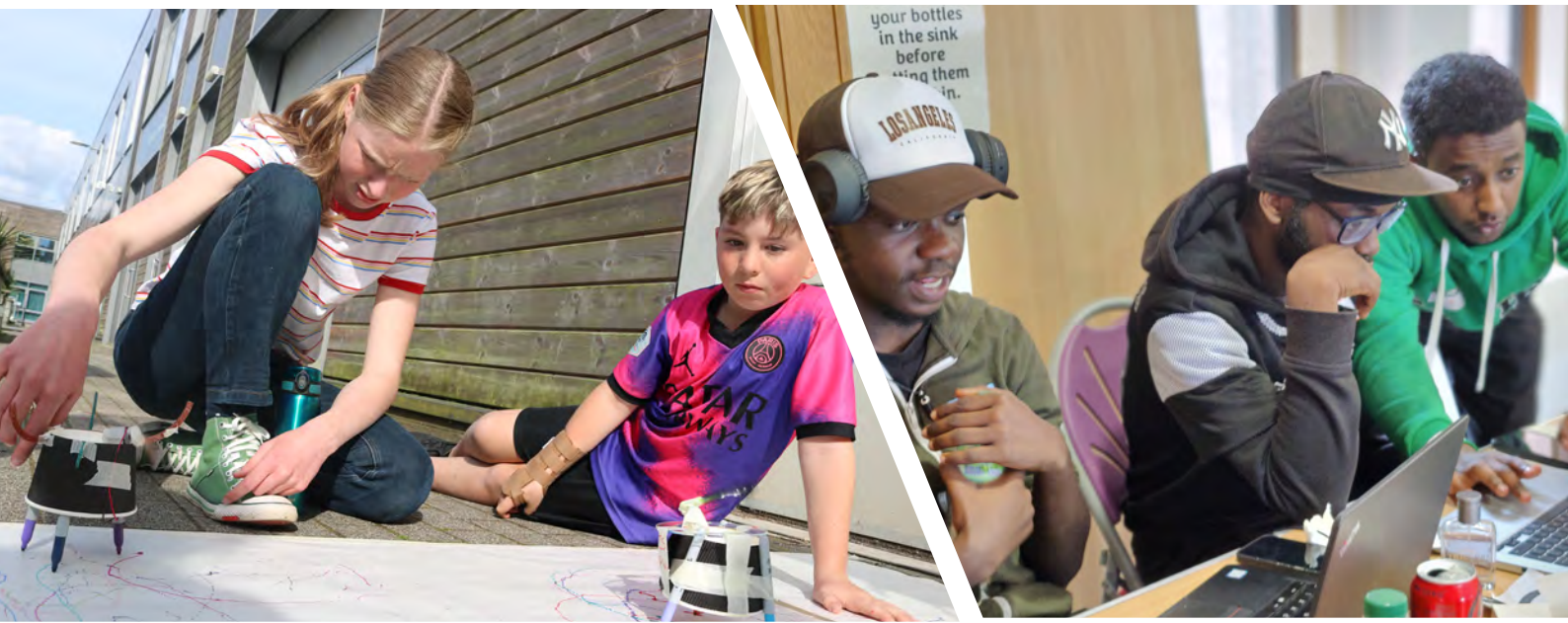


MAKING SPACES 2:
**Impact and
evaluation
report**

2024



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Making Spaces 2: Impact and evaluation report

This report summarises the activities and impact of the Making Spaces 2 project. It explains the project, describes how it was conducted, and considers the extent to which it was delivered as intended. It also covers what impact its activities had on participating practitioners, organisations and young people. Illustrative case studies are included to exemplify findings and convey the richness of the impact achieved.



1. About the Making Spaces 2 project

The Making Spaces 2 project (2022 to 2024) was led by Professor Louise Archer at UCL and funded by Lloyd's Register Foundation. It aimed to increase knowledge and identify equitable practices which support diverse young people's engagement with STEM (Science, Technology, Engineering, Mathematics). The focus was on makerspaces, which are informal, hands-on STEM education or activity spaces. The project explored how to increase the agency of diverse young people, challenge inequalities, and support positive outcomes.

Makerspaces are often heralded as sites that can increase youth engagement with STEM. However, there is currently a lack of support and resources to help practitioners understand equity issues and adopt inclusive practice. Improving this could support the participation of young people from marginalised and underserved communities. Like other informal STEM learning settings, the people who run makerspaces need to understand and embed equity issues into practice so they can avoid reproducing social injustices through their everyday activities. This project sought to develop and extend the understanding of what socially-just youth practice in makerspaces entails. The purpose was also to translate insights into co-produced, practical, and accessible resources to inform and improve international STEM education policy and practice in and beyond makerspaces.

Building on the first phase of the project – Making Spaces (2020 to 2022), Making Spaces 2 (2022 to 2024) expanded its partnerships to collaborate with practitioners and young people from international makerspaces¹ in the United Kingdom, United States, Nepal, Slovenia, and Palestine. The work involved a partnership with practitioners, young people and advisory board members around the world (see Table 1 for the data collected and participant numbers).

Based on the data collected across these international contexts, the partners co-developed, implemented and evaluated the 3-Steps Towards Equitable Practice (3-STEP) approach. This approach helps practitioners to develop an equity mindset ('prepare'), put equity ideas into practice ('do'), and capture and reflect on how equitable their practice and attempts have been ('evaluate'). Guidance on how to use the approach (along with examples, ideas and case studies from partner settings) are provided in a guidebook and via a multimedia massive open online course (MOOC), produced by the UCL research team and partners. Together, these resources help support practitioners to understand, develop, extend and evaluate equitable practice within their settings.

