

# Communication is not collaboration: observations from a case study in collaborative learning

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# Communication is not collaboration: observations from a case study in collaborative learning

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**Abstract:** This paper presents a case study that focusses on developing communication and collaboration skills of undergraduate design students studying at a distance, and vocational learners based in a community maker-space. Participants were drawn from these formal and informal educational settings and engaged in a project framed in the context of distributed manufacturing, with designers working at a distance from the makers, whilst communicating using asynchronous online tools. Early analysis of the collected data has identified a diversity of working practice across the participants, and highlighted a disjunction between communication and collaboration. Encouraging learners to communicate is not the same as encouraging collaboration. Instead effective collaboration depends on sharing expertise through dialogue.

**Keywords**: design education, maker-space, distance education, formal/informal learning

## 1. Introduction

Design is social, involving multidisciplinary teams working together, often remotely, to understand and identify solutions to real world problems (Cross and Cross, 1995). Design outcomes are reached through argumentation and negotiation (Bucciarelli, 1994; Henderson, 1999), and designers have to collaborate and communicate with a diverse range of actors who may have an interest in the design process, from managers, to members of the public, from marketers to makers (Chiu, 2002). But this is a potential barrier to design success because of a wide range of issues, including differences in culture, language, process, and location (Vandevelde and Van Dierdonck, 2003). An education in design should prepare students for these difficulties and equip them with the necessary skills to work effectively within multidisciplinary teams. However, design education often offers little exposure to the necessity of effective communication and collaboration, because student

projects are, on the whole, contained within the comfortable context of a design studio (Kuhn, 2001). Exposure to external agents is limited because design students often implement all aspects of a project themselves, from ideation to prototyping, and they carry out their design processes alongside their peers, supported by their tutors (Boling and Smith, 2013). As a result, concepts and ideas can be shared using common language familiar to the studio inhabitants. This is very different from the realities of an authentic design process.

In this paper, a case study is presented in which undergraduate students, studying for a design qualification at a distance with the Open University, undertook a design-make project in collaboration with vocational learners based in MAKLab[1], a community maker-space in Glasgow. One of the aims of the study was to provide participants with exposure to the challenges of collaborating remotely and of communicating design concepts and intent, whilst providing opportunities to develop essential design skills. In the case study participants worked remotely using an online forum, and we say that communication occured when "*participants post messages [...] making contributions to the specific topic of the ongoing dialogue*" (Montero et al. 2007, p. 567), and we define collaboration as "*the process through which a specific outcome, such as a product or desired performance, is achieved through group effort*" (Koltarsky and Oshri 2005, p.40).

Design students at the Open University have ample opportunities to communicate their work, due to the distributed nature of their education, and this is supported by the provision of the Open Design Studio, an online space, which hosts a studio-like community where students can share and discuss their work with tutors and peers (Lotz et al., 2015). But, as with a traditional university, exposure to agents external to their course of study is limited. Working with MAKLab learners provided the Open University learners with an opportunity to communicate with agents outside the boundaries of the design studio and to collaborate with other learners. Onstenk (2013) identifies how such collaboration can be mutually beneficial to both parties. In this study, design students, could benefit from the informal, skill focussed training that takes place in that MAKLab, while the MAKLab learners could benefit from communication with the designers, and exposure to the formal learning that takes place within the Open University. It was anticipated that all participants would collaborate in designer-maker pairs, but early analysis of the data collected during the case-study has shown otherwise. During the project all participants engaged extensively in communicating with their partners, with the joint aim to design and make flat-pack furniture, but not all participants collaborated. This is arguably an obvious observation, but is of significant importance to the design of learning activities. If the intended learning outcomes of an activity are to encourage collaborative working practices then providing opportunities for communicating is not enough. Instead, learners must be encouraged to engage in dialogue, to build working relationships and to share their own expertise (Kotlarsky and Oshri, 2005).

