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Exploring Interactivity and Co-Creation in Rural China

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Co-creation across cultures is a fertile area for the study of design and human computer interaction. Many studies have examined what can be learnt from cultures across the world and how cultures respond to interactive technology, and yet open questions remain on how to engage people in co-creation across cultures. In this article, we reflect on a study of cross-cultural co-creation with the Kam ethnic minority group of China. We report on the kinds of collaboration and value that emerged through the co-creation of an interactive drama, and how a traditional Chinese literature composition method was used to structure the design process. We present a notation for describing cross-cultural co-creation and reflect on the careful balance that we found needed to be struck between the depth of co-creation, immersion in local culture, cultural exchange and interactivity. We report on the use of our approach to elicit serendipitous design opportunities *in-situ* and how our non-utilitarian approach allowed us to explore different meanings of 'interactivity' across cultures.

RESEARCH HIGHLIGHTS

- An example of how drama with interactive elements can be used as a focus for co-creation around HCI in developing regions.
- An account of how a traditional Chinese literature composition method with digital making can be used to structure a co-creation process.
- A study of the kinds of cross-cultural collaboration, exchange and value that emerge during the co-creation on an interactive drama in rural China.
- Reflection on what 'interactivity' may mean across cultures.
- An account of challenges and limitations in undertaking non-utilitarian co-creation across cultures.

Keywords: participatory design; user centred design; empirical studies in interaction design; performing arts; sound and music computing; interculturalism

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1. INTRODUCTION

Co-creation, the act of 'collective creativity' shared by two or more people (Sanders and Stappers, 2008, p. 6), builds value between people through emergent empathy and engagement. When co-creation happens in off-grid rural locations between cultures who have different languages and traditions, the challenges and opportunities for digital innovation and engagement can arise in radically unexpected yet enriching ways. Human–computer Interaction's (HCI) interest in looking 'out there' (Taylor, 2011, p. 685) beyond industrially advanced countries to inform and understand design has resulted in numerous ethnographic studies of minority cultures' use of technology and ethnic minority groups' responses to interactive technologies, e.g. Bidwell *et al.* (2008), and studies of undertaking HCI

design with such communities (Jin *et al.*, 2014). To date the goal of such co-creation activities has predominantly been to research, design, and develop products and services to meet the needs and expectations of minority cultures.

In this article we explore how interactive drama could be used as a design goal for co-creation across cultures, how the co-creative process might be structured, and what value might emerge through this non-utilitarian focus. We do this by reflecting on 13 days of digital making and interactive performance creation we undertook with the Kam ethnic minority group predominantly located in the southwest of Hunan Province (湖南), China.

2. BACKGROUND

In developing countries, Information and Communications Technology (ICT) has the potential to 'provide education and empower those who are, or were formerly marginalized' (Marsden, 2006, p. 39). Indeed, HCI's growing interest in global development issues (HCI for Development; HCI4D) comes in part from the international development community seeking out electronic technology 'as a way to further the development agenda' (Toyama, 2010, p. 10), and from an interest in understanding how to design in 'far flung places, and practices not ordinarily considered' by ICT [(Taylor, 2011), p. 685]. However, as Marsden (idib.) points out, simply developing ICT solutions for people in developing countries ignores the 'complexities and subtleties' (p. 39) of design in such contexts, and working with people from the community to make sure that 'they feel like an equal member of the team, and ensuring that the project output truly meets their needs are real challenges' (p. 39).

Throughout this article, we use the following vernacular Chinese terms to distinguish between the stakeholders involved in cross-cultural co-creation. Members of the local ethnic minority group are referred to as *local* who in this article are Kam villagers. *Outsiders* are people who are not local, and are either: *domestic* people from the same country as local people, but not from the same location or ethnic minority group; or *foreign* people from a different country.

We begin this study by reviewing key approaches to engaging with communities across cultures when considering the potential use of ICT, ranging from learning about the local community through to co-creating with locals. We then present our research questions and provide an overview of the cultural and research context of our study in rural China. Our study of exploring the co-creation of an interactive drama drawing on local culture is then presented followed by discussion of our results and observations.

2.1. Learning about the local community and perceptions of technology

To understand local context and practices, Bidwell *et al.* (2008) suggest that outsiders may need to look beyond traditional (text based) design frameworks depending on the design challenge. For example, Bidwell *et al.* (ibid) used extensive interviews, observations and diary studies over an extended period of time to examine 700 rural Africans' responses to the deployment of solar powered mobile phone charging stations. In doing so they uncovered the importance of walking as a basis for engagement with local communities to build social interaction and inform design (ibid). Wyche and Murphy (2012) studied mobile phone usage in Kenya using in-depth ethnographic techniques over 6 weeks of intensive fieldwork. These engagements led to the identification of design implications for mobile technology which focused on understanding how existing ICT is already used and perceived within poor communities, rather than imagining how they might be used.

Similarly, through field observations and interviews, Dey *et al.* (2008) studied the effects and role of technology amongst rural Bangladeshi. They supplied local farmers with mobile phones to provide access to community based ICT services and noted that whilst there was limited uptake of the services, a bottom-up design of services would be required for such technology to be fully embraced.

Key to these approaches to understanding local context and engaging with communities is the immersion of outsider designers in the local culture and the foregrounding of voices from within the community over external observation.

2.2. Learning design from the local community

Carefully studying local craft skills can help outside designers to create culturally aware solutions. For example, Yao and Hall (2011)'s approach focused on examining aspects of Chinese culture to 'improve a contemporary design using Chinese elements at the conceptual design stage' (p. 3). Their approach involved foreign students engaging with local students and traditional craftsmen in a 2-day design workshop at a prestigious Chinese University including 'observations, case studies and concept designs' (ibid., p. 3). In this way Yao and Hall (2011) achieved a level of cultural immersion and appreciation in a very short amount of time and within the controlled environment of a University campus.

Chuenrudeemol *et al.* (2012) describe a 5-month project in which industrial design students worked with local craftspeople *in-situ* in the role of apprentice and contrasted this with the the typical outsourcing model of craft-inspired production in Thailand. Similarly, Tung (Tung, 2012) undertook an extended *in-situ* craft-design collaboration process between design students and local craftspeople which resulted in the development of new product lines with the local craft community. Furthermore, the collaborative engagement with local artisan rush-weavers meant that they were 'able to recognize new creative capabilities as they became aware of the design potentials in rush-weaving' (ibid., p. 79).

In contrast to these collaborative approaches, Murray (2010) describes how to engage with local craftspeople through outsourced craft production by commissioning local craftspeople to undertake craft work, and co-develop business models for local craft production. However, as noted by Murray, the collaboration in these projects is unequal with the outsider initiating the projects and taking the lead throughout (ibid.).

2.3. Designing for and with the local community

Designing for the local community typically involves stages of situated requirements gathering, followed by periods of implementation and deployment. Designing for minority groups has often focused on designing practical technology solutions which address well-defined, specific ICT design problems such as accessing digital content and social networks. When designing across cultures it is important that designers recognize that 'design research and practice is culturally located and power laden' (Irani *et al.*, 2010, p. 1312), and that designers' training and practice may inherently sideline other cultures' values, beliefs, and conventions cf. Bidwell (2012). To address these issues designers often follow a Participatory Design ethos cf. Greenbaum and Loi (2012) and focus on designing *with* local communities rather *for* local communities. For example, recognizing the practical constraints of designing in remote and infrastructure-poor settings, Wyche *et al.* (2010) proposed the idea of deliberate interactions—a planned, pragmatic and purposeful interaction design style that involves offline design preparation as an alternative vision for people in developing regions. In their case study Wyche *et al.* (2010) followed their offline preparations with travel to Nairobi to undertake interviews with locals in order to understand their mobile technology design requirements.

Audio Pacemaker (Bidwell and Winschiers-Theophilus, 2012) is an example of an *in-situ* design and development concept which supports rural African healers in recording and sharing descriptions of traditional medicinal plants. Audio Pacemaker was revised *in-situ* as part of a process of co-design with local healers. In this way local participants were engaged with refining an existing piece of technology to suit their needs through *in-situ* observation and design discussions. Similarly, MXShare (Bidwell *et al.*, 2014) allowed for digital content creation and real-time text-based chat, and Rodil *et al.* (2012)'s and Jensen *et al.* (2012)'s co-design work developed 3D computer based visualizations of indigenous knowledge.

In these approaches, outsiders design and build the software systems with local users in response to their needs. However, over extended periods of study, these software systems are sometimes found to be less useful and less used than physical solutions to practical problems (such as solar powered mobile phone chargers) (Bidwell *et al.*, 2014). The lack of sustainability in these cases may stem more from pragmatic issues such as ICT maintenance rather than from systemic design issues.