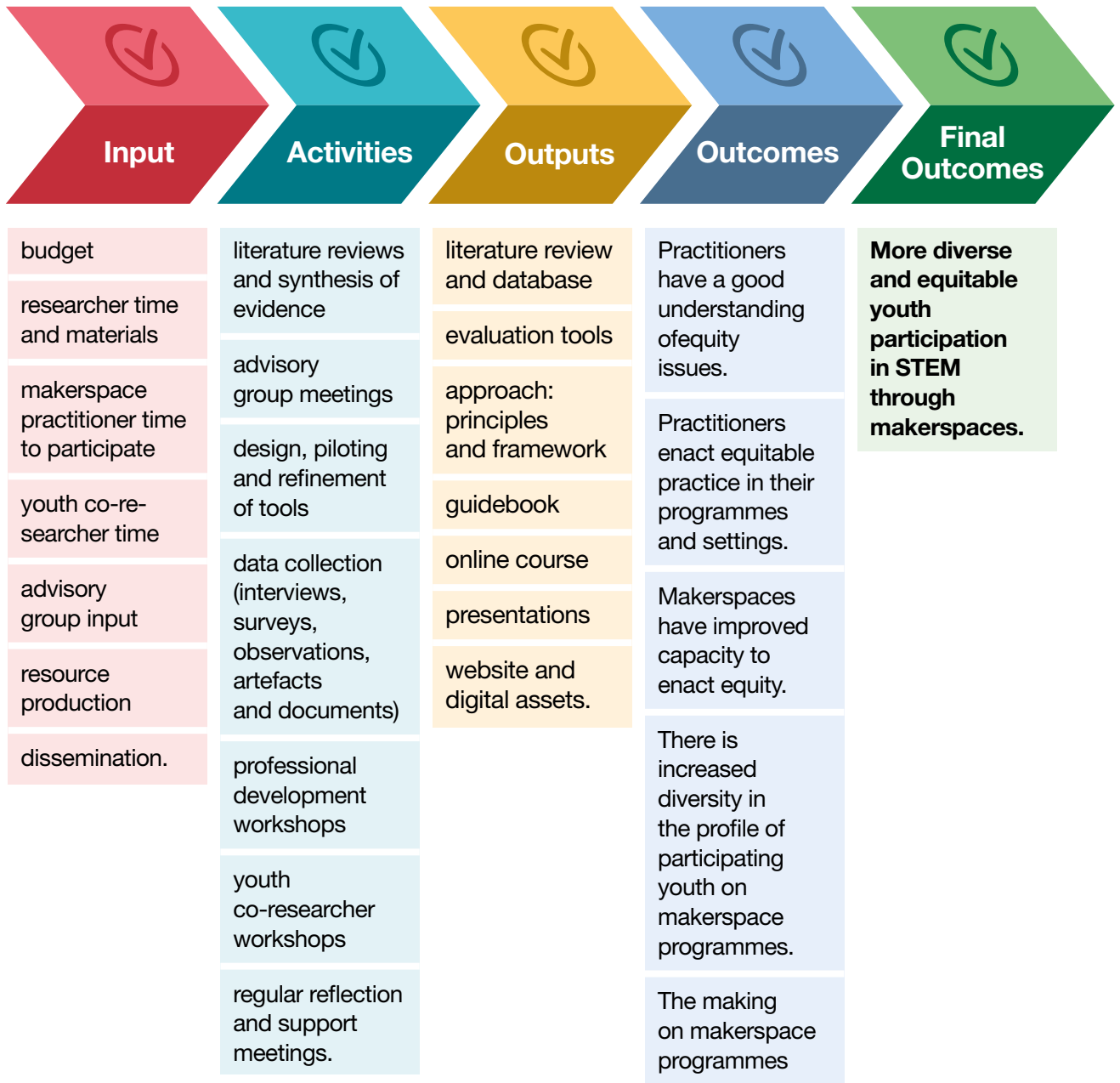
The overarching aim of the Making Spaces 2 project was to develop new, evidence-informed knowledge and resources to support equitable and inclusive practice in makerspaces. Specifically, the project aimed to work in partnership with practitioners and youth to co-develop evidence-based resources that can:

- **Improve (increase and extend) practitioners' understanding and confidence in addressing equity and inclusion issues within their practice.**
- **Help implement and embed equitable forms of policy and practice within makerspaces.**
- **Increase and diversify youth participation in the makerspace programmes involved in the project.**
- **Support equitable outcomes for participating youth.**
- **Increase capacity in the sector for equitable practice.**

¹ This included six makerspaces that actively implemented the approach and one further makerspace that participated in an advisory capacity.

The Making Spaces 2 project was guided by the theory of change detailed in Figure 1.

Figure 1: Theory of change for the Making Spaces 2 project



There were some key assumptions driving the project, as follows:

- There is a need for additional resources to support more equitable and inclusive practice in makerspaces.
- To be effective and equitable, the project and the resultant resources need to be: (i) strongly informed by existing international evidence and literature; (ii) co-produced with stakeholders to ensure they are valid, relevant, accessible, attractive and ‘close to practice’.
- Partners need to be carefully selected and appropriately resourced and supported throughout the project, to ensure they can engage and contribute fully.
- An understanding of equity issues, plus time and support to engage in regular critical reflection, are key requirements for practitioners to undertake effective equitable practice.
- Equitable approaches to governance, access, outreach, and pedagogy help to increase and diversify participation within makerspaces. This can result in positive equitable outcomes for youth.
- Resources to support equitable practice need to be high quality, co-designed, iterated, and ‘close to practice’. These will help increase capacity within the sector for diversifying participation in STEM.



2. Data and evidence

To evaluate the implementation and impact of the Making Spaces 2 activities, the team collected a range of multimodal data from various sources, as detailed in [Table 1](#) (main data) and [Table 2](#) (supplementary data).

Data were primarily collected by university researchers and youth co-researchers (the latter being supported by the academic team).

The project also developed two survey tools – an equity barometer survey to capture young people’s experiences and perceptions of the equity ‘climate’ within a makerspace, and a tool to [capture equitable youth outcomes from participation](#).

Table 1: Summary of data collected in the Making Spaces 2 project

Data	Number of	Overall total
Youth interviews	Interviews	88
	Participants	85
Practitioner interviews	Interviews	33
	Participants	28
Parent interviews	Interviews	6
	Participants	6
Practitioner feedback or reflection meetings	Meetings	104
	Participants (number of practitioners)	27
Youth co-researcher workshops	Workshops	23
	Participants (number of youth co-researchers)	34
Short endline practitioner survey	Surveys	25
Observations	Observations conducted	61
Equity barometer survey	Participants	80
Youth quick check survey	Participants	119
Other youth co-researcher research activities	Activities (e.g. online research, personal reflections etc)	12

Table 2: Supplementary data² on the Making Spaces 2 project outputs

Data type	Detail
Funding secured by partners for programmes that implement the approach	Over £2 million (during Making Spaces 2) Additional £1.6 million (for extending the approach)
Download numbers of the 3-STEP resource guidebook (in the four months after publication)	English – 504 Arabic – 52 Slovenian – 43 Nepali – 64 Total – 663
Enrolments on the MOOC (in the four months after launch)	507
Number of participant comments or pieces of feedback on the MOOC (in the four months after publication)	383
Number of practitioners who took part in MOOC beta testing	15
Advisory group engagement	10 members, bi-annual consultations and interim feedback on drafts
Number of young people engaged in makerspace programmes during the project	2,880



² All the data on downloads of the guidebook and enrolments of the MOOC are from 25.11.2024.

3. Implementation

Was the project implemented and delivered as intended?

The purpose of this project was to co-develop tools and resources to support equitable practice within makerspaces that would be effective, relevant and attractive to practitioners.

To ensure a robust basis for development, an initial review of existing literature and evidence was conducted. This focused on the understanding and support of equity within makerspaces and informal STEM learning settings in Global North and South contexts, prioritising work that was conducted from a critical, social justice perspective.

This review surfaced 180+ international studies, which were organised in an annotated database and written up into a set of thematic working summaries. These working summaries included factors relating to unequal participation in makerspaces by gender, the foundations and benefits of co-production, and others. Review findings were synthesised and integrated into the research process, and used to formulate the core principles underpinning the 3-STEP approach. This was subsequently subject to further iterations and refinements with makerspace partners and advisory group experts.

The advisory group provided oversight, quality assurance of the project principles, and supported the lead team's interpretation of the evidence base. The advisory group also reviewed and approved drafts of the study's underpinning principles and draft tools. Interim data analysis on the implementation of the draft tools and approach, was also used to inform further iterations. The practitioners' reactions, experiences and views of the approach were captured via interviews, audio recordings of meetings and a short endline survey. The views and responses to the approach among wider practitioners were captured via the online discussion board comments of the MOOC.

