Transcending Disciplinary, Cultural and National Boundaries: Emergent Technologies, New Education Landscape and the Cloud Workshop Project

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Abstract. As technology continues to become more accessible, miniaturised and diffused into the environment, the potential of wearable technology to impact our lives in significant ways becomes increasingly viable. Wearables afford unique interaction, communication and functional capabilities between users, their environment as well as access to information and digital data. Wearables also demand an inter-disciplinary approach and, depending on the purpose, can be fashioned to transcend cultural, national and spatial boundaries. This paper presents the Cloud Workshop project based on the theme of 'Wearables and Wellbeing; Enriching connections between citizens in the Asia-Pacific region', initiated through a cooperative partnership between Queensland University of Technology (QUT), Hong Kong Baptist University (HKBU) and Griffith University (GU). The project was unique due to its inter-disciplinary, inter-cultural and inter-national scope that occurred simultaneously between Australia and Hong Kong.

1 Introduction

Developing innovative methods for teaching design and creative practice within higher education is critical. The development of 21st century skills is essential in ensuring students become critically informed creative leaders capable of understanding the broader implications of technological changes of the future and respond in a creative, ethical and responsible manner. The project augments, extends and constructs learning as a result of wearable technology's affordances. To achieve this the project involved teams comprising students from visual arts, industrial design, product design, fashion design and interaction design who cooperated throughout a two-week period in an attempt to develop innovative concepts that blended art, design and technology in response to the project theme. Students were presented with a challenge to design wearables that transcend various boundaries including cultures, nations and space. In total five groups worked together across disciplines, with different cultural backgrounds

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in two countries to explore the potential of technology from a human-computer interaction perspective. An unpacking of the workshop structure, pedagogy and final student outcomes are discussed revealing distinct benefits as well as certain learning and technological challenges. The future potential for the project within the context of human-computer interaction is outlined.

2 Technological Shifts

As technology continues to become more accessible, miniaturised and diffused into the environment, the potential of wearable devices to impact our lives in significant ways becomes increasingly viable [1, 2]. Wearables afford unique interaction, communication and functional capabilities between users, their environment as well as access to information and digital data that was previously not possible [3, 4].

Part-product, part-fashion and part-technological creations, wearables demand an inter-disciplinary approach and, depending on the purpose, can be fashioned to transcend cultural, national and spatial boundaries. It is this specific criterion that was the focus of exploration with the Cloud Workshop project developed as an inter-national, inter-cultural and inter-disciplinary collaboration.

This paper presents Cloud Workshop based on the theme of 'Wearables and Wellbeing; Enriching connections between citizens in the Asia-Pacific region' initiated by the authors as a cooperative partnership between Queensland University of Technology (QUT), Hong Kong Baptist University (HKBU) and Griffith University (GU). Through this project we explore the ways in which wearables can transcend disciplinary, cultural and distance boundaries often imposed by other types of interactive devices. We found the project permitted students to bridge distance and cultural gaps while also permitting students from various disciplines to come together to envision creative human-computer interactive art and design outcomes.

3 Classroom of the Future: Transcending Boundaries

Students were presented with a challenge to design wearables that transcended cultures, nations and space. Being in two locations separated by large distances, interdisciplinary teams were asked to create wearable concepts that functioned across, and linked through, this distance. The final solutions could not function as separate entities but rather exist as a bridge to connect the design that shared data and information through the cloud in some way.

Teams comprising various creative disciplines such as visual arts, industrial design, product design, fashion design and interaction design cooperated throughout an intensive two-week workshop. Utilising digital technologies to overcome physical distances and cultural divides, the program challenged students to envision future ideas for wearable technologies that enriched connections between citizens in the Asia-Pacific region.

Using emergent technologies as a channel for information exchange in a multitude of ways, rather than a trickle down approach to knowledge dissemination, Cloud

Workshop was based on active engagement in knowledge generation through practice based experimentation and ongoing problem solving. Hence, the focus was on sharing knowledge between participants. The educator's role, rather than hierarchical oracle, was facilitator of learning experiences. This involved creating a framework for activities to happen, as well as anticipating and responding to deficits in information or emerging roadblocks to thinking by changing pace, drawing focus or exposing participants to specialist knowledge.

From the onset of the project students gained exposure to different perspectives to the research theme from the vantage of the three facilitators' varied professional disciplines and research interests. Connecting via live digital video streaming enabled the project participants to access a wealth of shared knowledge, extending across the professors research fields as well as the participants interests and skills. Everyone's perspectives were equally valid and learning was acknowledged as a two way process. The project became coherent through a shared mindset – to move things forward.