Significant amount of time and resources have been devoted to the introduction of ICT into rural educational practices with varying levels of uptake (Therias *et al.*, 2015). This has consequently resulted in several studies of the role of introduced ICT in rural education, and how such system can be better designed for local communities. For example, in their exploratory studies in northern India Kam *et al.* (2006) highlight the crucial role local school children can play in participatory design of software. Over a 2-week period they undertook design and prototyping workshops with school children to develop language learning computer games based on existing games. Again, these projects typically focus on introducing ICT into a rural location to address specific perceived (educational) needs.

2.4. Co-creating with the local community

Co-creativity, where creativity is shared by two or more people (Sanders and Stappers, 2008), has become increasingly popular in HCI4D (Irani *et al.*, 2010). For example, CrowdMemo (Balestrini *et al.*, 2014), a technologically mediated collection of local stories, was instigated, developed and contributed to by local community members in collaboration with outsider researchers. The key value here is that not only is the content generated by, and aimed at the local community, but that the technological aspects of the project were initiated locally. This is argued to increase the sense of ownership of the project, and the potential for the project to become self-sustaining beyond the outsider engagement.

Barbosa *et al.* (2015)'s research explored how to design and create Digital Musical Instruments with local musicians in North Eastern Brazil. Outside researchers explored current local musical instruments, practice and repertoire, then undertook an iterative design and build process followed by feedback from local musicians. The final instruments were then used in a public jam with the local community which provided an opportunity for co-creation with local musicians, and contributed value to the local community through a shared social artistic experience.

The Future Living Studio (FLS) concept (Jin *et al.*, 2014) was developed explicitly to initiate a sustainable design dialogue between local (Vietnamese) and outside designers with a focus on creating value for local culture. The FLS concept involves extended periods of design collaboration, typically up to 3 months, in which shared learning of local cultural insights and expertise together with outsider design skills combine to produce shared value which remains in the local context. An example design project included a range of bamboo furniture designed primarily for local consumption and

employing a novel flat-pack approach to bamboo furniture distribution to reduce cost.

Similarly, Wang *et al.* (2014) describe a co-creation process in which local Chinese craftspeople and outside designers worked together to design and create products for both local and outside markets drawing on resources from local (e.g. craft skills) and outside (e.g. mass production factories). Importantly, they focused on both outsider initiated product development (e.g. exotic items for tourist trade), and local initiated development responding to local needs. Despite extensive design and market research work, the value of these co-design activities lies in the knowledge gained and shared by local and outside designers, rather than physical products for sale. As Jin *et al.* (2014) note, the development of long-term collaborations is itself a tangible output of their approach.

In contrast to these approaches which resulted in the co-creation of physical products, Jones *et al.* (2017) developed methods for exploring possible future designs with local populations that address local needs and concerns. Through a series of participatory design workshops Jones *et al.* (ibid.) worked with local participants in India, South Africa and Kenya to imagine future product and service designs. As with Jin *et al.* (2014), the value here lies in the future design possibilities and collaborations generated by the approach rather than immediate product development and revenue generation.

For HCI4D, an important challenge is how to structure co-creation processes to foster the equality and initiative needed to achieve shared goals between outsiders and locals. A recurrent issue is that local participation often becomes passive with people who live in the local area becoming treated as the 'user' (or worker) (Muller, 2002), or used to outsource production. Furthermore, the co-creation often takes place within a local network of people whose links are not necessarily transparent to outsiders (Winschiers-Theophilus *et al.*, 2012). These issues can lead to unsustainable solutions being developed even through a participatory process, as Kensing and Blomberg (1998, p. 179) note: 'when the researchers leave, the participatory processes seldom diffuse to other organizational entities'.

Brewer *et al.* (2005) highlight that inherently unique regional and cultural characteristics play a role in determining a project's success. This means that effective co-design requires using local knowledge to understand the appropriateness of certain technologies over others. They also argue that motivating local groups requires building relationships and showing concrete early results. Ho *et al.* (2009) argued that even when participatory approaches are employed in designing for rural community's unique needs, participation itself becomes a loaded term that is prone to unreflective usage. For example, in some cases the general aims of design projects are defined before engaging with the local community itself. In such cases local participants are only able to make marginal input to the design work.

Anokwa *et al.* (2009) explored different concepts of participation in HCI4D, and noted that 'some ideas seemed especially supportive of participation and local ownership, such as the emphases on involving local facilitators and designing for local ownership, while others suggested a more asymmetric relationship between researcher and participant, such as considering the practical advantages of becoming an eavesdropper' (p. 112). In contrast to asymmetric design relationships, Carroll and Rosson (2007) suggest that when people 'understand the value of their own knowledge' with respect to requirements and design of ICT systems 'they become less intimidated by information technology, and more able to act' (p. 257).

The majority of the approaches discussed above focus their co-creation activities on specific utilitarian design goals, e.g. Audio Pacemaker: the design of a system for recording and presenting knowledge of uses of traditional medicinal plants. As cross-cultural networks mature and deepen, and rural communities rapidly embrace digital technologies, there is increasingly scope to explore third wave HCI Bødker (2015) concerns beyond utilitarian design such as the experience of interaction. Responding to this, our research program explores the possible value of non-utilitarian design goals for cross-cultural co-creation. As discussed in Section 3.4, our study has the non-utilitarian design goal of creating an interactive drama.

2.5. Research questions

The research goal of this article is: *to explore the kinds of cross-cultural collaboration and value that emerge through the cross-cultural co-creation of an interactive drama*. This raises a number of research questions:

- RQ1 How can we structure a rapid co-creation process with digital making *in-situ*?
- RQ2 What kinds of cross-cultural collaboration and value emerge during the co-creation given that the goal is non-utilitarian?
- RQ3 What are participants' perceptions of interactivity and digital making?
- RQ4 What are the challenges and limitations in undertaking non-utilitarian focused co-creation across cultures?

In the next section we describe the Kam ethnic minority population in Hengling village, China, who worked with us in this research. Following this we describe our approach to structuring and driving co-creation with the Kam community, and the outputs of our creative process. We then report on analysis of interviews and observations of the co-creative process and its reception by local audiences. Finally, we reflect on our observations of co-creation across cultures and our approach to providing a shared focus for co-creation.

3. METHOD

The work reported in this article took place in Hengling village (横岭) in Tongdao County, China. Every year since 2009, Hunan University, China, has undertaken research projects with the local communities in Tongdao County through an ongoing social innovation initiative (Ji *et al.*, 2014) as part of the Design for Social Innovation and Sustainability (DESIS[1]) China Network. Projects undertaken include ethnographic studies of local crafts such as brocade work (Wang *et al.*, 2014); music performance; local craftspeople teaching design skills to outsider students; and, social innovation design (Ji *et al.*, 2014; Wang *et al.*, 2016).

3.1. Cultural context

The Kam (侗族) are an ethnic minority of ~3 million people who are traditionally rice farmers and foresters, and are distributed through Southeast Asia as a result of extended periods of migration. The mountainous Tongdao Autonomous County (通道侗族自治), in the southwest of Hunan Province (湖南), China, is one of the main Kam regions. The Kam minority have distinct cultural traditions and language (called Dong or Gaeml) to the dominant Han ethnic group in China who mostly speak Mandarin Chinese. Kam villages are usually comprised of wood and stone buildings with elaborate architectural features (see Geary, 2003 for an in-depth description of the Kam minority).

Most Kam villages have a central Drum tower (鼓楼) with a stage which plays a key part of Kam village life and provides a location for the many festivals that the Kam celebrate throughout the year. As we are interested in co-creation around ICT it is worth noting here that like some of the ethnic minority groups described by other researchers in Section 2, the Kam are mobile-first—their first experience of digital technology is typically a smartphone, not a desktop computer or tablet. This clearly shapes their experience of, and expectations of technology.

3.2. Participants

The authors of this article formed the core facilitating team of outsiders who led the project with extensive research and design experience, and were supported by two locals responsible for local organization and logistics. One of the authors had visited Hengling village for two previous social innovation projects and has an understanding of the area and local community networks. These existing connections meant that we did not enter the rural location 'cold' but had some existing community networks to build upon.

We assembled a multi-disciplinary outsider team of five foreign European students (four undergraduate and one postgraduate with professional design experience) paired with five domestic Chinese postgraduate design students (three with experience in social design, and one with professional design experience). The students volunteered to take part in response to adverts in the authors' Chinese and UK home institutions. Students in the UK were recruited from across the author's University faculties and included students studying design and innovation, mechanical engineering, digital media, history and geography, whereas students from the Chinese University were recruited solely from the School of Design. We note that none of the students were professional musicians, though two domestic students had Western and Chinese classical music training.

Five local musicians with 10–30 years of musical experience took part and were compensated ~10 GBP per person per day for their participation in the project.

In our discussions the team members are referred to anonymously as:

- Facilitators with extensive research and design experience (two foreign outsiders and one domestic outsider).
- Foreign students with cross-disciplinary backgrounds (Alison, Badr, Charlie, Dave, Etel).
- Domestic students with Design backgrounds (Ju, Ke, Li, Mei, Nuo).
- Local musicians (Wenyan, Xiang, Yong, Zhilan, Jianhuai).