The project sought to engage effectively and equitably with practitioner partners. At the start of the project, the research team worked with each makerspace organisation to identify potential practitioners to participate, reviewing their appropriateness and capacity to participate, and ensuring a spread of demographics and job roles. Funds were provided to each makerspace to cover staff time and involvement.

To support practitioners' participation, professional development workshops were used at key points in the project to develop knowledge and understanding about equity issues and, in later stages, to ensure fidelity when delivering aspects of the 3-STEP approach.

The participation of practitioners was tracked via registers of attendance, and regular formative check-ins with practitioners were used throughout the project to develop an ongoing, two-way dialogue between researchers and practitioners. These were used to:

- Explore the understanding of participants.
- Address any concerns or misconceptions.
- Support implementation.
- Engage in participatory work, such as co-design and iterating particular aspects of the approach.
- Jointly reflect on data.
- Share feedback on core project aspects, such as whether delivery was faithful to the underpinning principles, and identifying which aspects of the approach needed further improvement and iteration.

We needed to understand practitioners' experiences of delivering the 3-STEP approach and the impact of the approach on their practice, the wider makerspace community, and on young people's outcomes. As such, we collected a range of multimodal data with and from practitioners and youth (see [Table 1](#) and [Table 2](#)).



3.1 Value of project outputs

The project outputs and the 3-STEP approach were found to be evidence-based, relevant, and they were received as being ‘close to practice’.

According to the international advisory group and a peer review of project outputs, the project – and the 3-STEP approach – were strongly informed by key principles and findings from international equity research. The project and 3-STEP approach aligned with critical understanding of good equitable practice, such as using non-deficit, assets-based approaches that support youth agency. The underpinning principles and the resultant approach were endorsed by international advisory group experts via written and verbal feedback.

The 3-STEP approach and resources were well-received by practitioners within and beyond the project, and were regarded as being attractive, easy to use and ‘close to practice’. This was confirmed by stakeholder feedback on the MOOC (beta testing and live course participant discussion boards), interviews with practitioners, and via discussions with audiences at numerous presentations and talks given by the team. This included events the team was invited to specifically in order to share the resources.

3.2. Project delivery

The project was delivered effectively.

The written register of attendance showed regular, frequent engagement in the project among participating practitioners. These practitioners took part in reflective meetings with the research team every two to three weeks on average, over a period of 18 months. Content analysis of practitioner reflections demonstrated their highly positive experiences of the delivery process. Analysis of practitioner interviews, observations and endline surveys showed increased understanding of equity issues as a result of participation in the project. Advisory group feedback showed their positive endorsement of the overall project delivery and the 3-STEP approach.

To evaluate the delivery of the 3-STEP approach, we analysed interviews, meetings and observation data. This analysis indicated initial variable implementation in the first few months of the project. At least one or two practitioners within four out of six settings demonstrated a practice using a faithful and authentic interpretation of the approach. Other individuals, including all practitioners from two settings, showed lighter touch implementation and/or low faithfulness to the approach in their implementation. We used mitigation measures and professional development workshops to help produce more consistent implementation. This resulted in more consistent and faithful implementation across the settings, with the exception of two individual practitioners who did not achieve the threshold level of implementation. Case studies detailing strengths, weaknesses and areas for further iteration are included in the 3-STEP guidebook.

3.3 Learning and reflection points

Overall, the various evaluations found the project and the 3-STEP approach were delivered and implemented effectively. A number of learning points and limitations were identified. These were:

- Using iterative and co-production approaches – and working in partnership over time with practitioners and youth – helped to ensure that outputs were relevant, accessible and ‘close to practice’.
- Participatory working was valuable for shaping the language, design, format and nature of the handbook, the MOOC, and other resources. For instance, a summary poster was created in response to practitioner requests for a short, accessible, visual summary that could be stuck on a door or wall in their settings.
- Having international academic and policy/practice experts on the advisory group helped deepen and extend the project’s grounding within existing evidence and literature. For instance, these individuals highlighted useful publications and resources to the project team.
- While the implementation of the project and the 3-STEP approach was largely effective, there were some examples of reduced or restricted participation in the project. There were also instances when the 3-STEP approach was either not delivered in particular youth programme sessions, or was not delivered faithfully. Reasons for these limitations in implementation included: staff turnover, mismatch of timelines of the project with a particular youth programme schedule in a makerspace, and delays in gaining consent from participating schools and young people.
- Some male members of staff did not participate as fully as hoped, and/or found aspects of the 3-STEP approach difficult to implement in practice. This bears further investigation and consideration in future work to help better understand the barriers to adoption. This should be considered particularly among practitioners who may be newer to – and/or less invested in – equity issues.



4. Impact

To evaluate the impact of the project, researchers collected a range of data over four years (see [Section 2](#)). This was to understand the extent to which our activities supported:

- Improved (increased and extended) understanding of equity and inclusion issues and positive outcomes among participating practitioners.
- Implementation and embedding of equitable forms of policy and practice within makerspaces.
- Increased and diversified youth participation.
- Equitable outcomes for participating youth.
- Increased capacity in the sector for equitable practice.

4.1 Understanding of equity issues

The project and 3-STEP approach improved understanding of equity issues and supported positive outcomes among participating practitioners.

We found evidence that the understanding of equity was improved and extended among practitioners as a result of participating in the project. This was both for practitioners who participated in the project as a whole, and specifically among those who implemented the 3-STEP approach.

In particular:

- 100% of practitioners reported improved understanding of equity
- 96% had more confidence designing youth programmes
- 96% valued young people's voices and input more
- 88% were more aware of diverse youth needs.

See the summary in [Figure 2](#).

Data collected from practitioners over the course of the project also offer some novel insights that help extend existing knowledge regarding Global South practitioners' understanding of equity. For example, makerspaces in the Global South have to navigate equity issues at the national, local and individual level, which can often look very different from Global North contexts.

Figure 2: Understanding of equity by practitioners



"I see a lot of benefit for our organisation ... we find it [the approach] very useful and inspiring."
- Practitioner who participated in Making Spaces 2

The benefits experienced by participating practitioners are illustrated through the following two case studies.

Case Study A: Increased practitioner understanding

A practitioner within a grassroots makerspace was already successfully engaging with many school children and other young people in her makerspace. The project provided an opportunity for her to consider, understand and reflect more deeply on the equity issues within her space, both in terms of youth participation and the pedagogy adopted within their programmes. After participating in professional development workshops and completing the MOOC, the practitioner explained how she had developed a new perspective on her work:

“The project gave me a lot of skills and knowledge around equity issues. I often share these ideas with my staff, colleagues and the teachers now.”

She felt the opportunity to engage in regular critical reflection was particularly crucial for developing an equity approach. She said:

“This project has helped us with reflections, and how to pay attention to what happened during sessions. ‘How do the children interact with the others? Do the children support others? Why [is] this boy ignoring the others? What are the ethical issues when they work together? How [do] we, our staff, deal with the children? Is it with equity or not?’. A lot of questions now start to come in our minds when we observe or run the sessions.”

The practitioner went on to embed reflection as an element within the programme design of the course. She explained how this included critical reflection on issues of power, and the practitioners’ driving assumptions when planning youth sessions. She set up collective reflections among staff to consider why and how sessions should be delivered. She also established regular, post-delivery, all-staff meetings to enable collective critical reflection on how things went.