The acceptance of difference is an inherent factor that the students first observed as the facilitators shared their views and quickly adopted themselves as they began to work in inter-disciplinary, inter-cultural, inter-national project teams. Knowledge generation became a shared activity. This is a cornerstone, coherent with a perspective that predicates "postmodern knowledge is not simply a tool of the authorities; it refines our sensitivity to difference and reinforces our ability to tolerate the incommensurable. Its principle is not the expert's homology, but the inventor's paralogy…" [5].

The ecology of working with emergent technologies, that is a feature of both the theme of the workshop (wearables) and the context of the work environment (cloud computing), is that it is defined by change. Pedagogy within the digital technology sphere is 'messy'. It is both protean – as software screens are unstable and can change rapidly; and opaque – as you can't see from the outside how it works inside. Survival in this environment involves flexibility and creativity. Teacher's primary role becomes that of change agent, activator, or accelerator. They are the designer of the context around pedagogy, content and technology. Shuman's model of Pedagogy, Content, Knowledge (PCK) is well known to educationalists, where pedagogy and content need to be brought together to enable learning [6]. The evolution in educational theory posited here contextualise Shulmans work in the contemporary paradigm, technologies deliver access to information so the teacher is no longer the sole provider of knowledge, instead they guide learners in how best to navigate the relationships between Technological Pedagogical Content Knowledge. (TPACK) is the revised acronym posited by Mishra and Koehler [7].

The Cloud Workshop project is an example of pedagogy that transcends disciplinary, cultural and national boundaries. There are other reasons to validate this approach:

1. New media and emergent technological environments are the predominant workspace where design of the future will take place.
2. Knowledge acquisition is a whole body experience, not an activity of the mind alone. Learning is an individual organic process, so contrary to the current predominant approach in education to standardise learning and to prioritise the mind

over the body, learning environments need diversity to engage the whole body physically and cognitively for creativity to thrive.

The workshop leverages the portability of online digital technology and the affordances of mobility to enable participants to engage in collective design processes where and when they choose. Within this space of learning it is never clear where the end is as information is ongoing. There are no right and wrong answers and no absolute judgements, everything is relative. Every solution leads to new problems, or opens new possibilities. It is as if the workshop door is never closed. Learning is ongoing. In the 21st century emergent technologies are constantly transforming the way we access data. Higher education and teaching is transitioning slowly compared to the adoption of these tools by society. People expect to be able to access and perform tasks, whether for work, study or play, all the time and everywhere.

The architecture of the Cloud Workshop included connecting two physical workshops, the Wearables Lab at HKBU and The Edge at the State Library of Queensland, via live video streaming. These spaces became the physical hubs for activity, facilitating live-streamed lectures, group presentations, feedback sessions and prototyping. The Cloud Workshop website (www.hifcloudworkshop.com) stored programme information, schedules, links to resources and documented the resulting projects. The Cloud Workshop Facebook page connected the workshop activities into to participant's social lives and provided a space for ongoing blogging and discussion (www.facebook.com/groups/187119418091614/). In addition the five group projects established social media platforms as workspace for their individual project and utilised shared domains in the cloud, such as Google docs, Google drive, Dropbox and the like, to facilitate exchange and work on shared drawings, documents and images.

Fig. 1. Virtual doorway set-up for pop-up exhibition (left, HK; right, AU)

The configuration of a pop-up exhibition took place in two connected galleries linked via a virtual doorway (live-stream video projection) (Fig. 1). The exhibition housed the resulting wearable design prototypes generated in the preceding two-week intensive workshop. From either gallery visitors could look into the other space through the (virtual) doorway. To launch the exhibition, group participants presented their prototypes to the audience simultaneously across the two countries. Half of each group

were on either side of the virtual doorway, physical components of each project could be viewed in both galleries, and a video documentary bridged the divide by providing a complete picture of each project.

Victor Hugo predicted that "the dominant idea of each generation would, in future, be embedded in a new material…" [8]. The media of communication, the technology, is bound to the way in which we think. The cognitive process for Palaeolithic man, whose advanced technological tool was the stone axe, differs from that of Shamanic societies whose tools are objects that connect physical to spiritual worlds. Societies think differently in alphabetic systems than those who adopted ideographic writing systems. Different cognitive processes evolved once we developed handwriting, which restructured consciousness in that it produced a form of retention. This dramatically shifted again with the widespread use of the printing press. In the digital era retention and dissemination are altered again. In each case accessibility to knowledge creates different forms of politically coherent communities. "Thinking is conditioned but not determined by technical conditions" [9].

