

A Human Centred Design ‘Makerthon’: The creation of a framework for teaching Humanitarian Engineering competencies

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STRUCTURED ABSTRACT

CONTEXT

Organisations, like Engineers Without Borders Australia (EWB), deliver initiatives in which participants develop a deeper understanding of the role a Human Centred Approach, the process of Human Centred Design (HCD) and the development of appropriate technology play in creating a positive change within communities. One such initiative, EWB’s Humanitarian Design Summit program has seen over 1300 students participate in immersive study tours delivered in six countries in the Asia-Pacific region since 2015. A refined version of the Humanitarian Design Summit is proposed to run locally in the form of a weekend ‘Makerthon’ event. Through problem based learning, participants in the ‘Makerthon’ are encouraged to further explore the application of human centred approaches and human centred design and how it relates to their studies and professions. While similar makerthon or hackathon type initiatives are becoming more popular, the potential impacts of delivering these initiatives with a focus on the above mentioned concepts could be examined through the implementation and evaluation of this focussed ‘Makerthon’.

PURPOSE

To strengthen the effectiveness of the HCD ‘Makerthon’ event, an opportunity exists to develop a teaching and learning framework that can be implemented to provide participants a basic competency in human centred approaches and HCD in a short period of time, and to develop an evaluation plan to assess whether learning outcomes were met.

APPROACH

Core skills and capabilities that demonstrate competency in HCD were identified through content analysis of HCD models applied across different industries and interviews with subject matter experts. Initiatives following similar formats of problem and multidisciplinary team based solution generation were reviewed as case studies; to assess how participation and competencies are evaluated in short, intensive workshops. An assessment of competencies gained by participants were then determined through a combination of observation and surveys.

RESULTS

From this investigation a pedagogically sound learning framework to develop HCD competencies and engineering teaching and learning approaches for intense training was created. The framework was validated at HCD focussed ‘Makerthon’ events, leading to recommendations on best practice for these events to be refined and successfully delivered nationwide.

CONCLUSIONS

The success of the ‘Makerthon’ in effectively delivering concepts of HCD was proven through questionnaire surveys, which demonstrated participants’ appreciation of community involvement and deep understanding of the human centred approach. Feedback from the community partner implied that the ‘Makerthon’ adds value to their work. The pedagogy developed reflects best practice and approaches to deliver future ‘Makerthon’ events.

KEYWORDS

Human Centred Design; Humanitarian Engineering; intensive learning; problem based learning

Background

There has been a growing need to educate engineers on sustainable development, which is described by the World Commission on Environment and Development as “meeting the needs of the present without compromising the ability of future generations to meet their own needs”. This has led to initiatives across engineering education integrating the concept of sustainable development (e.g. The University of Sydney’s Humanitarian Engineering Major) and the rise of organisations focussed on creating social impact through engineering (e.g. Engineering for Change, Engineers Without Borders).

The Humanitarian Design Summit is one of many initiatives that have been delivered in response to the need to cultivate the next generation of engineers with the appropriate mindset and skills to support sustainable development. Developed by Engineers Without Borders Australia (EWB), the Design Summit Program creates and delivers international study tour experiences that aim to nurture future development leaders and embed human centred values and approaches in engineering, design and technology education. Design Summit student participants undergo two weeks of field-work, which typically begins with four to five days of acclimatisation in the form of workshop sessions and cross-cultural trainings. This is followed by four to five days of community immersion, where students form smaller teams to explore challenges and opportunities faced by the community. In the final few days, participants develop and prototype their ideas before presenting it to the community (Smith, Turner, Brown, & Price, 2016).

Between 2015-2018, more than 1300 students have participated in Design Summits across 6 countries in the Asia Pacific region. While the Design Summit has been shown to positively impact the professional social responsibility attitudes of participants (Daniel & Brown, 2018), the duration, cost and location of each Design Summit potentially creates a barrier for participation. Additionally, there may be engineering students or professionals who would prefer an introductory level course in human centred approaches before committing to a Design Summit.