Case Study B: Practitioners new to equity issues

An engineer turned makerspace practitioner had been co-managing a makerspace for over a year before collaborating with the Making Spaces 2 project. While she was passionate about increasing the participation of women in STEM, particularly among those from marginalised backgrounds, this was not being achieved in the makerspace. She wanted to use the Making Spaces 2 collaboration to learn about how to set up and run youth programmes that support young women to participate in meaningful ways.

She used the opportunity to learn about and try out different recruiting strategies. This included going into local schools to give talks on the makerspace, designing accessible outreach materials, and re-designing the format of the outreach programme modules. She reflected that to engage young people – particularly girls – in the makerspace programmes, she had to work hard to create a space that offered more than just ‘hard skills’ training. She said:

“Hard skills ... is easy to learn, I would say. But the programme developed softer [skills too]. Particularly among the female students coming for the workshops, we saw they were gaining this soft skill, for example, to be able to talk for themselves, and gain confidence in expressing ideas. The things that actually matter in your life and career.”

She also found that the project provided her an opportunity to talk about gender issues with her makerspace colleagues, creating a space for staff reflection. She said:

“I have always found it difficult as a woman in this field, because it is a male-dominated sector. This project provided an opportunity to share these ideas with my colleagues. I have started talking about this. For example, the need for doing a girls-only programme... This has sometimes led to heated discussions, but it has helped normalise these issues within our organisation.”

While the practitioner later left the organisation and moved on to a new job within the sector, she reflected on how the Making Spaces 2 experience made equity a central concern that continued in her new role. She said:

“Even while I am writing down the strategy at the moment [for my new job], equity is something I have in my mind – so I think that is how this project has played a role in my life.”

4.2 Implementing and embedding equitable practice

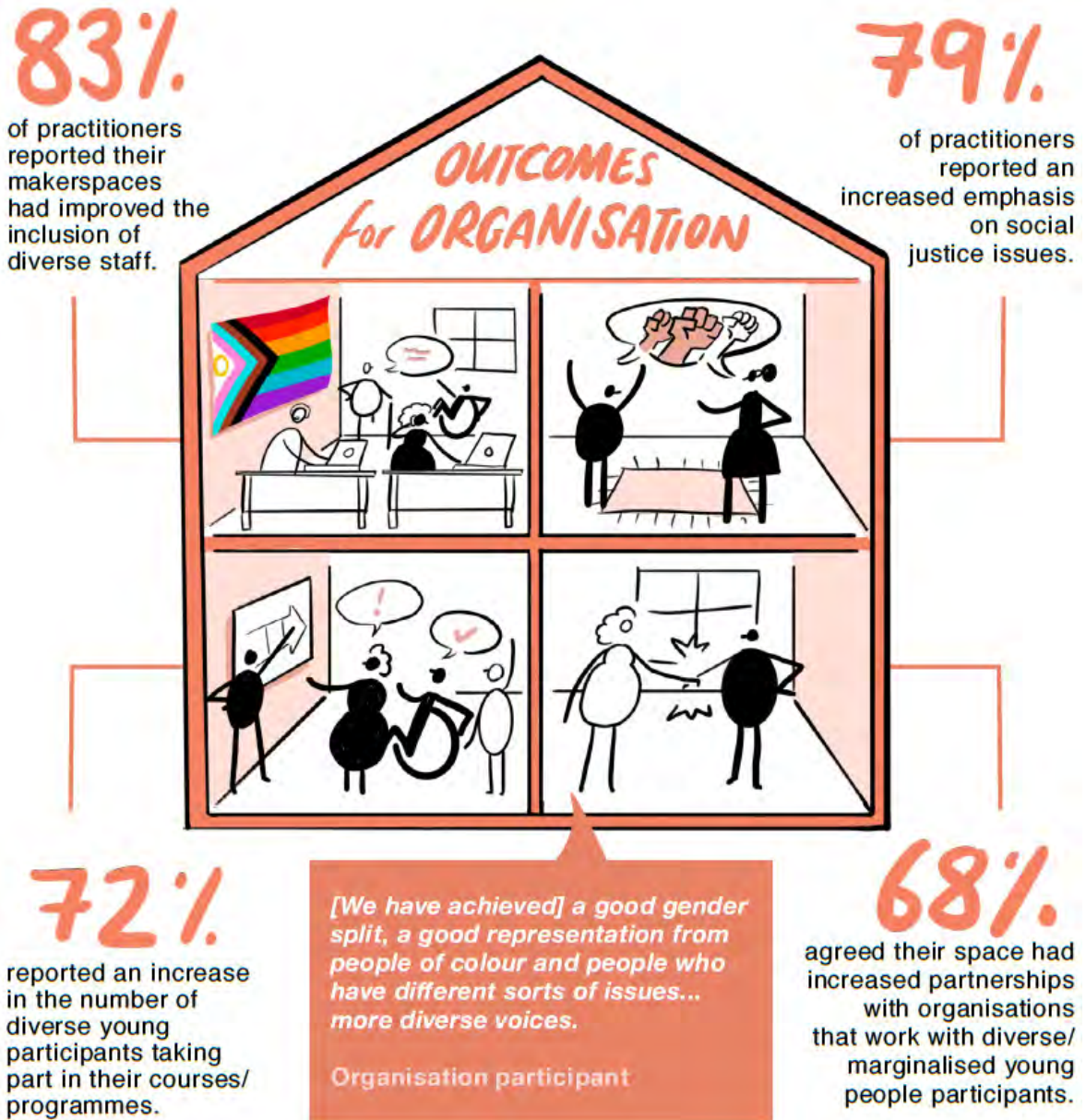
The 3-STEP approach resulted in the implementation and embedding of equitable practice within participating makerspaces.

Within all of the makerspaces, we found evidence that practitioners had extended and deepened their practice in more equitable and inclusive ways, as a result of training in and delivering the 3-STEP approach. This included:

- Advances in equitable pedagogy in all six makerspaces that implemented the approach (see [case study C](#), case studies 2.7 and 2.8 in the [3-STEP approach guidebook](#)).
- Innovations in equitable access and/or outreach practice in five out of six settings, for example, in expanding notions of outreach by engaging directly with communities. See case study 2.5 and 2.6 in the [3-STEP approach guidebook](#).
- Improvements in equitable governance in five out of six spaces, for example, the inclusion of a youth board chair on the main institutional board at one makerspace, and increasing the proportion of diverse staff in four out of six makerspaces. In addition, 79% of practitioners reported an increase in emphasis on social justice issues within their space.
- Widened and increased organisational partnerships in six out of six makerspaces with a range of local, national and international organisations. Additionally, 68% of individual practitioners reported an increase in partnerships within their youth programmes.
- £1.6m additional funding leveraged by partner makerspaces to implement new or extended programmes using the 3-STEP approach.



Figure 3: Makerspace outcomes following participation in the project



Case Study C: Moving towards equitable making

At the start of the project, and prior to implementing the 3-STEP approach, one of the makerspaces had a relatively prescriptive way of delivering STEM activities, as highlighted in these researcher observation notes:

“The session adopts a traditional ‘recipe’ approach, with youth following written instructions on how to make a solar powered bug. [...] The white male facilitator adopts a fairly didactic approach, speaking from the front and providing the STEM knowledge. There is very little eliciting or valuing of the young people’s own cultural knowledges or experiences.”