[1] http://maklab.co.uk/

## 2. Collaborative formal/informal learning in design and making

MAKLab is an innovative Scottish charity focused on providing resources for people from all backgrounds, of all ages and all abilities to use physical making as a tool for social empowerment, regeneration, economic growth and social capital. It was founded in 2012 to allow people access the latest disruptive technologies but since then has grown to a network of spaces that deliver teaching workshops, community outreach programmes, professional development and accredited learning for a wide demographic across Scotland. MAKLab are committed to developing innovative teaching environments that are responsive to the future needs of design and manufacturing and they are investigating teaching scenarios that equip designers and makers for the challenges of the future.

Maker-spaces, such as MAKLab, offer novel environments for training in networked, distributed, yet localised environments. Existing programmes, such as the MIT led FabAcademy[2], have identified a role that higher education (HE) providers can play in supporting maker-space based learning. This programme follows a distributed model similar to the Open University's, where tutors are trained and teaching material is produced centrally, but learning takes place remotely, within independent maker-spaces distributed globally. In the case-study presented in this paper we explore an alternative model of maker-space based learning which involves equal collaboration between the HE provider and the maker-space, with students from the formal HE context benefiting from the learning that takes place in the informal context of the maker-space, and vice-versa. In this particular scenario, the HE provider is the Open University, an innovative centre for distance learning, and the maker-space is MAKLab.

Maker-spaces offer a locus for training programmes that bridge educational needs of differing students and enhance both technical expertise and 'soft skills', including problem solving, communication and collaborative working (Halverson and Sheridan, 2014). However, this informal education can be too instrumental, because methods and skills are often learned in specific situations, with little consideration of underlying concepts and theory (Resnick, 1987). As a result learners may have difficulty applying learned methods in new situations. MAKLab are interested in identifying how to generalise their educational offering, and one approach identified is to offer longer projects that have practical real-world applications.

Conversely, higher education typically focuses on developing widely useable skills and understanding of theoretical principles, but these rarely map directly onto the knowledge that people use in work situations, even those learned through highly technical professional training (Garner, 2005; Resnick, 1987). Providing authentic practical experience for design students studying at a distance is a challenge that The Open University has engaged with since the 1970s. Only recently with the introduction of online technologies, such as Open Design Studio (Lotz et al., 2015), has a studio-based learning environment been possible.

[2] http://fabacademy.org/

But, providing access to tangible aspects of a design education, such as making and prototype building, is still difficult because students typically do not have access to the tools, materials and expertise, that are available in traditional design studios, and online activities cannot act as a replacement.

In the case-study presented in this paper, participants engaged in an authentic learning experience (Stein et al. 2004), that replicated a real-world distributed designer-maker relationship, with an aim to bridge formal and informal learning. During the case study participants were encouraged to collaborate on a design problem and to work together to develop designs via reflection on physical prototypes. The aim was for participants to learn from each other, so that the vocational learners at MAKLab could develop conceptual and theoretical understanding of the design process, while the Open University design students could engage with the making process and the realities of production. The extent to which the collaborative learning experience achieved these aims remains to be investigated. Instead, the remainder of this paper presents early results that focus on the participants' communication skills as they worked with each other to address the given design brief.

# 3. A collaborative design-make project

## *3.1 Background*

The case study indirectly builds on a similar study reported by Prats and Garner (2009) in which design students with the Open University were given an opportunity to engage with the model making process, in order to augment and enhance their studies. In that research, the focus was on the role of making in design education, expanding on McCullough's (1998) premise that design students studying via a distance learning approach must be able to engage with physical models as well as with digital tools and outputs. Participants were tasked with designing a children's chair, to be manufactured out of 15mm MDF, and the study took place over several iterations of a design-make-analyse-reflect cycle, replicating a typical design process while drawing strong parallels with the Kolb cycle of experiential learning (Kolb and Fry, 1975). Technical and design support was provided at a distance and the participants' rough sketches of chair designs were converted into plywood fifth-scale models which were then mailed back to them, for analysis and reflection. The study confirmed that giving students access to physical models is vital for supporting design education because they assist in the act of reflecting about form and shape. It also confirmed that distance learners need not be deprived of this important aspect of their education, but that the design-make cycle can be incorporated in their design processes. However, some weakness were identified in the pedagogical model used, the most apparent of these being the work-overhead for the technician who had responsibility for converting drawings into models. This often involved lengthy communication with students in order to elicit design intention. In the case study reported here we adapted this model by including vocational learners located at a MAKLab, who took on this role of technician, and were given additional authority with the extended role of 'maker'. Both parties were briefed to