To empower the use of human centred values and approaches in the engineering discipline, a refined Design Summit focussed on embedding human centred approaches was proposed to run locally in the form of a ‘Makerthon’ event. A ‘Makerthon’ is a design sprint-like event where participants given a design challenge and work in teams to devise a solution in the form of a prototype. This event aims to deliver an introductory level training in the application of human centred approaches in a controlled environment through intense workshops. The training also encourages participants to further explore and practice human centred approaches in their studies and professions.

Human Centred Approaches

Design approaches have traditionally been technology driven since the Second Industrial Revolution (also known as the Technological Revolution). The shift in paradigm from a technology driven approach to human centred approach, as noted by Zoltowski, Oakes, and Cardella (2012), is likely due to leading design firms like IDEO attributing their success to the application of Human Centred Design (HCD), and Stanford University’s integration of HCD into the curriculum. Compared to conventional “waterfall” design processes, the HCD process is far from linear; and unlike user centred design, which focuses on the end user of the product, HCD considers a wide range of stakeholders, and includes them in every step of the design process (Krippendorff, 2004).

Definition and Mindsets

Don Norman, the father of Human Centred Design (HCD), defines it as:

An approach that puts human needs, capabilities, and behaviour first, then designs to accommodate those needs, capabilities, and ways of behaving. (Norman, 2013)

There are many organisations and institutions that use HCD principles in their development approach, each has a slight variation in how HCD is communicated and taught. Based on literature (IDEO; Maguire, 2001; Senova, 2017), common mindsets identified were:

- Empathy - Deep understanding of people and context
- Radical collaboration - Working in multidisciplinary teams and involvement of diverse stakeholders
- Rapid prototyping - Transforming thought to form and experimenting rapidly
- Iterative - Constantly facilitating feedback and learning from failure
- Navigating ambiguity - Recognising uncertainty and embracing it with optimism

Human Centred Design Process

The Human Centred Design process is one way to apply a human centred approach. Several HCD proponents have modelled their own processes (IDEO; Stanford d.school, 2018). Based on these models, EWB created its humanitarian design spiral, as shown in Figure 1. The process is separated in 6 stages: Discover, Empathise, Ideate, Screen, Prototype and Communicate.

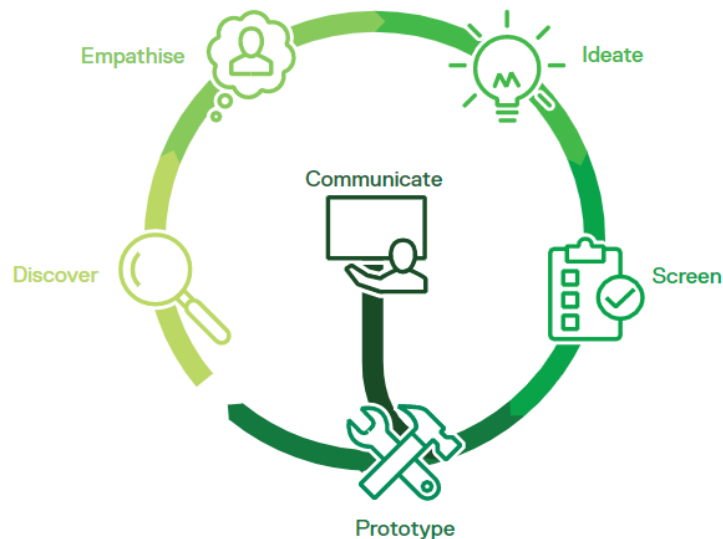


Figure 1: EWB's Human Centred Design Spiral (Engineers Without Borders Australia, 2018)

Makerthon

The term 'makerthon' is a portmanteau of the words 'make' and 'marathon'. Formal definitions do not currently exist in literature; in this context, a Makerthon is considered as a design focussed, sprint-like event, where the goal is to create a prototype of a solution based on a stakeholder identified design challenge and share solutions with the same stakeholder. Its digital counterpart, the 'hackathon' is increasingly popular, with an average of one hackathon a week in London (Briscoe, 2014). In tertiary education, initiatives called 'Markathons' have been run as a marketing class project (Calco & Veeck, 2015).

Within Australasia, technology corporations organise hackathons as an opportunity to encourage digital innovation and scout fresh talent, in return for prize money and industry networking opportunities, such as (e.g. Microsoft's Protégé). Companies like Google Ventures also run internal Design Sprints, a 5-day process that puts development process stakeholders (marketing, design, development and testing) in small teams to answer critical business questions (Knapp, Zeratsky & Kowitz 2016).