The final part of the study involved over 300 people (including <30 outsiders) attending a public event produced by the team.

The study was undertaken under the ethical practices and norms of the domestic facilitator's University.

3.3. Data collection

Throughout our process we kept extensive field notes on all aspects of creation, logistics, meetings and points of interaction for later analysis. We also took photographs daily, recorded large amounts of video and interviewed all participants over the 13 days. At the final public event we interviewed all team members again and also 10 audience members who volunteered to be interviewed. The interview questions were open and prompted interviewees to freely talk about topics including: (i) their background; (ii) what they thought about the performance and interactive pieces; (iii) what they liked and didn't like; (iv) whether they had seen similar performances before; (v) how they would describe the performance to a friend; and (vi) what they thought of the interactivity. We also asked team members about: (vii) who they worked with in the team; (viii) what their role was; (ix)

[1] http://www.desisnetwork.org

how they would describe the process of creating the performance; and (x) what they felt they learnt from the experience.

We also used short questionnaires to survey the audience about their overall rating of the final public event and ranking of the interactive exhibits. Questions in the interview and questionnaires were written in both English and Chinese, and the responses were translated into English after the event where necessary. We used a deductive Thematic Analysis (Braun and Clarke, 2006) to identify themes in the interview transcripts as we wanted to explore whether people commented on co-creation and interactivity, but we were always open to coding items which were interesting or surprising.

3.4. The co-creation aim: interactive drama production

Before arrival in Hengling the facilitating team contacted local craftspeople and artisans in Hengling to discuss possible co-creation activities and to identify interested local participants. With the local musicians we developed the idea of co-creating an interactive drama for public performance. This draws on the authors' research expertise in digital making, interactive sound, and Interaction Design, and local experience in music and performance and developing new ways to perform their traditional material. Once the focus was confirmed we co-developed a plan to create a 13-day temporary makerspace in Hengling village and to aimed to co-create a drama performance with interactive elements for a local festival (New Rice Day) with an exhibit of the interactive pieces after the drama to entice local interaction and feedback. In this way the early stages of our process were similar to the deliberate interactions of Wyche *et al.* (2010)—we defined the scope and focus of our co-creation with locals before arriving the the local context in order to maximize the use of our time *in-situ*.

It is worth noting that drama, which has been variously used as a technique for encouraging participation in design (Brandt and Grunnet, 2000) and social change (e.g. Augusto Boal's Theater of the Oppressed (Boal, 1979)), had not previously been explored in the area of cross-cultural co-creation with ICT. There are, however, examples of the use of drama throughout the design process. For example, (Buur and Torguet, 2013) use theater and professional actors to convey the outcome of ethnographic user research studies—as a way of making the results of ethnographic studies more compelling and engaging. This could be a useful approach to reporting back to locals on ethnographic studies, for example. To raise awareness of technology accessibility and design issues (Morgan and Newell, 2015) use interactive theater to demonstrate the challenges faced by older people using technology. Similar approaches could be used to dramatize challenges faced by local cultural groups when faced with new technologies which may have been designed from a different cultural perspective.

Product idea reviews have been facilitated using drama techniques through *Focus Troupes* (Sato and Salvador, 1999) in which performers act our dramatic vignettes of new product usage in order to elicit feedback from potential users. This approach may be useful in enticing feedback from local populations on new product ideas developed for their cultural context. Iacucci *et al.* (2000) developed Situated and Participative Enactment of Scenarios (SPES) in which designers and participants act out usage scenarios for imagined devices in real-world situations. In terms of cross-cultural design, this approach may be useful in exploring ideas for ICT solutions to rural challenges through *in-situ* performances.

Brandt and Grunnet (2000) used drama throughout the design process from user requirements elicitation through to *in-situ* prototype testing, and argue that 'Drama can help designers to achieve a greater empathy for the users and the contexts of use' (p. 19). A recurring theme in the approaches which use drama to present new products and product ideas is the crucial role that props can play as focal points for performance and feedback, and which can 'play a role in creating coherence within the projects' (ibid., p. 12).

Our intended use of drama is as a focus for co-creation around ICT—to give a concrete aim which participants would hopefully work together towards. In this way our approach is similar to (Barbosa *et al.*, 2015) who used public musical performance as a focus for co-creation.

3.5. Materials

To facilitate the co-creation of interactive objects *in-situ* we created a temporary markerspace. The materials in the makerspace had to be mobile, portable and robust so that they could be transported by car to Hengling and used in rough rural conditions. As such, our maker space included Arduinos—an open-source prototyping platform based on easy-to-use hardware and software (Arduino, 2015), along with Adafruit waveshields (Adafruit, 2015) for Arduino which support playback of recorded audio, and Tinkerkit shields and modules (Tinkerkit, 2015) which allow quick plug-and-play of input sensors and output devices such as LEDs, flex sensors, relays, motors, servos, speakers, etc. to Arduino. We also brought basic tools for physical making including soldering irons, wood working tools, hammers, saws, glue guns, etc., as well as a 3D printer.

3.6. Structuring the co-creation process

We structured our *in-situ* co-creation process following four steps 起承转合 (Qǐ-Chéng-Zhuǎn-Hé) outlined in Table 1 which we refer to as the Qi2He process for short (pronounced 'chee to he'), and which is adapted from traditional Chinese literature composition methods (see Kirkpatrick, 1997 for an overview of such methods). The steps also align with design

TABLE 1 Stages in the 起承转合 (Qǐ-Chéng-Zhuǎn-Hé; Qi2He for short) co-creation process.

Stage	Activity	Days
起 (Qǐ)	*Introducing/starting*: Start by learning new technical skills	2
承(Chéng)	*Following/inheriting*: Follow by immersion in the traditional culture	3
转(Zhuǎn)	*Changing/transferring*: Co-creation and mutual inspiration	4
合(Hé)	*Concluding/combining*: Conclude by refinement and production together	4

thinking approaches such as Tim Brown's three steps of Inspiration, Ideation, and Implementation (Brown, 2008), as well as Participatory Design's (PD) research design phases of Exploration, Discovery and Prototyping (Spinuzzi, 2005). See (anonymous) for a discussion of how this approach differs to other social innovation design approaches. However, our Qi2He process is based on a traditional Chinese cultural thought pattern and writing model which focuses on exploration of ideas in contrast to the typical Western problem-solution schema (Chen, 2007). We chose this approach because: (i) Chinese participants (including Kam) may already be familiar with it through their through state education; (ii) it can easily be aligned to design processes that students may be aware of; and (iii) it emphasizes exploration of ideas rather than designing to meet requirements.

Recognizing the inherent challenges of undertaking traditional PD in remote rural locations (cf. Brereton *et al.*, 2014) we aimed to explore how we could encourage engagement with co-creation as a first step toward possible future deployment of problem oriented PD approaches once we better understood how we might engage the local community. We borrowed elements of the ethos of PD to help us focus our process and to provide some possible connection to future PD activities. In particular, we drew inspiration from approaches which emphasized facilitating the engagement of participants with different voices, opinions and skills in a shared creative process (Bannon and Ehn, 2013). Drawing on this perspective we emphasized community engagement with a public aim, respected different voices in design discussions, aimed to provide a range of means for people to get involved (cf. Bannon and Ehn, 2013), and aimed for continual participation in the co-creation process (cf. Spinuzzi, 2005). However, it is worth noting that the aim of our co-creation was a public performance. We did not strive to foster technological, work practice, or social or political change as would usually be expected from a PD approach (cf. Greenbaum, 1993). Furthermore, due to the short time available for this study we did not envisage iteratively revisiting stages of the design process as PD would strive to do (Spinuzzi, 2005).

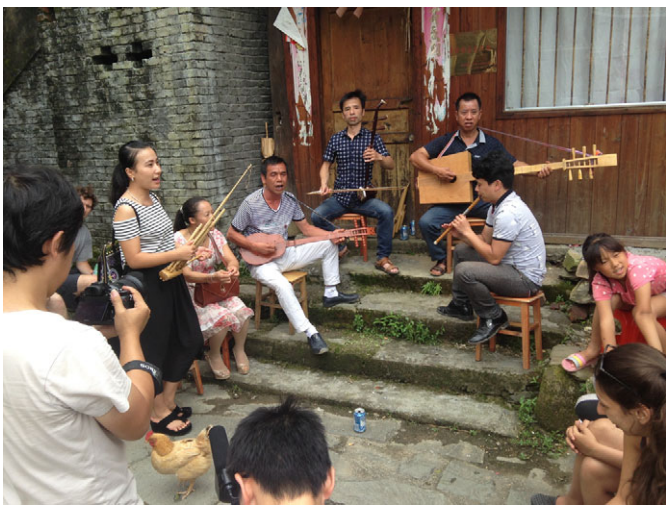

FIGURE 1. Local musicians perform traditional songs for outsider students.

3.6.1. 起*(Qǐ): Introducing/starting*

We ran two 1-day workshops to raise outsider and local awareness of Interaction Design and physical computing. The first day introduced basic circuit design and computer programming with input and output for Arduino. The second day explored higher level Interaction Design concepts and digital making skills.