understand that the tutors expected equal participation rather than a model of a technician acting as a service provider to the 'designer'. It was anticipated that this collaborative model of learning would benefit both groups of learners by giving them a real-world project that enabled them to develop necessary technical skills, and also by encouraging them to collaborate with external agents by communicating asynchronously, using online technology.

## *3.2 Participants*

Sixteen participants were drawn from the Open University and MAKLab, two distinct educational settings. The eight Open University participants had recently completed a second-level design module, focussing on practical designs skills, and the eight MAKLab participants were vocational learners interested in developing their making skills using MAKLab facilities. The project attracted a diverse group, with a wide range of experiences, education, and backgrounds, and this diversity was apparent in both groups of participants.

The Open University participants (who will be referred to as *the designers*) were selected from a pool of applicants who responded to a call to participate. This was circulated to students who had recently completed the second level design module *"T217: Design Essentials"*. No remuneration was offered, but applicants were told they would be allowed to keep the prototypes they built during the project. The designers were all studying at a distance, distributed around the UK, and one was based in Germany. Six of the designers were registered on a design-based qualification, e.g. BSc in Design and Innovation, while the remaining two were working towards an unnamed Open Degree. Their experience of design and making outside of their studies varied, ranging from no experience at all, to practicing designers e.g. in jewellery, and 3D modelling. For most, their primary motivation for participating in the case study was to enhance their learning, by engaging in making activities that are difficult to support in distance education. A popular secondary motivation was to experience collaborative working on an authentic design project. All of the designers engaged with the project from their own remote locations, and it took place over the summer study-break, to minimise the impact on their formal learning, whilst also providing a bridge between successive periods of study.

The MAKLab participants (who will be referred to as *the makers*) were selected from a pool of applicants who responded to a call to participate. This was circulated via MAKLab mailing lists, and advertised at MAKLab locations. No remuneration was offered, but participants were given membership of MAKLab, which also enabled compliance with health and safety requirements. The participants were all based in or around Glasgow, and all of the making activities took place at a MAKLab facility in Glasgow. Two of the makers were already members and volunteers at MAKLab, but the other six had never previously used MAKLab services. Some had prior design experience and/or prior making experience using traditional tools and techniques, but none of them had prior experience working with the manufacturing tools used in this project. Two were graduates, in aerospace engineering and

media technology; two were employed, in the IT industry and electronics engineering, the others were self-employed, e.g. as artists or designers, were volunteering or were unemployed. For most, the motivation for participating in the project was around career development, including learning new skills, developing their portfolio for future job applications and for the employed/self-employed individuals, using the opportunity as Continuing Professional Development training.

## *3.3 Task*

Participants were randomly allocated partners to form designer-maker pairs, and within their pairs they were tasked with designing a chair that can be economically manufactured and transported. The brief specified that the chairs needed to

- accommodate adults
- be designed for ease of assembly, with no adhesive or fixings
- be manufacturable using a CNC router
- be flat-packed for ease of transportation
- be manufactured from a single material, specifically 12mm thick plywood
- minimise waste created during manufacture

This brief was composed with reference to the earlier study reported by Prats and Garner (2009). MAKLab identified CNC (computer numerical control) routers as an appropriately flexible technology, with scope for learners to develop useful skills and expertise. The other requirements were identified with the intention to constrain the design process, and to ensure the designers' material discovery was focussed on human needs and production realities (Morgan, 2012). It was anticipated that the resulting project would be a collaboration between designers and makers, with both developing skills and knowledge, as they worked together in a manner that mimicked a real-world scenario of distributed manufacturing.