“The young people mostly made their own solar chargers by themselves, following step-by-step instructions.”

However, researchers noted a change in practice when makerspace practitioners applied the 3-STEP approach. For instance, the practitioners reflected together on how to integrate assets-based approaches that support increased youth agency. They decided to host an ‘open lab’ workshop where young people were encouraged to innovate and create their own designs for submission to the [Making Good Prize \(MGP\)](#). This is a competition celebrating and showcasing STEM-rich making, and addresses themes of safety, social justice and/or sustainability. Instead of following step-by-step instructions, young people were free to decide what they wanted to make and work on in relation to these three broad themes. This approach resulted in innovative youth-led making. Their projects included an app to teach young people how to cook seasonal and local food recipes that reduce food waste, and an animation exploring human impact on nature, trying to change the way people treat the environment.

As one practitioner noticed, both young people and practitioners responded very positively to these changes:

“It is really great to see the young people participate in this way. We were initially nervous that they [wouldn’t] have any ideas and wouldn’t know what to do, but having the MGP categories gave them a purpose and they [were] able to innovate within that. The open labs have been great!”

Case Study D: Fostering deeper critical reflection

In one makerspace, practitioners were already experienced at working with young people in participatory ways. However, taking part in the Making Spaces 2 project helped remind them that equity work is never finished. It provided a framework to encourage practitioners to identify and reflect on areas where they could further extend their practice. When it came to applying the 3-STEP approach, one practitioner used co-production strategies within their youth evaluation work. She felt this was highly successful, and in turn, extended her own understanding of the possibilities for centering youth voices within her practice. She reflected:

“What I noticed straightaway was how naturally the young people understood our evaluation process. After watching them facilitate the evaluation tasks themselves – giving out worksheets, and me not having to explain too much but just going with it – I reflected on my own practice, and was like, ‘OK these young people do not need everything spelt out to them to a T’. So that was a real good learning thing for me, personally.”

Seeing how well young people were able to participate in the co-design of evaluation encouraged her to further explore how to integrate co-design into other youth programmes. She said:

“Within the new programme there is going to be a lot more room for young person to young person mentoring, and further co-creation.”

Hence she found that, even as an experienced practitioner, employing the 3-STEP approach helped encourage further innovations in her own equitable practice.



4.3 Results: youth participation

The 3-STEP approach resulted in increased and diversified youth participation.

Over the two years of the project (September 2022 to August 2024), the makerspaces engaged with 2,880 young people from diverse backgrounds. While makerspace partners did not collect comparable, detailed systematic data on the intersectional demographics of their youth participants, overall figures covering the Making Spaces 2 project period show an **increased number and diversity of youth participants** on programmes within five of the six spaces. For instance, interview and endline survey data showed that 72% of practitioners reported increased numbers of diverse youth on the particular course they ran. Institutional-level data also showed an overall increase in diversity among participants. This was in relation to:

- The race/ethnicity/caste of participants in two out of six makerspaces.
- Gender in four out of six makerspaces. Note that one further space already had very strong gender diversity recruitment, which remained unchanged.
- Socio-economic status/social class in four out of six makerspaces. Note that one further space already recorded a high percentage of low-income youth participants, which remained unchanged.
- Neurodiversity in two out of six spaces. Note that one further space already specialised in this area and recorded a high percentage of neurodiverse youth participants, which remained unchanged.

One makerspace, informed by the 3-STEP approach, adopted a number of changes in practice. This included changing language and representation within its outreach marketing materials, introducing new all-girl workshop programmes, and reserving spaces for girls within its regular mixed programmes. This resulted in an increase in the overall number of girls participating within its programmes, and an improvement in the gender balance of its regular mixed sessions.

Another makerspace established new youth programmes from scratch, using the 3-STEP approach to inform its outreach and pedagogy. The makerspace recorded both increased youth participant numbers and improved gender balance. In particular, the makerspace found participants were 86% female on the new youth programme, compared with its existing programmes that served predominantly male engineering degree students.

Case studies E and F further illustrate how two other makerspaces increased and broadened participation in their programmes as a result of employing the 3-STEP approach.

Case Study E: Inclusive access and outreach

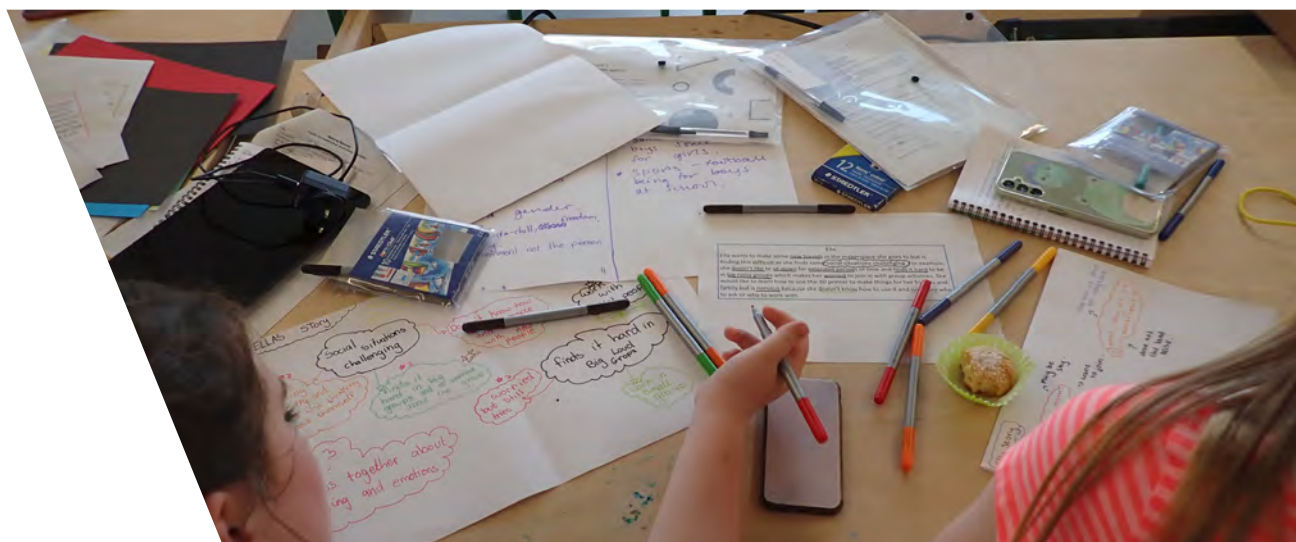
One makerspace applied the principles of the 3-STEP approach to its access and outreach work, to help diversify youth participation on its programmes. The team started by establishing a physical location within a deprived area near to the city where they usually worked. The practitioners also initiated new partnerships with local youth and third sector organisations who already worked with diverse youth, and who were happy to publicise the makerspace's coding programmes through their networks. As one practitioner reflected, "referrals from partner organisations were very successful", which was largely attributed to the approach taken. They said:

"We took time and resources to rebuild our networks and make meaningful partnerships. We attended drop-ins hosted by other organisations, [gave] talks, [spoke] to libraries and other council departments, attend[ed] job fairs."

Their strategy resulted in:

"Within the new programme there is going to be a lot more room for young person to young person mentoring, and further co-creation."