The workshop also provided opportunities for outsiders to increase their immersion in the local context. For example, by engaging with the local community to find materials and sounds for the interactive objects. The physical outputs of the workshops also provided local observers who passed by the workshop opportunities for hands-on interaction with examples of digital interactivity which may have raised local awareness of what digital making could achieve.

3.6.2. 承*(Chéng): Following/inheriting*

After our introduction to making we aimed to expose students to more of the local culture and to provide opportunities for cultural sharing between students and local musicians. We held a knowledge sharing workshop in a social space of the village in which local musicians explained the content of traditional songs and taught students how to play their instruments over several days (Fig. 1). Students also visited local musicians' homes to explore the local lifestyle, and visited a local school where 20 school children performed with traditional Kam musical instruments, and outsiders reciprocated through an extended session of teaching English songs. The culmination of this stage was a full day visit to a neighboring Kam village's festival attended by thousands of local people.

In this stage we emphasized to participants the importance we attached to mutual knowledge exchange and sharing

between outsiders and locals in the workshop. We attempted to encourage this exchange through the introduction by locals and outsiders of examples of their culturally specific music, stories, and related cultural elements and artifacts.

3.6.3. 承 *(Zhuǎn): Changing/transferring*

We then aimed for students and local musicians to co-create and innovate together as a team. To provide focus we directed the team to identify local stories that could be used to produce a public output for local villagers, inspired by the approach of (Barbosa *et al.*, 2015). Local stories about love (as witnessed during the Valentine festival in the 承 Following/inheriting stage) were identified as interesting by the outsiders, and so the team started to work on the idea of producing *Kam's Romeo and Julietta*—a love story derived from a local story with an outsider twist.

To focus the creative work further we split the team into groups: script, acting, props and costume, set, and music, and charged them with identifying Interaction Design opportunities in each of these areas, e.g. what elements of props and costumes could be interactive.

The script group set about developing the core script and storyboards based on a version of the love story found in a Chinese book about the local area. However, they soon found that several versions existed with different endings. Students reported in later interviews that they initially chose a happy ending, but in discussion with the local musicians they realized that the sad ending would be preferred locally as it fitted with local cultural expectations as explained by the local musicians. The students reported that the local musicians also helped to enrich the story with more detail as the book only provided a very brief synopsis of the plot. We observed that the script was then used extensively by all the groups to structure the various elements of the performance, and drove discussion of the Interaction Design possibilities within the performance, e.g we observed discussions and brainstorming of what elements of props could be interactive, and how they might be interacted with.

The local musicians reported in interview that the script and musician groups co-created the musical content of the drama together. They reported that this was achieved by local musicians iteratively selecting appropriate music from traditional repertoires, checking its fit to the intended emotional content of the script with the students, and then improvising improvements.

The staging of the script was pushed to be more unconventional by the outsiders. In part this was driven by the facilitators' focus on exploring interactive performance, and in part to contrast the local story with outsider performance values and norms as suggested by the foreign students in discussion with domestic students. It should be noted that traditionally Kam performances are quite minimally produced, as the team had the opportunity to observe at the Valentine festival in the 承 Following/inheriting stage. The set group reported that they developed the idea of large moveable painted screens to create different backgrounds inspired by traditional Chinese room dividing screens, and that they decided to direct actors to move off stage to perform in other locations to reduce the amount of staging required. It should be noted here that moving off stage is not usually part of Kam staging. The set group also reported proposed that the sad ending scene be performed using back projection onto the stage's curtain to convey an idea of the after-life through shadows projected onto the curtains by actors. The local musicians reported in interview that these were forms of production that would not have been experienced before by local people. In total, the props group designed 16 props including smoking pipes, handcuffs, baskets, etc., the costume group designed costumes for six actors, and four main pieces of staging were designed by the set group.

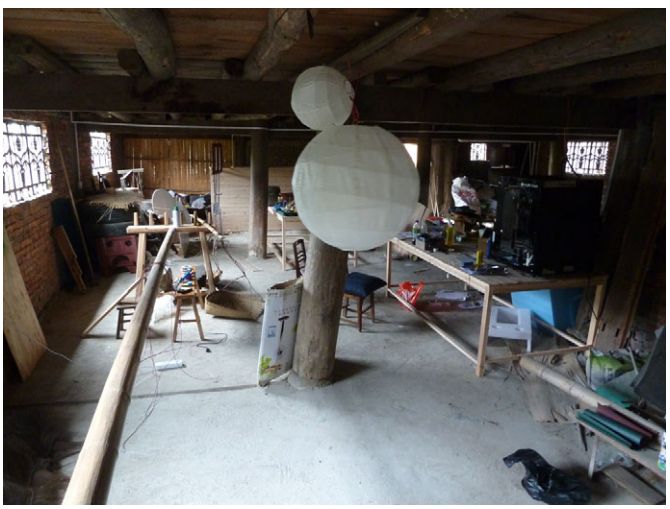

FIGURE 2. Maker space.

3.6.4. 合*(Hé): Concluding/combining*

In the final stage the team built the props and sets, made costumes, and rehearsed the performance. Figure 2 shows the maker space we established in the basement of one of the village houses. This included several tables for making objects, part completed props and sets, a 3D printer (front right), and numerous objects from the village which could be used such as bamboo poles, unused baskets and so on. The team built three interactive props for the drama informed by the workshops in the 起 Introducing/starting stage:

- *Interactive tree*: a movable tree hung with six Arduino controlled illuminated paper lanterns which pulsed between different colors to fit the scene of the drama, and responded to the notes played on a connected MIDI keyboard.
- *Money box*: a small wooden box which used Arduino to make a disproportionately loud sounds when opened and

shut, and to create a bright gold shimmering light for dramatic effect.
- *Shoulder pole*: a pair of baskets hung from a bamboo pole, to be carried on the shoulders. As the baskets are carried the Arduino triggered loud sighing sounds to suggest heavy manual labor in the drama.

During this 合 Concluding/combining stage team members reported that it was necessary for them to engage with the local population to complete their making activities, e.g. to source materials for the props. As the props were being made we observed occasions in which locals, whether part of the team or not, would enter the maker space. For example, Fig. 3 shows one of the numerous occasions in which children would come in to the maker space and play with objects as they were being made (the Money box in this case). During such serendipitous interactions the team reported developing ideas for additional interactive pieces for the final interactive exhibition which they felt reflected the needs and interests of local people as discussed with these passers-by:

- *Football goal*: foreign students noted that children rarely played sports, even though a basketball court was provided in the village. An interactive football goal was constructed with the aim of exciting local children about playing football. Arduinos were embedded in wooden 'goal keepers' who shouted excitedly when hit with a ball.
- *Alcohol game*: the team observed that locals often drink a lot of alcohol at festivals. This was confirmed in discussion with local musicians and local officials who stated that there were some health concerns about this behavior. In response to this the team developed the idea of creating a 'cute' interactive game to illustrate levels of alcohol present. This was achieved by the students and facilitators using an Arduino and alcohol sensor to create a game in which participants blew into a tube and a series of LEDs lit up on a clown's face, and the clown's eyebrows moved to indicate level of alcohol present.
- *Bamboo whistle*: the local musicians stated from the outset that they were interested in how technology could be used to create musical instruments (this was part of their motivation for getting involved with the project) so a new instrument was created by the facilitators to demonstrate basic principles of sound synthesis. This instrument used an Arduino to provide real-time control of pitch and volume of a sine wave, encased in fragments of local bamboo.

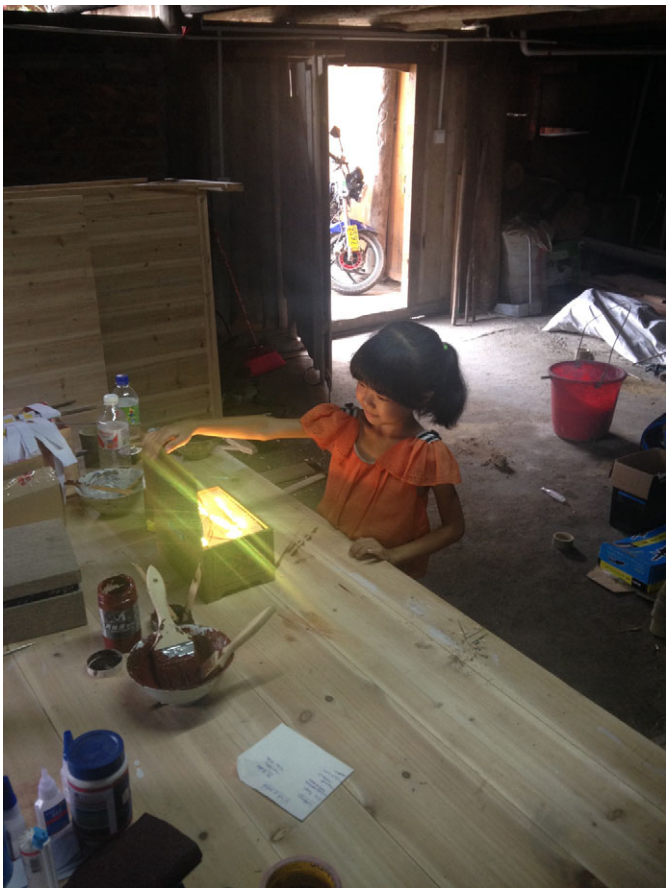

FIGURE 3. Children in the maker space.