EWB's region chapters have run similar initiatives with varying objectives in the past, such as NSW's Design Corner, WA's Makerthon and Monash University's Ideathon. A common theme among these initiatives is to begin developing sustainable and appropriate solutions for or with a selected community partner.

Pedagogical Approach

Hackathon-type initiatives are largely result-driven, and a typical format is discussed in detail by Briscoe (2014). The proposed Makerthon, however, is process-driven and education-focussed, specifically in delivering the concepts of human centred approaches through problem based learning and experiential learning.

Problem based learning is the use of problems in the instructional sequence (Barrows, 1986), as opposed to lecture-based course delivery. It was derived from theories suggesting that given a problem in a realistic context, students acquire knowledge more effectively (Kilroy, 2004). It was found that problem based learning is analogous to strategies of teaching design, where students are given an identified problem related to the subject, pass through a number of stages using active learning, and arrive at an open-ended answer (Mills & Treagust, 2003). Most problem based assessments are not marked for technical correctness but for the way the solution is structured and presented, discussion and analysis demonstrating understanding of the problem, as well as how the student motivates their design choices. Similarly, the Makerthon is structured to guide participants through a recommended design process, and participants are assessed based on how well they have embraced the design philosophy.

Experiential learning is simulated by reflections from the learning process (Healey & Jenkins 2000). The Lewinian Experiential Learning Model describes the general process of experiential learning, which is a cycle of concrete experience, observations and reflections, formation of abstract concepts and generalisations, and testing implications of new concepts in new situations. According to Kolb (2014), the characteristic of experiential learning is to conceive it as a process instead of a set of outcomes, and to treat it as a continuous creative process grounded in experience and in pursuit of creating knowledge. To reflect the experiential element of the Makerthon, facilitators conduct regular debriefs with participants to reflect on their learning experience and view the challenge holistically.

Delivered Program

The result of this research project is a structured 3-day Makerthon event, the format of which is outlined in

Table 1 below. 26 participants took part in the event, consisting of both students and professionals from various STEM disciplines. The Makerthon was delivered by a team of professionals with diverse backgrounds from EWB.

To provide participants with a real-life context, the delivery team partnered with Choice, Passion, Life (CPL), an organisation whose mission is to help develop an inclusive society where people with disabilities have the same opportunities as everyone else.

The program was structured using a variety of complementary sessions as outlined below.

Workshop

The workshops are analogous to structured tutorials, being a combination of facilitated discussions, case study reviews and activities. These sessions are structured to deliver key competencies in HCD (Kramer, Agogino, & Roschuni, 2016), with objectives specific to each workshop as shown in Table 1. Concepts delivered are discussed further in a thesis that expands upon this paper (Gan, 2018).

Community Partner Storytelling & Interview Session

Representatives from the organisation, including storytellers, caretakers and volunteers, were present during these sessions. They provided participants with context for the design challenge, which is to create an inclusive society for people with a disability. The storytelling component is an introduction to the storytellers and their daily lives, while the interview sessions are held informally between all the representatives and participants.

Pitch & Showcase

Participants present a 2-minute elevator pitch on the core principles of their design and how it addresses the challenge. This is followed by a showcase where each team gets a 5-minute slot to present the prototype of their solution, explain their design process and answer questions posed by judges. Judges consist of representatives from the community partner, assistive technology start-ups and EWB.

Facilitating Design Session

These sessions are for participants to work on the design challenge they identified through engagement with CPL at their own pace. The facilitator's role is to encourage participatory group decision making (Kaner, 2014) and guide the teams through the design process. Opt-in sub-workshops were held during

these sessions for participants interested in learning more about HCD tools and methods, such as the Empathy Map (IDEO) and Feedback Capture Matrix (Stanford d.school, 2018).