- Improved gender diversity of youth on their programmes, achieving 50% participants identifying as women and non-binary genders.
- Increased ethnic diversity of youth on their programmes, achieving a 50:50 balance of racially minoritised to white participants. This was despite the population of the local area being 92% white, and the wider metropolitan area being 84% white.
- Improved participation of learners from low-income communities, with 70% of youth participants from Index of Multiple Deprivation (IMD) quintiles 1-3.



Case Study F: Participation among marginalised youth

Karina is a young person who had never previously participated in a makerspace or extracurricular STEM programme. She had always been very interested in science, yet she had faced long-standing challenges in her STEM educational journey. When a friend told her about the new girls-only digital fabrication programme being offered by a makerspace, Karina was excited but also nervous. She was interested in digital fabrication, having watched many YouTube videos on the topic. However, she was concerned about how long it would take her to travel to the makerspace, and how she would balance school pressures and home responsibilities. She tentatively attended the first session but confided that she was not sure that she would continue. She said:

“I am really fighting with my family to do science, as I really like it. But everyone tells me it’s very difficult and I won’t be able to cope. I want to excel in my school and keep that [as] my focus, but I’m also really interested in the activities in the makerspace. I will see how it goes, but I’m not sure I will continue.”

The makerspace practitioners reflected on what Karina told them and identified how they might be able to support her. As a result, they:

- Reimbursed her travel costs.
- Set up hybrid sessions that she could join remotely.
- Provided free food during the sessions, as many participants said that they would need to miss lunch in order to attend.

These changes helped Karina to participate. She later shared how important it was that the session content was engaging. But more importantly, she felt that the challenges she faced in participation had been both heard and acted upon. She felt the practitioners had really listened to her and made her feel more welcome and at home. She said:

“Apart from the making, the equipment like 3D printing, I really appreciate the positive behaviour and respect towards us by the facilitators. If we informed the facilitators about something missing, they would provide that for us. We could see the facilitators really valued our opinions. It felt like home for us. And to make it more comfortable, I used to address [the facilitators] as ‘brother’ and ‘sister’.”

Despite her initial apprehension, Karina attended all the sessions of the youth programme through a mix of in person and online participation. She also created an entry for the Making Good Prize (MGP), which was recognised in the awards.

4.4. Supporting a range of equitable youth outcomes

Analysis of qualitative and quantitative data from youth and practitioners suggested that the implementation of the 3-STEP approach was significantly associated with a range of positive youth outcomes.

For instance, survey and interview data indicated that the majority of young people on the focal programmes reported positive equitable experiences. Survey data showed that youth outcome means were higher following participation (post-test) than at the start (pre-test). Non-parametric significance tests (more appropriate for our sample size) showed that youth outcome means increased in multiple survey areas following participation (post-test) than at the start (pre-test). In particular, significant increases were found in the following areas:

- STEM skills (including increases in relation to digital skills, computing, engineering, science and general STEM skills, but with no significant increase in mathematics skills)
- General job and career skills and preparedness
- STEM identity (feeling recognised by other people as being 'good at STEM' and/or a 'STEM person')
- Community-orientated making (using STEM skills to make or design things that will benefit the community and/or society)

Post-hoc surveys also showed that a high percentage of young people agreed that participation had benefited them in a range of ways. As detailed in Figure 4 and Figure 5, the majority felt their networking skills improved, their confidence increased, they were more prepared for the future, they were more connected to STEM, and they had developed broader views of the types of people who do STEM – to name but a few areas.

Figure 4: Analysis of pre- and post-survey data of youth outcome areas, after participating in programmes developed with the 3-STEP approach.

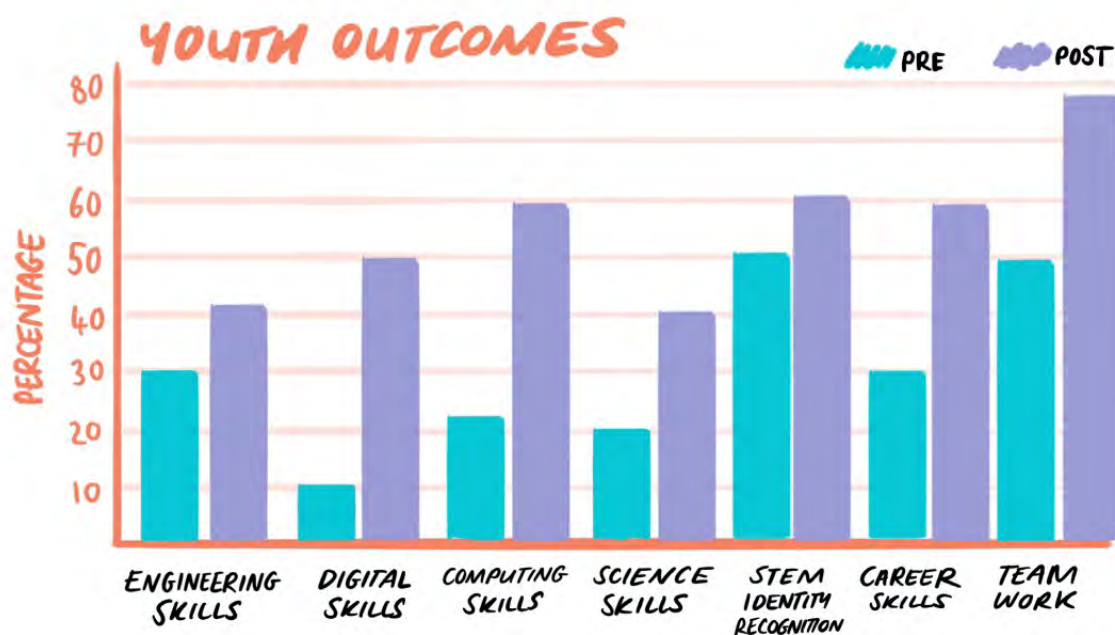


Figure 5: Youth self-reported outcomes from makerspace programme participation



Case Study G: Young people's career trajectories

By implementing the 3-STEP approach, makerspace practitioners have the potential to make a life-changing impact on young people. Rosella, a participant on one makerspace programme, experienced this first-hand. She said:

“Using the skills I got from participating in [the makerspace], my career has been propelled forward in ways that I could not even imagine. My life has changed drastically. [...]. Overall the experience has not only inspired me to do better but to also give back to the community in the future.”

Rosella's life trajectory changed dramatically after she participated in an online coding course offered by a makerspace. The course had been developed by practitioners using the 3-STEP approach. On the course, Rosella learned new software development skills alongside receiving general career support training. Her experiences enabled her to change her career trajectory. Whereas previously she was employed on unstable short-term contracts in fast food restaurants and retail companies, she was now able to secure a place on a graduate software engineering scheme with a prestigious media company. She said:

“Before starting this programme, I did not have much direction. I wanted to get into tech but figuring out the necessary steps was difficult, and I wasn't sure I could do it. This programme changed that – the mentors not only helped me figure out how to reach my goal, but gave me all the essential skills to get me there. I'm now a lot more confident in myself, my coding skills and ability.”

Rosella continues to be involved with the makerspace as a youth advisor and young mentor, helping to support new cohorts of young people to reach their potential. She also assists with the ongoing development and improvement of the makerspace programme.