The culmination of the 合 Concluding/combining stage was a 2-h public evening event including the drama and interactive exhibition we had created. The event was structured to create a cross-cultural experience for the entertainment of predominantly local people which was set on and around the village's Drum tower stage (Fig. 4). Figure 5 illustrates the staging for one of the scenes of the drama. In China such events are social occasions and so the audience was lively and vociferous, talking, laughing, eating, drinking and moving about during the whole event. After the drama performance the stage was set out with all interactive objects as an interactive exhibition. Team members acted as guides and hosts to facilitate public interaction with the objects. Figure 6 illustrates the typical interaction between local audience (foreground) and team members (to the back of the image).

4. RESULTS AND OBSERVATIONS

Seventeen locals and thirteen outsiders completed the questionnaires after the public event and we found that the overall impression of the event was 'Very good' (average 1.97 on a Likert scale −2 very bad, 0 neutral, 2 very good). One local audience member commented that 'foreigner playing the traditional drama is a highlight—it quite attracts their eyes', she was 'initially worried that it would be foreigners pretending to be local people', but, she liked it that is was 'foreigners playing us for us'.

FIGURE 4. Hengling drum tower.

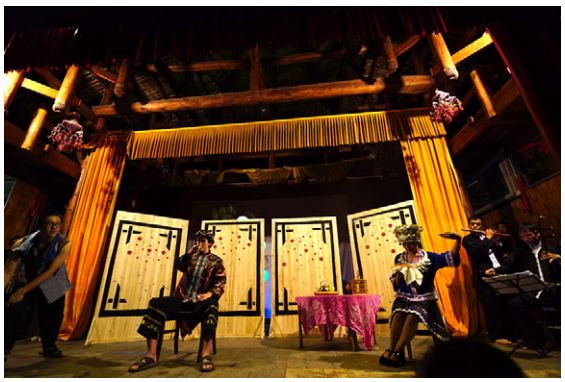

FIGURE 5. Staging showing movable screens, actors, props and musicians.

Overall, 39 codes were identified in the Thematic Analysis of the interviews, leading to six broad themes: (i) Design process (related to RQ1); (ii) co-creation (related to RQ2); (iii) interactivity (related to RQ3); (iv) translation (related to RQ4); (v) drama style (related to RQ4); and (vi) role of local context. In this section we discuss the research question related themes with reference to the discussion of approaches to engaging with communities across cultures outlined in Section 2.

In this section we use a notation to characterize cross-cultural co-creation between people. This is indicated in curly brackets with the initiating group first (if there was one), followed by the who undertook the co-creation e.g. {domestic: domestic ⇔ local} indicates co-creation between domestic and local participants initiated by domestic participants. Note that the sequence does not reflect the amount or quality of contribution, it is simply a rough indication of who got involved with the co-creation. Where there was a clear sequence to the co-creation, e.g. translating some text for a collaborator, this is indicated by an arrow to show the sequence. For example, {domestic: domestic → local} indicates that the domestic group initiated and undertook some activity which they handed over to the locals as part of their co-creation.

4.1. Theme: Design process (related to RQ1)

In the interviews team members reported that during the Qi2He process most of the creative decisions were made by the participants together {local ⇔ outsider} though from the interviews it is clear that not all of the elements were contributed to equally by the groups. For example, the choice of topic for performance was reported as a shared decision {local ⇔ outsider}, but the creation of script was reported a mostly being undertaken by the script group {foreigner: foreigner ⇔ domestic → local}, the choice of music was initiated by the musicians and undertaken in discussion with outsiders {local: local → local ⇔ outsider}, the design of staging was mostly undertaken by the students {outsiders}, as was the design of the interactive objects {outsiders}.

Foreign students commented that they enjoyed their 'experience of a different design approach' which was 'very free and open' (Alison). Dave commented that is was a 'cool idea', that everything was a very creative experience, and that using the performance as a goal for the design process was a good idea. Similarly, Charlie commented that the 'objective to make a drama in local with local people is good, an inspiration', and Etel commented that the 'idea is great because whole design is beyond traditional design or interaction design'.

Local musicians did not comment on the design process as being novel. Xiang commented that the 'whole process matches his former experience of working with local singers', and that because there is no new music he didn't see that he was doing co-creation work, describing himself more as a facilitator {outsider: local → outsider}. Similarly, Wenyan did not comment on the novelty of our approach—in his view our objective is 'just a performance, but this time with students'. And, Yong thought that students' creation process is

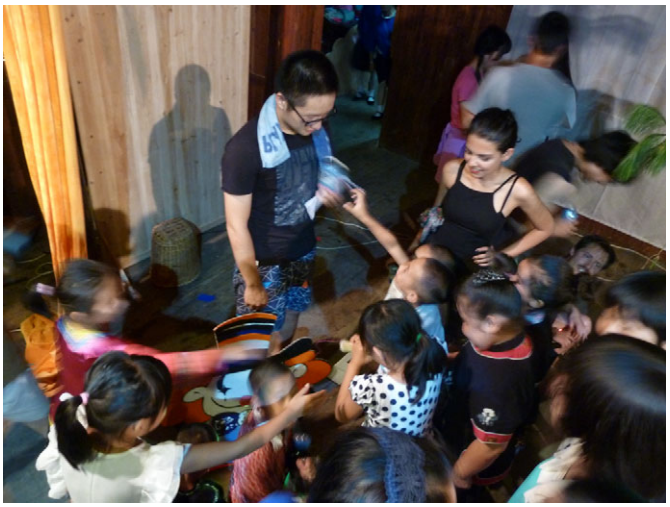

FIGURE 6. Engagement with the Interactive exhibition.

somewhat similar to his previous experience of performance creation outside the local area {outsider: local ⇔ outsider}. However, Xiang did comment in interview that basing the script on a traditional Kam drama made the collaboration easy as they already understood key elements of the drama {outsider: local → outsider ⇔ local}.

This difference in perception of novelty of the design approach may reflect the fact that the foreign students had not engaged in drama design or production before so were relatively inexperienced compared to local musicians—mostly the students had design or academic backgrounds so understood more product oriented design and production processes such as graphic design, industrial design, product design, film production and Interaction Design.

4.2. Theme: Co-creation (related to RQ2)

Several examples of co-creation across cultures (RQ2) were reported by team members in the interviews which we describe below. As outlined earlier, before the Qi2He process started locals contributed to the development of the structure the overall co-creation process. Specifically, before the official kick-off, the facilitators worked remotely with the local musician leader Jianhuai to develop the four steps of Qi2He {facilitators: facilitators ⇔ local}. This was undertaken to ensure that the steps were feasible in the local context, and to make sure that the knowledge requirement for local participants was appropriate. Then, during the 转 stage, Yong, Xiang and Wenyan raised doubts with the team about why our schedule prioritized so much time for collaborative making at the expense of rigorous rehearsal which they expected. This resulted in discussion about the purpose and motives of the co-creation (to engage local audience and to explore interactivity with co-creation beyond the drama {musicians: local ⇔ outsiders}), which led to suggestions from locals about which areas to prioritize for the public performance {local: local ⇔ outsiders}. This may be an example of meta-level co-creativity—the facilitators and local musicians negotiated the aims of the co-creation activity from the perspectives of: (i) the facilitators' interest in exploring interaction, and (ii) the local musicians' concerns about producing a good quality performance for local consumption.

In the interviews Etel, Badr and Mei were reported as being the key creators of the script in collaboration with Zhilan. The script development process was reported as initially involving Zhilan sharing one version of the Kam love story with Mei {local: local → domestic}, which Mei translated into English for Etel and Badr {domestic: domestic → foreign}, resulting in an initial collaboration on the script between Zhilan, Mei, Etel and Badr {local: local ⇔ domestic ⇔ foreigner}. In the interview Zhilan expressed concern that the initial script was too much like a Western musical script, and so found a video of a traditional performance for the outsiders to watch with her to improve their understand the traditional performance {local: local ⇔ outsider}.

In the interviews Zhilan was reported as playing a key role in validating the style and content of the script—for example, one iteration of the script was reported to pass from Etel and Badr to Mei and then to Zhilan {outsider → domestic → local}. This iterative loop engaged local, domestic, and foreigner in the co-creative process of shaping the script to fit with local traditions yet having a modern twist {foreigner ⇔ domestic ⇔ local}. Nuo reported having heard a similar local story when learning local music from the local musicians {domestic: local → domestic}, and described using this knowledge to add further details to the script with an afterlife scenario {local: local ⇔ domestic ⇔ foreigner}. The team reported that there was on-going discussion between all members of the team about the ending of the drama, and a decision was finally jointly taken to end on a (semi) happy note. This could be seen as a cross-cultural compromise {local ⇔ outsider} between a truly sad ending (traditional Kam) and a happy ending (Western musical). Such compromises may indicate a good level of understanding between participants.