Table 1: Makerthon Schedule

Duration	Session	Key Concepts
DAY 1		
15 min	Introduction	
1 hour	Workshop 1: An Introduction to Human Centred Approaches	- Standard Engineering vs Human Centred Approach - Human Centred Design vs User Centred Design
15 min	Brief on Reading Material	Mindsets of the human centred approach
DAY 2		
1 hour	Workshop 2: Discover & Empathise	- Addressing biases and assumptions - Strengths based approach
1 hour	Facilitating Design 1	
30 min	Community Partner Storytelling	Immersion in experience of people with a disability
45 min	Community Partner Interview 1	Developing interview approach and practise empathy
1 hour	Lunch	
45 min	Community Partner Interview 2	Synthesising information from interviews
1 hour	Workshop 3: Ideate & Screen & Prototype	- Structured brainstorming - Problem framing - Mapping design considerations
2 hours	Facilitating Design 2	
DAY 3		
30 min	Workshop 4: Communicate	Facilitate feedback
3 hours	Facilitating Design 3	
1 hour	Lunch	
1 hour	Facilitating Design 4	Iterative prototyping
2 hours	Pitch & Showcase	Communicating a design
1 hour	Reflection & Winner Announcement	
1.5 hour	Networking	

Discussion

A post-event questionnaire survey was completed by participants to assess whether key concepts were effectively delivered; and to determine the success of the initiative overall.

One of the capabilities that demonstrate competency in a human centred approach is the ability to develop deep understanding of the people and context. As such, the Makerthon was structured to include extensive community consultation. Based on feedback by participants on their favourite sessions throughout the 3-day Makerthon, the Community Partner Storytelling Session topped the list, with comments such as:

Hearing from the storytellers directly is really powerful.

Real interaction with marginalised groups with important stories to be heard.

It is a very rare opportunity to have such great access/collaboration with end users of a specific group.

These comments show that participants value the presence and required input of the representatives in enhancing their ability to design appropriate solutions and following the design process effectively.

The human centred approach outlined in this Makerthon can be interpreted differently depending on each individual's background and experience. While there are no formal definitions, participants' perception on what a human centred approach is were captured in order to improve the relevance of future initiatives. Some comments made were:

Meeting the needs of the user while communicating with all parties throughout the process.

Identify the problem clearly before embarking on solutions. Keep the end user in mind at all stages.

Thinking in the perspective of individuals, considering their opinions, views and empathising with their situation to solve and relieve them from their discomfort.

The first comment reflects on how the human centred approach is not only about the user but also engaging with a range of stakeholders, as outlined by Krippendorff (2004). The second comment mentions focussing on framing a problem rather than jumping straight to solutions, as implied by the British Design Council's Double Diamond Design Process. The third comment shows deep appreciation for users beyond treating them as a source of information, but understanding their perspectives and opinions, which may affect and improve design decisions made. While these comments may have been a result of introspection from other experiences, similar themes captured among the rest of the participants are sufficient to show that the Makerthon has shaped the perspective of participants on the relevance of a human centred approach in the right direction.

While the analysed survey data shows positive reflection among participants, the views of the community partner play an important role in validating the success of the initiative. Therefore, a debrief meeting was conducted with the community partner to discover the impact of the Makerthon on the community. Below are some comments made by the community partner:

The experience of isolation and vulnerability without intervention (solution) was well understood.

Opened new 'windows'/experiences for clients and their lived experience of being heard and valued.

One crucial insight that can be extracted from these comments is the fact that they did not mention the solutions that participants came up with. This reflects community development is not merely about coming up with solutions, but taking the time to hear about one's experience, displaying considerations for one's needs and acknowledging the contribution of their involvement in the design process.

Conclusion and Future Work

The Makerthon is a proposed mechanism that provides participants with basic competency in human centred approaches through an immersive and intensive experience. The community centred structure was shown to work well in a real world controlled environment, as highlighted by feedback from both the participants and community partner. Participants' responses related to their perception of a human centred approach also showed deep understanding of the difference between a standard engineering approach and a human centred approach, a threshold concept that lays the foundation for future applications in their studies or profession.

As this is the first iteration of a structured EWB Makerthon, the evaluation plan was used as a tool to better understand the participant pool rather than objectively measure the impact of the Makerthon. To support future iterations and nationwide rollout of the Makerthon, areas of future work include establishing a quantitative survey instrument that maps the impact of the Makerthon in selected competencies, and reframing qualitative questions to encourage diverse opinions and reduce potential misinterpretations.

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