## *3.4 Schedule*

The project involved three design-make cycles. In the first cycle, the designers were given the brief and asked to respond to it by conducting appropriate research and exploring initial ideas and concepts. In the third week, makers attended a CNC training course, during which they were introduced to the technology, and were given an opportunity to cut sample furniture. After the makers completed the course, the designer-maker pairs were introduced to each other and started working together on the project. Designers were encouraged to start communicating their ideas and their research to the makers. Similarly, makers were encourage to share their understanding of the CNC process, in order to help shape initial concepts according to their feasibility. During the fifth week, the first making session began, where makers were given access to MAKLab's CNC routers in order to fabricate the initial chair designs. These were shipped to the designers, flat-packed. In the second cycle, designers were given an opportunity to reflect on their designs, and together with the

makers, identify opportunities for improvement. During the eighth week, the second making session began, and the modified chair designs were shipped to the designers. The third cycle, replicated the second, with a third making session taking place during the twelfth week, and designers received their final prototypes soon after. Designers were encouraged to use Sketchup[3] to construct digital models of their designs, and to export these as 2D dxf files, for input to the CNC routers. To support the participants, one Open University-based project member was assigned the role of design-tutor, and one MAKLab-based project member was assigned the role of maker tutor. The extent to which these tutors managed the projects varied, but a hands-off approach was encouraged, and tutors intervened only when issues were identified that limited the progress of the participants, e.g. technical issues around constructing and exporting digital models in CAD files.

## *3.4 Data collection*

A variety of methods were used to record all aspects of the case-study. The primary method was an online forum that participants were encouraged to use to communicate with each other and with the project team. Open Design Studio was not available for this project, and instead a bespoke text-based forum was built. Forums have limitations as methods of communication, being impersonal, asynchronous and text-based (Ellis, 2001), but they also have significant strengths, because they can be accessed at any time and place, their asynchronous nature encourages more reflective and considerate dialogue, and a record of conversations is kept and can be revisited. For the purposes of this research, forums were deemed appropriate to replicate real-world asynchronous communication that often takes place between distributed designers and makers. The record of conversations was also identified as an important benefit for the research project itself, because it resulted in a rich data source which could be used to analyse the participant's communications.

Participants were given access to three project level forums, *Information*, *FAQ*, and *Discussion* forums, which were accessible to all participants, as well as the tutors and other project members, who acted as forum moderators. Each designer-maker pair was also allocated a *Chat* forum, with which to communicate to each other on an individual basis. Each Chat forum was accessible only to the allocated designer-maker pair, the tutors and the moderators. Designers were allocated a *Design Blog*, which they were encouraged to use to record their own thoughts and design process. These were private to the individual designers. In parallel to this, makers were encouraged to keep work-books, to replicate a typical vocational learning process.

In addition to the forums, designers completed surveys at critical stages of the project, in order to record their views on their progress, their interaction with their partners, and reflections on their design process. These were circulated prior to designers commencing on the project, and at the end of each design-make cycle. Also, at the end of the project

[3] http://www.sketchup.com/

designers were interviewed by telephone. The makers were interviewed, face-to-face, prior to the start of the project, and at the end of the project.

### *3.5 Summary of Results*

Seven of the designer-maker pairs completed the project, and a total of 18 full-size prototype chairs were made and posted to the OU design students. Participants' journeys through the process were all unique, but each had their own story to tell of their experience, and these were all positive. As a result of the process, participants developed technical skills in designing and making; they learned new approaches to communication; and they recognised the difficulties inherent in distributed manufacturing that result from working remotely. The designers also benefited from engaging with material aspects of their design process, reinforcing the findings of Prats and Garner (2009). Evidence for these claims were captured in the conversations on the forum, and in the surveys and interviews, and illustrative examples of this evidence is provided in Table 1. A more detailed analysis of the project as a learning activity is on-going; instead, on the remainder of the paper, the focus is on how the participants communicated as they worked together to address the design brief.