Kam drama traditionally utilizes exaggerated *gestures* to convey emotion and plot. We observed that Xiang provided frequent direction and advice during the rehearsals on how actors (outsiders) should move, gesture and position themselves {local: local ⇔ outsider}. In interview Xiang explained that this was done to best convey the authentic emotions of the scenes to the local audience. This stage direction contributed to co-creation of the script and performance cues {local ⇔ outsider}. Similarly, we observed Wenyan contributing to the staging and script writing, for example working on the techniques for switching between light and shadow, and developing a narrative for the story which would be perceived to have a good flow by local audience {local → outsider}. In

interview Wenyan explained that this was to help to make the performance understandable to local audiences. The reported purpose of Xiang and Wenyan's contributions of local expertise and knowledge to the co-creation was to ensure that the drama was comprehensible intended audience {local ⇔ outsider}.

We observed that Yong spent a large amount of his time co-creating the *music* with outsiders based on the script and outsider feedback during rehearsals {local ⇔ outsider}. Yong also reported spending considerable time working on the music. The process reported by Yong was that at first he was given a version of the English script which had been translated into Chinese {outsider: outsider → domestic → local}. He reported that he used his evenings at home to try to understand what the outsiders wanted from the whole story, and drew on his own experience to select the music from traditional repertoire. In interview Yong stated that during rehearsals he often found that scenes were shorter than in traditional Kam dramas and so the scenes would end before he felt that he had conveyed the meaning through music. He stated that this meant that he had to repeatedly edit and revise and the music *in-situ* with outsiders during rehearsal {local ⇔ outsider}. He would then revise the music off site with other musicians before returning for further rehearsals {local: local ⇔ local → outsider}. In this way Yong led the co-creation of the music {local: local ⇔ outsider} which may contrast 'outsourcing' approaches to co-design such as (Murray, 2010) in which outsiders give locals specific pieces of design work to complete {outsider: local → outsider}.

The set group reported brainstorming ideas for the final scene of the drama in which death and sadness are conveyed, and how to dress the set in a minimal but emotionally charged way. Whilst watching Western musicals to collect ideas for the stage performance Badr reported that she noticed the use of back projection onto a screen to create a simple but striking effect, and proposed this approach for the final scene {foreign: foreign → domestic}. The local musicians later commented that they would try to use this new effect in their future performances as they found it particularly striking {foreign: foreign ⇔ domestic → local} and reported that it may have value in making their performances more enticing for younger people.

We observed that designing and making the props offered numerous points of co-creation across cultures. Team members also mentioned in their interviews the amount of cross-cultural activity and immersion needed for the prop making—value gained through the approach (RQ3). For example, Ju reported working on the Shoulder pole prop and that when a local weaver and Wenyan saw Ju's baskets in production they engaged in working together on the carrying basket to fit the traditional style of basket making {local: local ⇔ domestic} and also gave advice on how it should be carried in the drama {local: local → outsider}. In another example, the prop group reported designing a set of handcuffs but on seeing these in rehearsal Wenyan proposed making more traditional shackles instead {local: local → outsider} and then helped the prop team to make them in the traditional way {local: local ⇔ outsider}.

Xiang was reported in interviews as contributing expertise in selecting, making and forming bamboo, the most common construction material in the local area. The prop team reported that this help accelerated the prop making process and gave outsiders some experience of traditional making skills {outsider: local ⇔ outsider}. Students also reported gaining expertise and knowledge serendipitously from the local environment and local people during the prop making {local → outsider}. In this way the co-creation supported elements of learning about the local community as outlined in Section 2.1.

The team reported that *serendipitous* interaction with local children in and around the maker space led them to design the Football goal interactive game {local → outsider} which in interview they stated that they hoped would have lasting use by local children {outsider: outsider → local}. It is worth noting that this serendipitous engagement by local children with making for the drama led to designing and making something for the local population which was not have been envisaged in advance. Not least because, as noted by the facilitators, the village already had a specially built basketball court implying to us that sporting activities for children were already accommodated.

4.3. Theme: Interactivity (related to RQ3)

Local musicians were observed watching the making process which, in discussion with facilitators and in interviews, they reported as increasing their understanding of digital technologies {local: outsider → local}. For example, Yong commented that he observed the making of the Bamboo whistle and was able to understand the basic mechanisms of interactive sound production with sensors. He commented that it increased his interest in learning more about digital technologies, and that it inspired him to try to improve his locally produced wind instruments with a similar approach. Figure 7 illustrates Yong using the Bamboo whistle to create ghost like noise whilst playfully scaring a group of local children.

From the feedback of the final performance and exhibition, one local audience member commented on the Interactive tree, stating that 'it is different' but did not comment on its interactivity. Another local audience member liked the Money box—'when opened it is shiny; traditional money box is just nothing'. A third local audience member liked the back projection and the shackles which he saw as 'interactive'. Whilst another commented that the 'biggest difference to traditional drama is that there is a lot of props; those interactive elements are quite new', and another commented that in future they want to see more drama of 'interactive style–never seen such style of drama before'. From these comments it may be that in general the term 'interactive' was interpreted

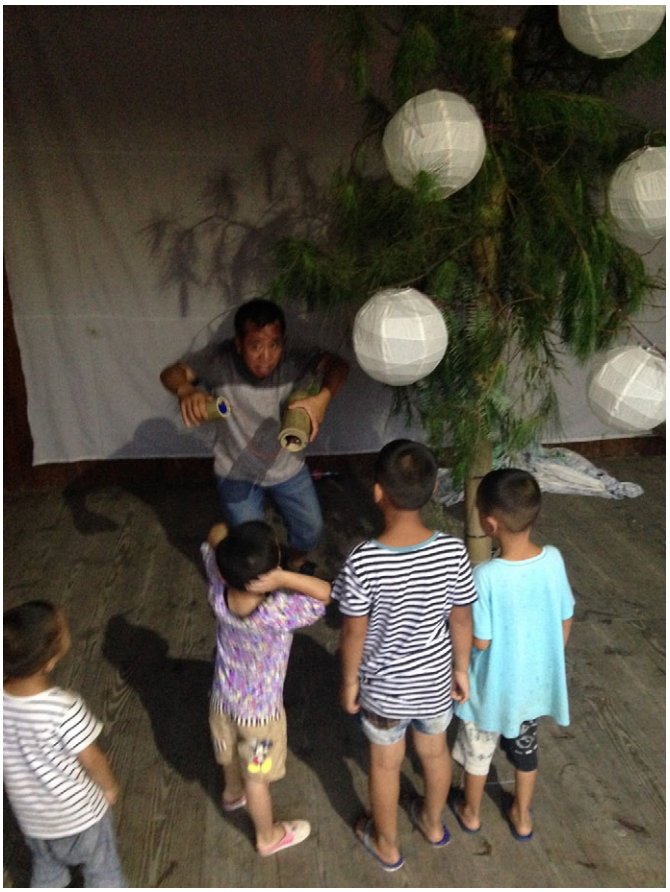

FIGURE 7. Performative interaction with bamboo whistle.

by local audience members as referring to the style of acting, the props on stage, and the staging (e.g. use of back-projection), rather than interactive objects created in our digital making. This could be a result of the two levels of translation needed (English–Chinese–Kam), or a difference in the broader concept of what interaction might be, or a lack of our highlighting the interactive aspects of the props during interviews.

From our analysis of the interviews we found that outside audience members commented more on the interactive objects than local audience members. In particular, they commented more on the Interactive tree ('liked that it changes colors and patterns', outside audience), the Money box ('the story follows this', outside audience), and the back-projected shadows. A foreign audience member 'liked the pulsing tree—looked kind of magical', whilst another liked it 'but [had] no idea that it actually was interactive'.

4.4. Themes: Translation and drama style (related to RQ4)

It almost goes without saying that translation would be a recurring theme in cross-cultural activities, but, in addition to the effort involved in translation between English, Chinese and Kam, we also observed unexpected issues around music and translation. The local musicians reported that they learn their music orally and have no Chinese or Western classical training. We had naïvely assumed that music would be a universal form which could easily be accessed and shared by local and outsiders, but in reality Li reported having to translate between Western and local music notations {domestic → local}, and that the reliance on notation to share and teach music became a barrier to collaboration. Yong also noted that he learnt music by listening to a local music master and practicing with him, and that local musicians do not know too much about music theory, so it was difficult for him to communicate with students who knew quite a bit of music education and were happier to communicate by notation.