The Cloud Workshop project augments, extends and constructs learning as a result of wearable technology's affordances. Many of the boundaries that define the limitations of conventional classroom-based teaching are overcome. Restrictions to learning are based largely on educational foundations that were designed for 20th century industrialisation where the aim was to standardise learning and produce workers for different levels of society. The focus on producing uniformity is at odds with societies need to stimulate creative minds to continue the organic evolution and intelligence of our species. "Implicit in electronic culture is the idea of multilevel participation in the creative process" [10]. In the 21st century the roles of work and life are evolving. Factories are becoming automated and robots will do much of the work of the future. In fact, the word 'robot' comes from the Czech word for 'worker' (appearing in the title of a 1920's play by Karel Capek) [11]. We live in a globalised world and students in the creative fields need to engage in learning in global and connected contexts so as to meet the demands of the 21st century economy.

4 IoT, Emergent Technologies and Future Practice

As objects and artifacts become increasingly interconnected and the Internet of Things (IoT) takes hold, new markets are emerging and new modes of teaching and learning are also being developed. The potential implications of ubiquitous technological interactions via tangible and ambient media have never been more real or more accessible [12]. Within this frame, wearable technology is an "emerging interdisciplinary field, bringing together concepts and expertise from a variety of disciplines, ranging from materials science, through computer engineering to textile design" [13]. Wearables that live on, near or in our bodies give rise to a previously unimaginable level of data about people and environments not previously available. By enabling the connection of divergent data sets, wearables provide life-augmenting levels of interactivity [12].

Providing an opportunity for students to engage with the emergent technologies is critical given Hughes' assertion that "artifacts are socially malleable when industries

are young, but resistant to social influence once they have matured" [14]. Given the techno-social implications of wearable technology, the workshop made an attempt to introduce students to critical theory of technology [15] and understandings surrounding technology and the lifeworld [16]. To do this, as outlined in Sect. 2, a learning context that explored the implications of connectivity, interactivity and cross-cultural collaboration was established through a physical yet temporal 'cloud' based teaching environment. Within this experimental classroom, students from the three universities were brought together, organised into multi-disciplinary teams and issued with a project brief. By attending Cloud Workshop, students were encouraged to engage both physically (design through making) and virtually (design through collaboration). This physical/virtual collaborative 'space' provided a unique opportunity for students to learn about wearable technology, associate technologies, future practice and interdisciplinary collaboration. Academically, it was anticipated that problematising 'connections through wearable technology' would provide a platform for rich exploration and investigation into the realm of future technology and associate potential scenarios.

Table 1. Group divisions and theme

Group	Project description	Students	Outcome
Techlace (n = 6)	Displays the wearer's emotions to assist communication between strangers or across different cultures	1 × QUT 2 × GU 3 × HKBU	Prototype - accessory and garment
Illumine (n = 5)	An attempt at sustainable wearable costume that explores connections between people to enhance large scale events (e.g. music festivals) and create digital surfaces made up of hundreds of people, each becoming as a pixel on a screen	1 × QUT 2 × GU 2 × HKBU	Prototype - Origami folded paper - worn garment (various combinations)
Sine Language (n = 6)	A sophisticated glove and neck garment used to break down language barriers between cultures through the use of persistence of vision	2 × QUT 2 × GU 2 × HKBU	Prototype - dress in combination with glove (predominantly an accessory)
Ignite (n = 5)	A dance garment that enhanced the dancers' movements and actions and transmitted this information across countries	2 × QUT 1 × GU 2 × HKBU	Prototype - dance costume, worn garment
Gutan (n = 5)	An exploratory fashion garment and bracelet that evokes ideas of celebration and friendship. It transmitted various messages from bracelet to wearable garment to connect people across the globe	1 × QUT 2 × GU 2 × HKBU	Prototype - 3D printed bracelet, accessory

Simultaneous connections between Australia and Hong Kong were achieved by organising the students into five groups, consisting of students from each university (QUT, GU and HKBU). A breakdown of each group, theme, distribution per institution and outcome is provided in Table 1. As illustrated in this table, each group maintained a unique approached to the set task. For the purpose of this paper, three projects; (i) Techlace, (ii) Sine Language, and (iii) Illumine, are explored as exemplars of concepts that attempt to confront ideas of cultural, national and spatial boundaries.