*Table 1 Evidence of learning.*

| Learning identified | Evidence of learning |
|---|---|
| Technical skills | "*I actually tried to avoid Sketchup [during the preceding OU course] … Now I am so confident in it I am actually applying for a job as an interior designer where they are asking for Sketchup*" |
| Communication skills | "*getting that [design] into a 'language' at the manufacturer can understand and can work with is an issue that needs to be addressed and overcome*" |
| Difficulties of redistributed manufacturing | "*the project has given me a great insight into what it is like working with someone remotely*"<br>"*words are a horrible way to communicate design concepts*" |
| Importance of materiality | "*seeing the actual chair helped me to realised how it really presents itself and adjust its dimensions*" |

## 4. Designing and making chairs at a distance

Early analysis has identified a diversity of working practice across the participants, with designer-maker pairs working and communicating in a range of different ways. For the purposes of this paper, we have identified three designer-maker pairs that illustrate this diversity, and analysis in Section 5 will focus on the communication data recorded in their Chat forum.

The chairs produced by designer-maker pair A are illustrated in Figure 1. The designer (*Designer-A*) had some prior experience having completed an internship which involved designing and building structures for a sustainable urban farm. The maker (*Maker-A*) was a self-employed digital artist who had experience in community building projects. Designer-A initiated shared early sketches and design ideas, and requested feedback about their feasibility with respect to CNC. She also uploaded photos of a paper-model to illustrate the intent behind the design concept. Unfortunately, Maker-A had limited internet access, and his responses were sporadic and brief; he gave little input into the first design concept, only positive encouragement and instructions on how to present parts in the CAD file. Consequently, when Designer-A received the first prototype, she was surprised that the geometry was different to the CAD model, due to CNC toolpaths not accurately reproducing the curves of the chair design. Designer-A become frustrated because she perceived this as a consequence of the lack of communication from Maker-A.

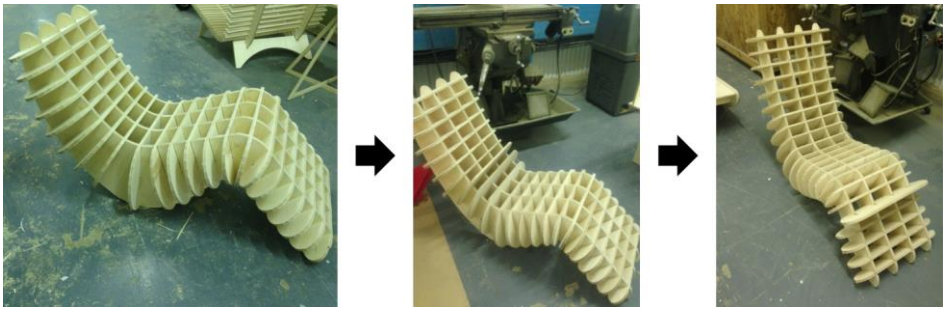

*Figure 1 Design concepts developed by designer-maker pairs A, over three design-make cycles*

On reflection of the first prototype, Designer-A developed the concept further by adapting the geometry of the chair. Having the physical artefact gave better insight into the required dimensions of the chair, and informed evolution of the concept. Again, design input from the maker was limited, however there was more communication about the manufacturing process. In the second prototype, the basic concept remained the same, but the back and leg rests had been extended to allow for better support. Unfortunately these modifications meant that the design could no longer be assembled. For the third prototype she attempted to develop her understanding of the making and assembly process in order to address this issue, but with only limited input from Maker-A.