The local musicians all expressed mixed feelings about the drama production approach—whilst they disagreed with the modern (fast) style, they did comment that they felt that it was a potential way for local musicians to engage younger local people with traditional music and stories. This may be similar to Brereton *et al.* (2014)'s highlighting of the importance of 'noticing each other's different ways' (p. 1185). We suggest that the fact that local musicians felt able to express negative comments about our work together illustrated the level of co-working and mutual respect that had developed between us.

The fast pace of the performance, reliance on spoken narration, and lack of singing were also criticized by the local audience in interview. However, the local audience all responded positively to the story itself (e.g. 'drama is very human and easy to understand'), whereas only one foreign audience member specifically commented on the story content.

5. DISCUSSION

In this section we reflect to our research questions of Section 2.5 in light of our observations, followed by a brief discussion of how our approach might be used beyond *in-situ* cross-cultural co-creation.

5.1. RQ1: How can we structure a rapid co-creation process with digital making *in-situ*?

Engaging end-user groups in participatory design activities traditionally involves activities such organizational games role-playing games, future workshops, storyboarding and so on (Spinuzzi, 2005). Bidwell and Hardy (2009) note that such techniques favor the visual and textual traditions of Western research and may fail to engage, or worse, may actually deter engagement by local communities. In keeping with this critique, we believe that the approach of creating and putting on a performance of a local story may have benefits for engaging

participation in co-creation as we discuss below. This may be similar.

Firstly, we feel that the narrative of the drama provided a commonly understood framework through which to co-create content. In our view it became the locus of co-ordination. Furthermore, we observed that drawing on local stories directly exposed participants to local culture and the similarities and differences between cultures, and that this may have reduced the reliance on language and translation to some extent.

Putting on a public performance necessarily requires a lot of rehearsal. This provides sustained opportunities for cross-cultural interaction (foreign, domestic, local). We observed that many elements of the co-creation such as the script, music and sets were refined *in-situ* during the collective rehearsals. Students commented that they enjoyed their 'experience of a different design approach' which was 'very free and open' (Alison), whilst local musicians reported that their interest lay more on working with new partners and outside objects, especially digital objects which they did not have access to in rural China.

We feel that the aim of putting on a public performance, combined with setting the drama in a local context, provided a shared goal for participants. Furthermore, drawing on local traditions and stories offers the opportunity for local participants to be experts. In this way all participants have skills and experience to bring to the co-creation. Similarly, rooting the drama in local craft traditions provided opportunities for outsiders to engage with a wide range of locals to source and create props and costumes for the performance.

Putting on a performance requires a range of roles, which we feel allowed participants to draw on their existing skills to contribute to the co-creation. In our opinion this gave concrete direction for students and offered clear delineation of tasks. From our perspective this made it easier to undertake focused activities within a group, as well as improving co-ordination and co-creation between groups. Also, in our opinion, the variety of roles and skills needed to produce a public performance helps with engaging mixed-skills groups as participants have the opportunity to find roles that suit their background (after all, not everyone is a maker or an actor). From our observations and interviews it seems that drama may be a useful focus for encouraging co-creation across cultures. In our case we observed that the goal of creating a drama gave focus to the co-creative process and provided concrete design challenges for working with ICT in a rural location, i.e. the creation of interactive props and staging. In broader design processes our approach may be appropriate in the early stages of design—to immerse outsiders in local context, to help uncover and understand local design problems, and to develop working relationships with locals. Similar to Brereton *et al.* (2014) who 'emphasized time spent together in practical activities' (p. 1185) to encourage the development of engagement and reciprocity with local communities, our approach emphasized the time spent together in activities geared towards producing a public performance. Although our activities resulted in what might well be referred to as non-practical outcomes (entertainment) our observations and interviews suggest that they provided a focus for co-creation across cultures and provided some exposure to ICT as discussed above.

The results of our study may also indicate that approaches which use drama throughout the design process (Brandt and Grunnet, 2000), may be appropriate for working in rural areas such as Hengling if cultural factors such as traditional Kam performance styles and conventional writing models are taken into account.

In terms of structuring the co-creation process we found that our Qi2He process provided a framework which all participants could understand, indeed, local participants commented that they did not see it as a novel way to structure a design process. We suggest that pairing outsider design models with local design models is a useful and pragmatic way to engage participants in co-creation.

5.2. RQ2: What kinds of cross-cultural collaboration and value emerge during the co-creation given that the goal is non-utilitarian?

We saw a wide range of kinds of cross-collaborations in our study as illustrated by the many example notations in Section 4. By reviewing the notations we developed we find that all participant groups initiated and undertook co-creation, and that there were a range of directed (→) and joint (⇔) co-creation activities observed. For example, when Wenyan proposed making traditional shackles {local: local → outsider} and then helped to make them {local: local ⇔ outsider}, or when the script team worked together on versions of the script based on local stories {local: local ⇔ domestic ⇔ foreigner}, or when local musicians learnt about the back projection technique and stated that they would use it in their own productions in the future {foreign: foreign ⇔ domestic → local}.

Reviewing the instigators of the co-creation in our examples in Section 4 we find that locals instigated the majority of the examples (27), followed by outsiders (12), domestic (3), musicians (1) and facilitators (1). This crude analysis of the examples may indicate that locals were the primary instigators of co-creation, or that locals were pivotal in instigating the widest range of co-creation activities.

As discussed above, many instances of co-creation across foreign, domestic and local were reported and observed. For us, an important contribution of this co-creation is the positive change it may bring to local population. For example, after the event, the local musicians stated that they would try some of the interactive drama elements (faster pace, and shadow performance) in their own performances to try to engage

younger audience with local culture. For us this is a important contribution of the co-creation activities as local musicians had stated that they were looking for new ways to engage younger generation with traditional culture and songs which the musicians reported younger people often find too boring. This contribution to local culture production contrasts with previous work of Chuenrudeemol *et al.* (2012) in which local artisans learnt how mass media techniques could be used to raise awareness of their work outside their local context.

Additionally, when outsiders were interviewed by local musicians in the 承 Following/inheriting stage about their cultural heritage, the local musicians commented that they developed a greater understanding of the value of their own indigenous cultural treasures after comparing cultural backgrounds with outsiders. We see this reassessment of the value of local culture by local people as having the potential to contribute to the sustainability of local culture.

5.3. RQ3: What are participants' perceptions of interactivity and digital making?

As the DIY maker movement gains momentum in technologically advanced regions (cf. Lindtner *et al.* (2014)) our approach to engaging communities with making through the co-creation of a drama may help to reduce barriers to its acceptance and uptake. This would be pertinent in developing regions which already have strong traditions of making and makers, such as homemade crafts, weaving and carpentry. Furthermore, we speculate that by introducing maker technologies through community engagement we may contribute a route to empower local communities to build on their accumulated local wisdom and heritage with unique cultural characteristics (as discussed by Lindtner (2015)) rather than attempting to introduce maker technologies from a western oriented design tradition and its associated values.

We planned the drama as an opportunity to introduce the local population to interactive objects which they could then explore in the interactive exhibition. In this way we hoped to learn something about local responses to technology (as per Section 2.1), and interaction in particular. The drama itself contained combinations of local traditions and knowledge with ICT and craft skills. Local people are not technologically naïve, but they reported not having experienced interactive art or interactive object making. What we found particularly striking was local people's response to the interview question 'What did you think about the interactive stuffs?' (translation from Chinese). In response to this question some of the local audience commented on the unusual interaction between the actors (e.g. a hug, or the fight scene), their movement off stage, and their facial expression. Local audience members also mentioned that they found the back projection an interesting interactive thing, and two mentioned the interactive Money box.

What we find interesting is that 'interactive' may be understood more broadly and ambiguously by locals than by outsiders. From the interviews it seems that for local audience the whole performance was interactive. However, the Interactive tree, which gained the most votes in the audience survey as the favorite interactive piece, was not commented on as being interactive at all by the local audience. Possibly this was because there was no obvious relationship between people's behavior and the interaction of the lights on the tree. In this sense the Interactive tree may be seen as being interactive by an outside audience because it is an unusual piece of technology, versus the local audience who may not see it as particularly interactive as no-one directly *interacts* with it. This leads us to suggest that local understanding of interactive might be more human-centric, whereas the outsider view might be more technology-centric. There was a similar distinction in general comments on the drama by different audience groups —local audience members commented more on the emotion, story and movement (i.e. the human elements), whereas outsider audience members commented more on the set, props and acting abilities (i.e. the production elements).

We intended our interactive objects to be playful, fun, enticing and intuitive by using exaggerated interaction, and emphasizing non-literal (surprising) noises and sounds to accentuate the novelty of the interaction. From the audience response, this approach appeared to work for the Interactive tree, Money box, Football goal and Alcohol game. The Interactive tree had the most opportunities for interaction during the exhibition—the audience could press keys on a musical keyboard which would result in sounds being played and lights on the tree lighting up. We feel that this made it intuitive and fun, and the large size of the tree may have made it enticing.