Techlace. The mantra underpinning the concept direction of Techlace is "feelings are beautiful, why hide them?". To serve this purpose, Techlace was created as a necklace and dress combination prototype to convey emotions through visual non-verbal cues using the process of illumination (Figs. 2 and 3). By centring the design on non-verbal approaches to conveying emotion, the team were able to transcend cultural boundaries as the point of 'communication' exists between the necklace of one wearer and the dress worn by another. This concept aimed to help people understand one another and to understand if they are being offensive in another country (they are not familiar with) and/or enable shy people to easily express emotion (refer Fig. 3). The necklace component was designed in Brisbane and the dress component in Hong Kong.

Fig. 2. Techlace expressing emotions 'angry' and 'euphoric/happy' (Australia)

Fig. 3. Techlace dress design (Hong Kong)

Sine Language. Sine language centred on breaking down language barriers between cultures by developing a sophisticated glove and headpiece as a method of interacting in order to facilitate non-verbal communication between people. Through persistence of vision technology, the glove was designed to send a message (Fig. 4). As a wearer's hand moves, a visual representation of a word is created (in a nominated language), and the headpiece subsequently receives the message and transmits a reaction/response (Fig. 5). The glove is designed so it can be programmed and configured to represent different languages, depending on the context, as illustrated in Fig. 5.

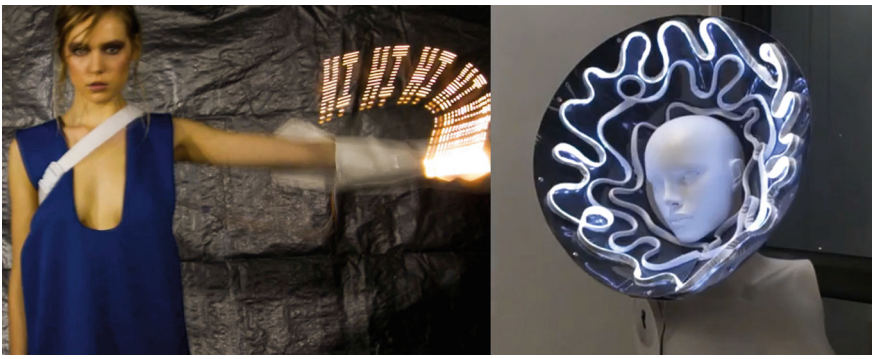

Fig. 4. Sine Language transmission in English "Hi" (left, AU) and headpiece receiving (right, HK)

Fig. 5. Visual representation of the glove capabilities "Nei Hou" (Hello in Cantonese)

Illumine. Unlike Techlace and Sine Language, Illumine (Fig. 6) is not so much person-to-person communication, rather the enhancement of group and festival-based experience.

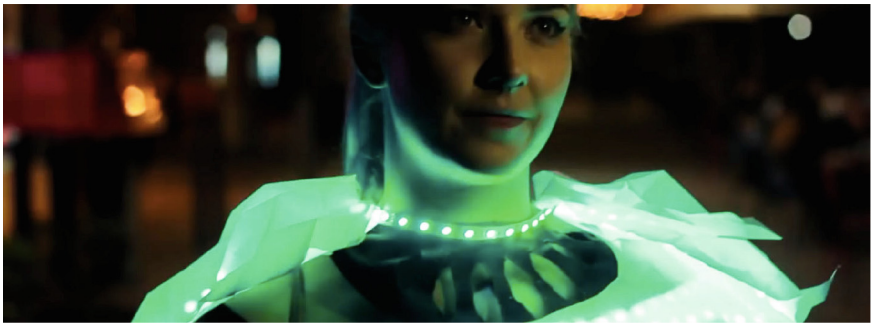

Fig. 6. Illumine, worn item is equivalent to one pixel (refer Fig. 7)

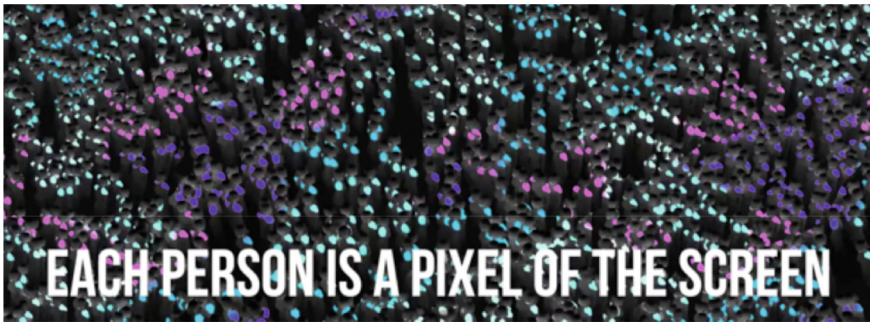

Fig. 7. Illumine, example of collective visual display

Illumine is designed to enhance interactions between people at public events. Using this product, each person at the event becomes a co-contributor to the immersive nature of the space. The garment worn individually acts as a collective visual display as people gather and coalesce to experience the festival or concert, with each person effectively becoming a 'pixel' in a larger display at the event (Fig. 7). As illustrated in Fig. 6, Illumine when worn, rests across the users' shoulders. This proposed design is made of paper and is recyclable to enhance sustainability of the 'one off' festival event item.