The chairs produced by designer-maker pair B are illustrated in Figure 2. Neither the designer (*Designer-B*) nor the maker (*Maker-B*) had any prior experience of designing or making. Maker-B shared information about CNC routers and their capabilities, in order to inform the design of the chair. Designer-B started the project later than the other designers, and as a result only had a week to develop the first concept. Photos of initial design concepts, in the form of sketches and a model, were uploaded for feedback, and Maker-B responded positively.

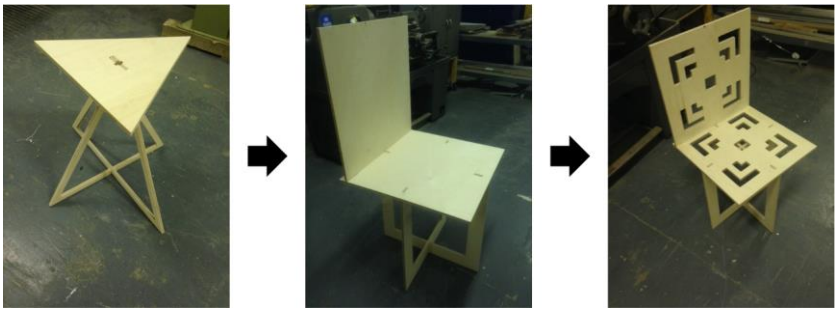

*Figure 2 Design concepts developed by designer-maker pairs B, over three design-make cycles*

During the making process, Maker-B had to modify the design to make it work. He posted images to show the making process and used these to illustrate possible modifications to the design. Designer-B was upset that the design was changed without his approval, and commented that Maker-B did not give useful design input. On reflection of the first prototype Maker-B, suggested a back was needed, in order to meet the brief, and Designer-B adapted the concept accordingly. Maker-B also suggested other design changes to improve the design, and provided images to illustrate his suggestions, but these weren't adopted. The third prototype adapted the concept slightly by adding some aesthetic detail, but the structural improvements recommended by Maker-B were not incorporated. Designer-B was concerned that the third prototype contained making errors, but these were identified as design errors by Maker-B.

The chairs produced by designer-maker pair C are illustrated in Figure 3. The designer (*Designer-C*) had significant previous design experience in jewellery design, furniture design, set building and 3D modelling. The maker (*Maker-C*) had some making experience, and was a volunteer at MAKLab. Communication was initiated by sharing personal information, including photos, to establish a relationship. The design brief was addressed by first exploring the problem and its constraints. The CNC process was discussed, Maker-C shared some existing chair designs, as well as examples of the types of joints that could be used. The pair also discussed the best way to communicate design intent using coloured lines, and identified an appropriate colour-scheme. Designer-C shared six potential concepts, as rendered 3D models, and requested that Maker-C help choose the most appropriate for the project, based on requirements of comfort and the project constraints. Design files were uploaded early to give Maker-C time to assess their suitability for making, and Maker-C shared photos of the making process.

Unfortunately the first prototype broke when Designer-C sat on it, and in response the chair was completely redesigned to ensure a stable structure. The second design-make cycle followed a similar process of exploring the problem to establish constraints and opportunities for improvement. Alternative methods of fixing the chair were explored by both Designer-C and Maker-C, as well as possible methods for finishing the design. Again design files were uploaded early to give enough time for discussion and identification of any issues. The third design-make cycle also followed this pattern, with designer-maker pair

discussing all aspects of the project, the design and the making process. Maker-C decided to modify the design during the making process and this was justified using photos. Designer-C was initially upset about this but eventually conceded that there was an error in the design files.

*Figure 3 Design concepts developed by designer-maker pairs C, over three design-make cycles*

## 5. Analysing project communications

During the project, effective communication was essential in order to meet the brief. The designers and makers were not co-located, and had no opportunity to meet face-to-face. Despite this, chairs were produced, and designs evolved over the three design-make cycles, indicating that all the designer-maker pairs effectively communicated aspects of their intent. The effectiveness of the collaboration of the three pairs is less apparent, but analysis of the communications recorded on the forums can provide insight into the extent to which the pairs collaborated during the process. Early analysis of this data is illustrated in Figure 4.

