knowledge°room'). In this way, we hope to reduce barriers for participation and to boost opportunities for those with low science capital.

Case 3: Copernicus, Warsaw, Poland

Target audience

We will be working with adults aged 35-45, living in Warsaw and its suburbs, who have relatively low social and science capital. They are on lower incomes and may be in financial difficulty. Many of them will be living from payday to payday with potential employment insecurity. We are targetting adults who have children and who do not have the financial resources to invest in their children's STEM-related education, but do see the value in it. These are adults who are likely to have low confidence and skills in STEM and who will not have experienced learning in this way before. They will be adults who live close to our Copernicus Science Centre but who do not usually visit due to a range of potential barriers such as time and family constraints or a perception that STEM is not something that is useful or relates to their lived experiences.

Associate/ community partner

We are partnering with Foundation 'W sercu Matki' ('Mother's Heart'), a social inclusion charity which supports adults and and families facing social or economic difficulty through educational and cultural activities, healthcare and health promotion and social assistance. Their broad objectives include the following:

- Supporting women, men, children, and young people and entire families by developing skills and talents
- Supporting family development as a place of growth for both children and parents
- Supporting mothers in their role as parents
- Counteracting social and professional exclusion of people because of disability
- Counteracting social and professional exclusion of people because of having children
- Supporting lone-parents

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Aims and outcomes

We are aiming to adapt one of our existing and successful workshops that we currently run for children at the science centre, which involves constructing a tower using basic materials. We want to help the adult participants feel more confident with STEM learning by modelling an engaging activity that can be done using very simple, low-cost and readily available materials. The activity also develops wide-ranging skills including teamwork, communication, resilience, design, creative thinking, problem-solving and numeracy.

Our broad aim is to show particpants that STEM learning is engaging and to break down potential barrriers they may have around particpating in STEM learning. We hope to inspire them to carry on this type of learning at home with their families using tools they have in their homes. We also want to show them different ways of thinking where an adult can identify problems to be solved, make them explicit, and develop strategies to solve them. We hope that the experience will help build self-confidence and perhaps inspire them to connect further with our science centre, coming for further visits or taking part in other STEM learning opportunities that could help with their own development, as well as that of their families.

Case 4: Fondazione Museo Nazionale della Scienza e della Tecnologia Leonardo da Vinci, Italy

Target audience

The target group will be women living together with their children in protected homes because they have been victims of domestic violence or are in situations of poverty or social disadvantage. Most of them are either unemployed or have temporary jobs. The Tinkering activities will be designed for mothers to do with their children in a comfortable, family-friendly learning environment that helps bring the adult into the learning process for themselves as an adult learner alongside their role as facilitator of their child's learning.

Associate (community) partner(s)

Our associate partner is 'Caritas Ambrosiana,' a philanthropic organisation associated with the Catholic Church in Milan. Established in 1963, Caritas Ambrosiana carries out a range of initiatives to support people with social, health, community and welfare needs. As such they work with a diverse range of people facing social, economic and cultural disadvantage including:

- People with issues relating to addiction
- People with issues relating to mental health
- People suffering from domestic violence
- People with HIV-Aids
- Prostitutes
- Older people
- Prisoners
- People with disabilities
- Marginalised groups including the Milanese Roma community
- Refugees
- Families and children

Aims and outcomes

We are aiming to develop activities that encourage cooperative learning between adult and child, and

which invite engagement in a personally meaningful and creative journey. Through the design and implementation of the workshops we aim to:

- Encourage the inclusion of individuals in situations of disadvantage and help increase their self-esteem.
- Create a positive relationship with STEM for individuals who do not necessarily normally identify with STEM or feel that this is something of relevance to them.
- Provide stimuli that could help support women in their role as educators of their children.
- Help to increase maternal awareness and understanding of the importance of building skills and competences for themselves and their children.
- Create conditions for developing self-esteem and overcoming the reluctance to engage in STEM-oriented activities.

Case 5: Traces, Paris, France

Target group

Target group 1: adults incarcerated at the Melun Detention Centre in the Paris region. They are all male, 18 years-old or older, with diverse backgrounds and scientific cultural capital. They are a hard-to-reach group because they cannot or can only very rarely leave their place of detention. They do not have access to scientific-cultural programmes outside their place of custody and can only access what is offered internally. Most have low confidence in their skills and are unlikely to have had opportunities to experience or experiment with STEM learning activities, however, they are interested in discovering and experiencing new things.

Target group 2: young adults aged between 18 and 25 years who are part of the 'Regional Integration Programme'. This programme aims to support the development and evaluation of young people's skills, particularly social and behavioural skills required for social and professional integration. The beneficiaries of the Regional Integration Programme are young people finding social or professional integration difficult. This could be for a range of reasons including low levels of education, minimal or no qualifications or because they face exclusion, for example due to disability or because they have entered France as an unaccompanied minor.

Associate/community partner

1. The service organising and delivering cultural and training activities at the Melun Detention Centre. Since 2020 we have worked with them to help them run scientific workshops. We will work with the employees of this service who will be our community leaders. The activities currently organised differ from the Tinkering pedagogical approach and the team are interested in exploring Tinkering as a new learning opportunity for the detainees.
2. The educator team in 'Regional Integration Programme'.

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Aims and outcomes

We are aiming to adapt our activities to an audience we do not usually target. We want to:

- Understand how it is possible to adapt these workshops within the constraints of a detention centre.
- Help these detained men have more confidence in their own technical, pedagogical, and creative skills.
- Support employees of the cultural and training department of the detention centre to become more aware of and more confident with STEM learning opportunities using Tinkering pedagogy.

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