The Money box had very simple interaction which gave an immediate and (hopefully) humorous response to opening and closing the lid (exaggerated open and close sounds as well as bright shining gold light) which the audience commented fitted well into the drama. The Football goal was reported as fun and engaging by the audience in interviews and questionnaires, and, again, had very simple interaction—kicking a ball at a figure would make a loud shouting sound. Finally, the Alcohol game required audience members to blow into a tube to test their alcohol levels which would then make a clown's face change in hopefully comic ways. Again, this had very simple interaction with immediate, and funny responses.

In contrast, the Bamboo whistle and Shoulder pole were not received well. Maybe this was due to the Bamboo whistle's more complicated interaction and the Shoulder pole's rather obscure audio interaction (it made exaggerated sighing noises when carried). One musician did engage in playful interaction with the Bamboo whistle (Fig. 7). Possibly the Bamboo whistle was intuitive for a skilled musician, but not usable or interesting for a broader audience.

However, as Fig. 6 illustrates, we had underestimated the levels of interaction that would occur in the exhibition—objects which were designed for individual use were often interacted with by several people at once (sometimes up to 10). We had designed the objects to be robust and portable, especially given the unknown supply of electricity. However, the Interactive Tree and Alcohol game were both irreparably damaged during the interactive exhibition—clearly our designs were not robust enough. There is a balance to be made here between the level of robustness that can be achieved in a short time in a mobile maker space, and the requirements of intense hands-on interaction.

The interactive objects were made *in-situ* from local, often traditional, materials in conjunction with ICT elements (e.g. the Money box and Bamboo whistle). Whilst a number of local children, some adults and the local musicians were observed interacting with objects as they were developed, we believe that staging the drama and including interactive objects enticed more people to engage with them. By showcasing the interaction through the drama, we speculate that the audience were encouraged to handle, open and explore the interactive objects in the exhibition. However, we learnt from audience feedback that we should have spotlighted the objects and their modes of interaction more clearly before, or during the drama.

Whilst the interactive objects were constructed locally, they were designed for a one-off event and not for long term use. We see this as a weakness of our approach to engaging local communities in co-creation of ICT. The approach may create interest and may raise awareness of the potential of ICT, but it does not produce products which return long term practical value to the community. Furthermore, as the objects were for use in a single evening we did not consider uptake, maintenance and long-term use of the objects in our design criteria.

Local people, including musicians, villagers and children, observed the co-creation process as it unfurled in rehearsals on stage and in the makerspace. A local merchant stated that he had thought that 3D printing would be some sort of magic which could create everything from food to airplanes based on what he had previously heard. But after he saw the 3D printing of a PLA-based flower for the set from a 3D model, he realized that 3D printers are not some sort of magic. It may be that such demystification could help to remove technology superstitions in developing regions and help to empower local people in the acceptance and adoption of new ICT.

5.4. RQ4: What are the challenges and limitations in undertaking non-utilitarian focused co-creation across cultures?

Whilst this approach may be useful for co-creation which requires all-round skills (public drama performance in this case), we do not think that it would suit collaborative activities requiring significant skills and experience such as fine art or engineering. Furthermore, whilst some students reported enjoying the flexibility to move between roles, others reported finding the need to take on multiple roles and the lack of clarity on roles and responsibilities problematic. We feel that there is a balance to be found here between assigning specific roles and tasks and allowing participants to be responsive to contingencies on the ground. As Etel put it: 'whole idea of performance is great, but in first week we should share the bigger picture clearly'.

Furthermore, whilst we aimed to facilitate co-creation where all participation contributed equally, it is clear that local musicians mostly focused on the creation of the music, whilst outsiders focused on the production of the performance. As discussed above, there is evidence of points of co-creation between locals and outsiders, e.g. co-creating props, the staging or co-creating the ending of the performance. However, the ability for groups to work independently meant that overall there was not an equality of contribution across the project as a whole. Locals did not equally contribute to the building of the interactive elements, and outsiders did not equally contribute to the creation of the music.

One of the pragmatic challenges with our approach was that creating a public performance consumes a lot of time and effort which can actually reduce the possibilities of co-creation. It is a balance between time spent in closed groups working on specific elements, and time spent co-creating and rehearsing together. Furthermore, we found that a careful balance needed to be achieved between (i) creating a professional *quality* performance, (ii) *immersion* in local culture, (iii) teaching and *learning* techniques *across cultures* and (iv) developing *interaction*. Each of these elements could in itself have been the core focus of the creative activity. We found that equal emphasis needed to be put on each element and carefully balanced so that one element did not dominate at the expense of others. This required that the facilitators made executive judgments on when focus should shift from one dominant element to another.

Co-creating across cultures carries with it an inherent risk of creating offense through misunderstanding, misinterpretation, and misrepresentation of cultural elements. We were mindful of this possibility and structured our Qi2He process with the aim of including opportunities for cross-cultural co-creation at all stages to try reduce the possibility of misconstruing cultural meaning. As can be seen through reports of the script writing process, there were several iterations in which co-creation across cultures ensured appropriate interpretation and use of cultural elements, e.g. selecting an appropriate (compromise) ending. Our audience also reported that they initially felt concerned about outsiders misconstruing and misrepresenting their culture, with some directly reporting that they were worried that it would be foreigners pretending to be local people. In the end, we feel that we achieved a

reasonable balance, with members of the audience reporting that they liked having foreigners playing 'like local for local', and that some audience were so caught up in the story and emotion that they reported weeping at key moments in the plot.

5.5. Application beyond *in-situ* cross-cultural co-creation

As discussed above, our approach of setting interactive drama as the goal of co-creation and using our Qi2He process to structure the co-creation process is likely to be most applicable to the early stages of design. Especially where rapid immersion and development of working relationships is important. Whist our approach is rooted *in-situ*, we believe that elements may be applicable beyond cross-cultural co-creation.

We believe that our use of interactive drama could provide a playful lens through which a broad range of user groups can be engaged, and their understandings of different forms of interaction explored. This is in contrast to reporting back on ethnographic studies (Buur and Torguet, 2013) or product idea reviews (Iacucci *et al.*, 2000). In this way our approach could be used as way to drive design explorations Fallman (2008) where the interactive props serve to provoke and explore design spaces. Key to success would be designing interactive props which balanced robustness, rapid prototyping, and interaction. In our limited time we created six interactive objects which enticed interaction, but were not robust enough; we could have made a smaller number of objects more robust and longer lived. We also found that spotlighting interaction which was immediate, funny and responsive was most engaging as illustrated by the: Money box, Football goal and Alcohol game.

Our Qi2He process may be a useful approach to facilitating diverse design teams within companies by aligning Western, design studio processes, with traditional creative structures. Furthermore, our co-creation notation could be used by design teams to examine their own team working and identify what kinds of co-creation occur and who leads them. For example, it could be used to identify groups who instigate collaboration, and also groups who do not engage, or are more focused on, say, production.

6. CONCLUSIONS

The primary contribution of this article is a demonstration of how drama with interactive elements can be productively used as a shared focus to engage people in co-creation across cultures with HCI. Our approach is non-utilitarian and framed by third-wave HCI concerns of interaction experience (cf. Bødker, 2015), and so using drama provides a shared goal around which diverse participants can come together to co-create content. By choosing a story which appealed to both locals and outsiders we provided shared points of reference across cultures. We showed that working together on an interactive drama provided points of cross-cultural insight and immersion for participants and helped to build working relationships which are especially important to develop at the start of a co-creation process. We structured our co-creation process following four steps of traditional Chinese literature composition methods and showed that our method (Qi2He) can be used across cultures to structure rapid digital making with interactive technologies. This method could be used in other cross-cultural collaborations to structure a co-creation process, especially between English speaking and Chinese speaking participants.

Creating interactive objects for public consumption through drama and exhibition provided opportunities to explore perceptions of HCI, and interaction in particular, across cultures. We found that local understandings of the word 'interactive' were more human-centric (i.e. people interacting), whereas outsider understandings were more technology-centric (i.e. interactive technology). Value was generated for local participants through reflection on the value of their own heritage as well as identifying ways to increase the appeal of traditional performances to younger generations of locals. The openness of our *in-situ* co-creation approach allowed additional societal issues to be serendipitously identified and addressed through the co-creation process, such as identifying a need to encourage children's physical activity. However, care must be taken to balance the time spent on co-creation, immersion in local culture, cultural exchange, and learning to create interactivity.

In these ways our approach would be useful in the early stages of co-creation when participants need to rapidly immerse in each others' cultures and contexts and build working relationships across cultures. It would also be useful in driving design explorations, debunking technological myths, and serendipitously enticing interaction. However, care should be taken to balance the contributions and roles of participants. For example, we found that by creating working groups we inadvertently reduced the collaboration across cultures with locals focusing predominantly on music production and outsiders focusing more on the production of the performance. A particular challenge for this approach is to manage the risk of causing offense through misunderstanding, misinterpretation, and misrepresentation of cultural elements. This risk should be reflected on throughout the co-creation process and used as a way to stimulate immersion, reflection and sharing across cultures.

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