5 Observations and Discussion

In each instance, the student teams identified future opportunities for wearables that promote and assist non-verbal modes of communicating. The focus of each prototype to enrich connections 'visually', are mostly likely, due to the workshop framework centred on working in cross-cultural interdisplinary teams. The creative outcomes produced also attempted to transcend the distance boundaries by sharing and transferring data and information across the two locations. This particular aspect of the

design however, appeared to pose significant challenges for the groups, as they struggled to successfully blend ideas that were culturally sensitive or meaningful.

Working in mixed teams was challenging given the different time zones, language barriers and varying levels of skill and capabilities. In most cases groups had limited to no knowledge of coding, sensors, arduinos or programming, resulting in limited scope and understanding of how to 'apply' the preferred technology at a sophisticated level. However, regardless of the challenges, each group successfully produced a working prototype of varying fidelity.

The emphasis by teams on non-verbal communication is not surprising given that the majority of meaning between people is conveyed non-verbally with only a small percentage of meaning conveyed through spoken words [17, 18]. Given the challenges faced by teams during Skype meetings, it is logical to assume this inspired the non-verbal focus of the proposed wearable prototypes. Moreover, it can be argued that each prototype pertained "telepresence" as the resultant of each team was a form of mediation of experiences of geographically dispersed agents. Teams achieved this by ameliorating their physical and/or psychological proximity through particular communication technologies [17, 19, 20].

Finally, it is believed that the workshop success was co-dependent on an effective integration of pedagogical and technological objectives. Embedding technology within a block delivery program run parallel in differing countries – was both intense and highly productive. Communicative and technological struggles aside (i.e., lack of programming knowledge, and or understanding of sensors), students commented during and post-event about their productivity, their pride in the outcomes as well as their surprise at what was achieved in the short timeframe. The inclusion of technology and non-technology related items as part of the collaborative learning process links well with current research that cites a need to increase the use of IT for educational purposes [21]. While this observation is positive, it is clear that establishing richer links between the use of technology and desired educational outcomes [21] are needed.

6 Conclusion and Future Work

Wearables afford unique interaction, communication and functional capabilities between users and their environment with the capacity to drastiacally impact people's lives. This paper outlined Cloud Workshop, which focused on utilising wearables as a source of creative inspiration for art and design students to explore the transcendence of disciplinary, cultural and national boundaries.

Developing innovative methods for teaching creative practice is critical in the 21st century that will ensure students become more critically informed creative leaders capable of understanding the broader implications of emerging technologies. The ecology of working with new media, that is a feature of both the theme of the workshop (wearables) and the context of the work environment (cloud computing), is that it is defined by change. As a result the workshop was based on active engagement in knowledge generation through practice based experimentation and ongoing problem solving.

In all, five groups presented projects varying in scope and approach. The paper highlights three projects including Techlace, Sine Language and Illumine, as exemplars of wearable creations that offer novel ways of interaction. In each instance, the student teams identified future opportunities for wearables that promote and assist non-verbal modes of communicating.

Cloud workshop was largely successful but further developments are needed. Any success is co-dependent on an effective integration of pedagogical and technological objectives. Students commented during and post-event about their productivity, their pride in the outcomes as well as their surprise at what was achieved in the short timeframe. Nevertheless, there were distinct communicative and technological struggles. It was also clear that establishing richer links between the use of technology and desired educational outcomes [21] are needed. Future versions of the workshop are already planned. Three main elements considered for change in the next round include preparing more thoroughly for the cultural exchange between students, providing more structure around project themes, and supporting students with expert knowledge around coding. It is hoped these changes will improve the pedagogical and learning outcomes and result in improved and more sophisticated wearable prototypes. Technology and creativity are the drivers of the Cloud Workshop, and as [22] highlighted "new technologies have had an immense impact on the how we live, work and communicate… " and it is for this reason that "teaching and learning in this emerging world needs to emphasize these twin issues—technology and creativity" [22].

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