The participants' Chat posts were categorised according to whether they referred to design aspects of the project, making aspects of the project, or other aspects. The graphs in Figure 4 represent the number of posts referring to design and making aspects, according to who posted them and in which design-make cycle. The important characteristic to notice is the cross-overs, with designers discussing making processes and vice-versa. The project was framed so that ownership of the design was held be the designer, whilst ownership of the making process was held by the maker. In a successful collaborative process, we would expect evidence of sharing across these boundaries, in order to develop mutual understanding and a common goal (Kotlarsky and Oshri, 2005).

Pair A posted a total of 82 comments, 35 of which referred to the design, and 10 of which referred to the making process. In these posts there is some evidence of sharing. In the first cycle the designer posted a message about the making process, and the maker posted a message about the design, but this dialogue does not continue into the second cycle. In the third cycle the designer explored a maker-solution to the problem of assembly, but there is not enough of this dialogue to resolve the problem.

Pair B posted a total of 39 comments, 13 of which referred to the design, and 8 of which referred to the making process. The first design-make cycle was completed with little evidence of sharing. The maker engaged with the design, but the designer did not engage

with the making process. This is possibly due to the short time-frame of this cycle, because the designer was late joining the project. In the second cycle, the maker focussed only on design aspects, with little reference to the making process, and did not respond to posts made by the designer on making. In the third cycle this pattern is mirrored with the designer focussed only on design aspects, with little reference to the making process; this led to errors in the final prototype.