Case Study H: Building young people's confidence and skills

“When I first joined [the makerspace], I liked staying quiet.” This was how Amir described himself initially when he joined a summer STEM camp in our partner makerspace. Amir was one of the youngest participants in the camp, and at the start, did not feel confident in sharing his skills or socialising with peers. As another young person noted:

“When Amir first came to the makerspace, he said, ‘I am a person who doesn’t like to speak too much.’ But now [he] is being so talkative and he is always the one coming up with new ideas.”

Practitioners used group work and team building activities to help Amir build his confidence interacting with peers and sharing his ideas with the rest of the participants. As one practitioner reflected:

“Things have changed a lot for Amir. He has become a friend to all participants in the camp, engaging in diverse conversations, openly sharing his thoughts, and contributing his exceptional ideas. He has even come up with a cool project idea for his team. He used to be shy and did not talk much during the camp’s start, but now he’s more confident and talks more [...] plus, he has gotten a lot better at programming and solving problems.”

By taking part in the STEM summer camp, Amir was able to build both STEM skills and confidence in his abilities.



4.5 Capacity in the sector

The approach is starting to increase capacity in the sector through modest international reach and positive reception.

The project guidebook, MOOC and associated resources were launched in June 2024. In the subsequent four-month period (July to October 2024), the team received positive feedback from organisations in the sector and recorded modest international reach based on download and participation figures.

The project is also contributing to the advancement of academic knowledge through journal articles on topics including the (re)conceptualisation of relationships between formal and informal STEM learning spaces, the challenges and possibilities for gender equity within makerspaces, and practitioners' understanding of equity in Global South makerspaces.

Online international practitioner webinar

In July 2024, we hosted an online international practitioner webinar to launch the 3-STEP guidebook and MOOC. The event had 117 registrations, 77 of which were from participants based in Europe (50), Asia (14), North America (9) and South America (4). Of the 50 subsequent attendees, 28 were from the United Kingdom, with others spread across India, Austria, Nepal, Portugal, United States, Pakistan and Germany. Most attendees described themselves as a 'member of the international STEM community' and were predominantly makerspace managers, administrators or practitioners. The active Q&A session included very positive feedback on the resources. Project website visitor numbers showed a clear uptick after the event.

Guidebook downloads

Download figures for the guidebook for the four-month period, July to November 2024, were as follows.

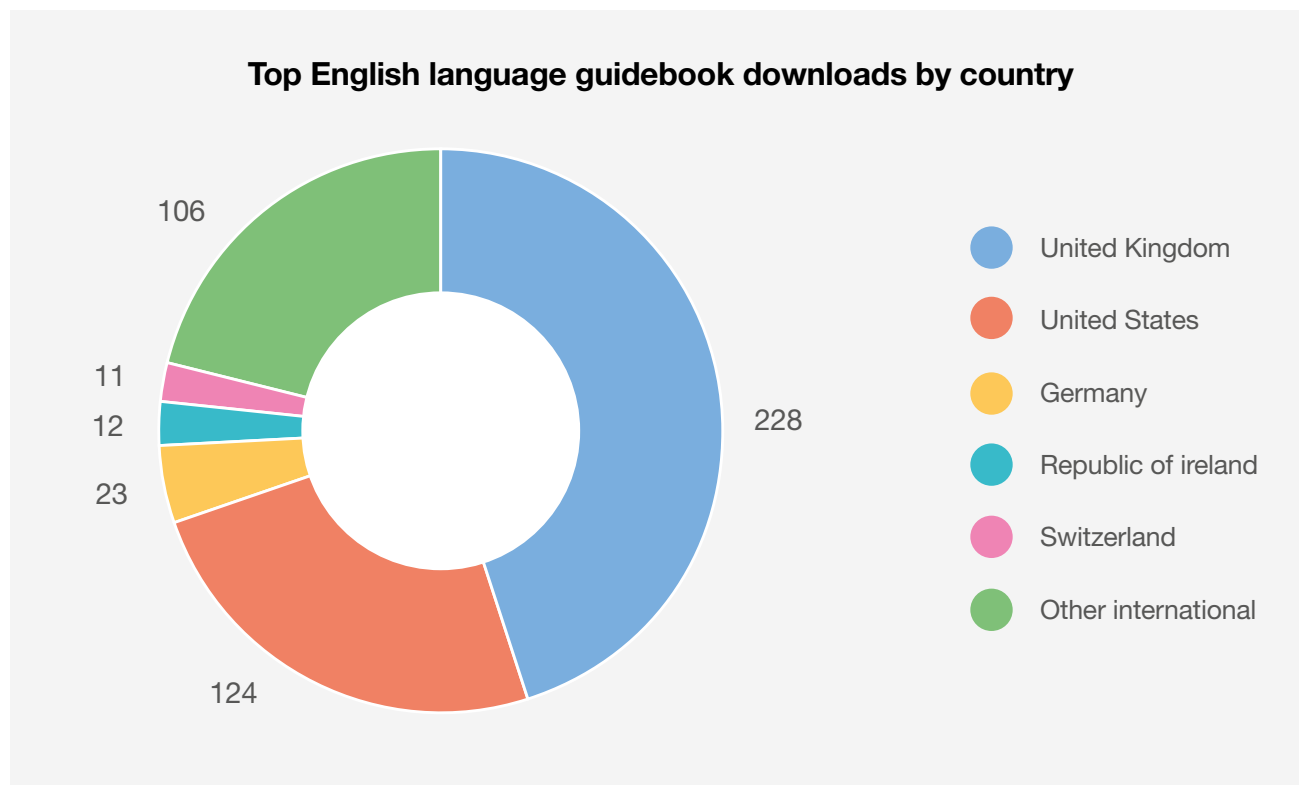
There were 663 downloads in total, in the following languages:

- English – 504
- Nepali – 64
- Slovenian – 43
- Arabic – 52.

Of the English language downloads, these were the top 10 countries they were downloaded from (see [Figure 6](#)):

1. United Kingdom – 228	6. France – 9
2. United States – 124	7. Nepal – 7
3. Germany – 23	8. Israel – 7
4. Ireland – 12	9. Sweden – 6
5. Switzerland – 11	10. India – 6

Figure 6: Top five English language downloads of the 3-STEP guidebook



MOOC participation

Figures for participation in the English-language version of the 3-STEP MOOC for the four-month period of July to October 2024 were as follows.

There were 395 enrolments in total.

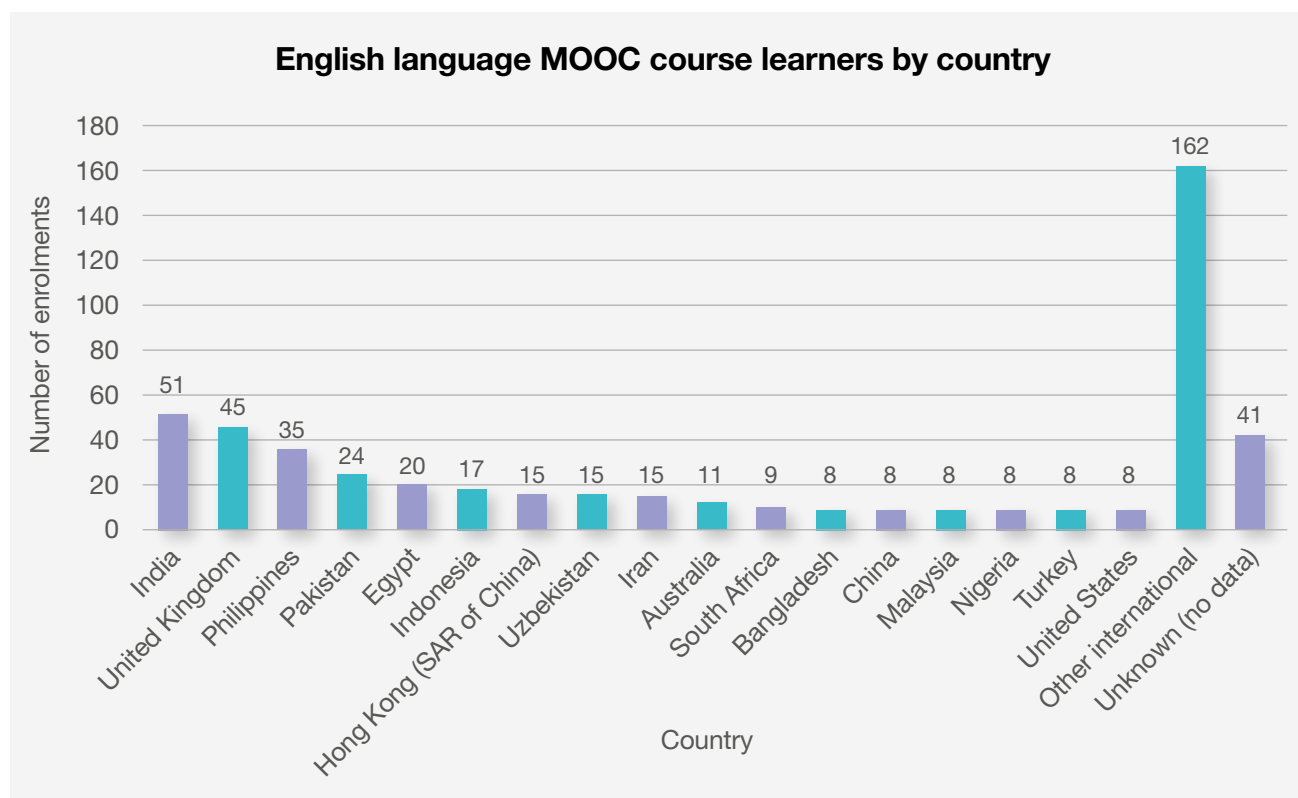
There were 383 comments on the course pages.

Learners were from a total of 86 different countries (see [Figure 7](#)). The top five countries people participated from were:

1. India – 51	4. Pakistan – 24
2. United Kingdom – 45	5. Egypt – 20
3. Philippines – 35	

From a survey of 58 MOOC participants:

- 98% said the course met or exceeded their expectations
- 95% said they had learnt new knowledge and skills
- 78% had applied what they had learnt in their settings.

Figure 7: English-language MOOC course learners by country

Participant feedback on the MOOC

Participants gave highly positive feedback on the course. In particular, they said it gave them a good understanding of equity issues, it was engaging, and they expressed a commitment to putting the information into practice. Here is a sample of quotes from the course feedback.

“I thoroughly enjoyed the practical examples and case studies provided throughout. They offered valuable real-world concepts, making the learning experience engaging and relatable. Specifically, the section on equitable governance stood out to me as particularly enlightening. Not only did it deepen my understanding, but it also provided practical strategies that I can immediately implement in my work.”
 – Course learner, Palestine

“Each and every aspect of this course is designed very well with appropriate examples, case studies and templates.”
 – Course learner, Nepal

“Loved this course. Very informative and well designed with [an] ample amount of new information.”
 – Course learner, Pakistan

“I would rate my experience this week on the course as highly positive. The content was insightful and practical, providing valuable strategies for fostering equity in makerspaces. The activities encouraged reflection and critical thinking, making the learning experience engaging and relevant.”

– Course learner, unknown country

“Thank you for the course! I feel empowered and equipped with valuable tools to promote equitable practice in my makerspace. The guide will be a great resource as I continue this journey. Looking forward to implementing what I’ve learned!”

– Course learner, Indonesia

“The 3-STEP approach is a practical framework for creating equitable makerspaces. It emphasizes the importance of equity for inclusive participation, benefits [to] everyone involved, and provides a clear roadmap for implementation. As a learner, I find it valuable and empowering for creating a more equitable environment.”

– Course learner, Philippines

“This course covered the progressive quality of making spaces in extremely thorough detail, and reinforced the importance of open-ended, open-minded, hands-on facilitation when working with diverse crowds of young people.”

– Course learner, unknown country



4.6 Limitations, learning, and reflection points

As highlighted in the previous sections, the data collected indicated a positive impact of the 3-STEP approach on practitioners (see section 4.1), makerspace organisations (see section 4.2) and young people (see section 4.4). However, there are also a number of limitations and learning or reflection points that need to be considered when interpreting these findings. These include:

- **Makerspaces are highly distinct in nature, and not all function in the same way.** The flexible nature of the 3-STEP approach also meant that not all spaces were developing and trialling exactly the same aspects of the approach and hence cannot be compared. There was no use of comparison or control groups, further limiting the potential assessment of impact.
- **Not all makerspaces delivered the approach in the same way.** Factors such as different levels of experience in delivering youth programmes, different staffing structures, and a range of other contextual factors arguably also played a part in producing different affordances and limitations of the approach in practice.
- **The recorded impact relates to a relatively short period of time and would benefit from a longer evaluation period.** There is also a need to explore the conditions required to support ongoing implementation and sustaining equitable practice. This is particularly important for spaces that experience high staff turnover and frequent changes in programming, based on the need to continually secure (often short-term) funding for youth programmes. Areas for further examination include the extent to which professional development can support more effective implementation.
- **There were some wider contextual factors that strongly impacted the extent the approach could be delivered in one of the settings.** Part way through the project, the Gaza makerspace was completely destroyed by the devastating war, with all practitioners and young people displaced and a number also killed.



5. Conclusions

The Making Spaces 2 project worked in partnership with practitioners and young people from international makerspaces in the United Kingdom, United States, Nepal, Slovenia, and Palestine. It aimed to increase knowledge about youth equity in makerspaces and develop new, evidence-informed knowledge and resources to support equitable and inclusive practice in makerspaces. In particular, the project sought to promote ways to increase young people's agency, challenge inequalities, and support positive life outcomes.

Based on data collected with partner settings, the project co-developed, implemented and evaluated the 3-Steps Towards Equitable Practice (3-STEP) approach. Analysis of multimedial data and evidence collected showed that the approach:

- Was evidence-based, relevant and received as being 'close to practice'.
- Improved understanding of equity issues and supported positive outcomes among participating practitioners.
- Resulted in the implementation and embedding of equitable practice within participating makerspaces.
- Resulted in increased and diversified youth participation.
- Supported a range of equitable youth outcomes.
- Is starting to increase capacity in the sector through modest international reach and positive reception.

While the data collected are necessarily small-scale and not representative of all makerspace contexts, findings suggest that the 3-STEP approach offers a promising basis for further development to help support more equitable and inclusive practice across the sector.



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