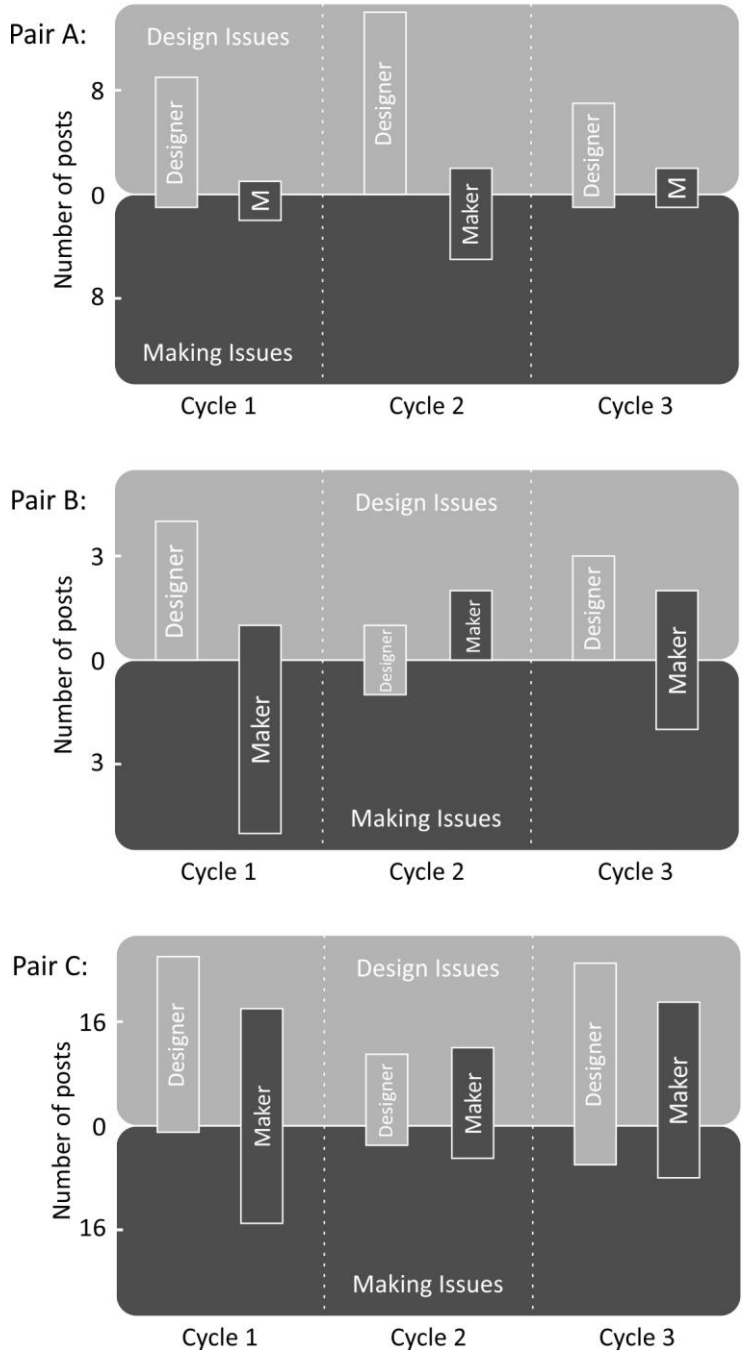


*Figure 4 A summary of communications between designer-maker pairs, according to the number of posts referring to design and making issues in the three different design-make cycles.*

Pair C posted a total of 252 comments, 111 of which referred to the design, and 38 of which referred to the making process. Sharing was an essential part of their process, and this is evident in Figure 4. In the first cycle, Designer-C posted few comments about the making process, but Maker-C was immediately willing to contribute to discussions on both design and making. In cycles 2 and 3, the dialogue between Designer-C and Maker-C had been established and their posts mirror each other, indicating equal contribution. Both designer and maker were generous with their expertise and their time, and an interesting design developed through collaborative dialogue about the problem, design-options, and the making process.

The graphs in Figure 4 show a high-level summary of the communications that took place between designer-maker pairs over the course of the project, and they concur with observations made in Section 4 about the ways the pairs worked together to produce their chairs. However, this is a very limited view, neglecting many subtleties about how the designer-maker pairs actually communicated. The content of posts is reduced to a tally of their number, thereby disregarding their intrinsic differences. For example, the graph of Group A indicates some elements of sharing, with Maker-A creating posts referring to design issues in each of the design-make cycles. But, in reality, these posts were very brief, with little content that could aid Designer-A in the project. Conversely, Designer-A posted infrequently about making, but some of these posts were extensive, listing questions and points of discussion, with the intention of initiating dialogue about the making process.

Despite their superficial nature, the graphs are useful in highlighting the disjunction between communication and collaboration. All three designer-maker pairs communicated but, arguably, only pair C collaborated, according to Kotlarsky and Oshri (2005): they used effective dialogue to share ideas and resolve problems. Designer-C and Maker-C started the project with more design and making experience than the participants in pairs B and C, and this likely helped them establish such a successful working relationship. Further analysis into how this relationship developed could provide insight into how to encourage learners to develop effective collaborations, and may inform the design of future design-make projects for Open University designers and MAKLab makers.

## 6. Conclusions

Post-project discussions with designer and makers have confirmed that the experiences of distributed design presented by the project have helped them develop technical skills, in CAD and CNC, as well develop an understanding of the complexities of communicating design ideas when working at a distance. Both groups of participants found the project to be an authentic learning experience that allowed them to apply and extend their learning in ways not previously offered within their respective learning environments.

Working together with the makers, the designers were exposed to the making process and materiality, and through this exposure they developed their understanding of design. Similarly, working together with the designers exposed the makers to new methods of

working and thinking, in an unfamiliar context. As a result, the confidence of all participants developed throughout the project.

Based on this feedback, it could be argued that the case study was a successful activity in collaborative learning. But, as discussed in the previous section the data collected reveals that not all participants collaborated to the same extent. The project was effective in encouraging participants to communicate, but communication is not collaboration.

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