Chapter 10

User-Centred Design in a Health Innovation Course to Address Hearing Loss in the Elderly

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Introduction

South Africa, like many other developing countries, faces challenges in the delivery of healthcare. The prevalence of acute and chronic diseases, the persistence of infectious diseases, and the rise of non-communicable diseases spanning all age groups present challenges for an overburdened public healthcare delivery system (Chopra et al., 2009; Mayosi et al., 2009). Lack of financial resources is a major impediment (Levitt et al., 2011). In such an environment, suitable low-cost solutions are imperative. It is against this background that we introduced a course on Health Innovation and Design at the University of Cape Town.

The Health Innovation and Design course aims to equip students with the tools to design and evaluate context-appropriate interventions to improve health. The course is anchored in design thinking (Brown, 2008), a methodology that cuts across disciplinary boundaries. The course is primarily attended by students enrolled for master's degrees in health innovation and in biomedical engineering and is open to students holding any four-year degree who have an interest in health innovation. Thus, it draws students from different disciplines, who are able to contribute diverse disciplinary knowledge, gained in a range of undergraduate degrees.

This chapter demonstrates and assesses the implementation of design thinking as a means to facilitate and promote health innovation in the Health Innovation and Design course.

Design thinking

Design thinking is premised on a reciprocal relationship between the end-user and the design thinker (Goldman, 2016). In this approach, in-depth research-based learning is implemented as a form of contextual and cultural immersion to meet the needs of the end-user/community (Renard, 2014; Schweitzer, 2015; Goldman, 2016). An important aspect of design thinking is the development of empathy as a way of fostering participation and engagement. Account is taken of socio-economic conditions and cultural differences and effort is made to understand the experiences of consumers (Brown, 2008). Thus design thinking is practiced within the user's experiences rather than the ideals of the expert (Tideholm & Rydén, 2015). It is a holistic and human-centred approach informed by interdisciplinary collaboration, prototyping, feedback and iteration (Renard, 2014; Goldman, 2016).

Design thinking toolkit

Supporting the design thinking mindset is a set of methodological techniques that are grounded in co-creation, collaboration and iteration (Tideholm & Rydén, 2015). Co-creation involves a number of stakeholders, ranging from academics/researchers to healthcare professionals and patients in addressing complex problems. Collaboration in an interdisciplinary team is vital to the learning experience to foster deep learning through the exchange of ideas with peers (Goldman et al., 2014). The notion of iteration enables learning through "real work experimentation" where students test their ideas, get feedback and use the feedback to further develop their solutions (Tideholm & Rydén, 2015).

Various organisations have implemented design thinking, e.g. IDEO (Ideo, 2017) and the Stanford Design School (Stanford University. Hasso Plattner Institute of Design, 2017). Different toolkits of design thinking use three, four or even five phases, all of which fall into three central categories (Tideholm & Rydén, 2015). First, there is an exploratory phase, wherein data collection occurs to enable understanding of the context, the people and their needs. Second, ideation is the formation of ideas for finding innovative opportunities to meet the needs of users. Lastly, 'iterative prototyping' entails testing and receiving feedback on the ideas (Tideholm & Rydén, 2015). Some toolkits may divide these three categories into more phases. We focus on the Philips Co-create Four-Phase Design Process (Philips, 2016). The Philips toolkit explains this method as a creative, iterative, multidisciplinary approach to innovation and problem solving in a people-centric way. This toolkit divides the exploratory phase into the Discover and the Frame phases. The Ideation phase follows. Prototyping and testing are referred to as the Build phase.

Data collection takes place in the Discover phase; observations, information, and insights are collected from various stakeholders and categorised into themes. This phase is used to understand the context, the people and their needs, as well as to build empathy (Tideholm & Rydén 2015). Various techniques are used to collect data such as structured or semi-structured interviews and observations. The observation may entail immersion of the researcher in the context of the phenomenon being studied, allowing the researcher to document their experiences as a reflexive exercise while gaining insight from the environment (Ritchie, 2003). The data is presented in a Journey map where key insights are identified (Philips, 2016).

The Frame phase uses the data collected to define a clear need or opportunity (Philips, 2016). This opportunity or need is formulated into a vision statement to represent the needs of the users as interpreted by the team.

The Ideation phase is where possible solutions are generated to the vision statement defined in the Frame phase; the group selects the most feasible ideas and expands on how these can be achieved. Collaboration between students from various backgrounds facilitates the development of diverse ideas (Philips, 2016).

The Build phase requires 'iterative prototyping' which is subject to testing and feedback and informs a process of rediscovery (Tideholm & Rydén, 2015). Tangible but low-fidelity prototypes are constructed and presented to stakeholders to communicate solution ideas and gather feedback. Presentations and role-play may be used to convey the ideas.

In each of the four phases, the input of the end-users plays a central role and the desirability of the intended solution to the end-user is always foregrounded. These phases are depicted in Figure 1.
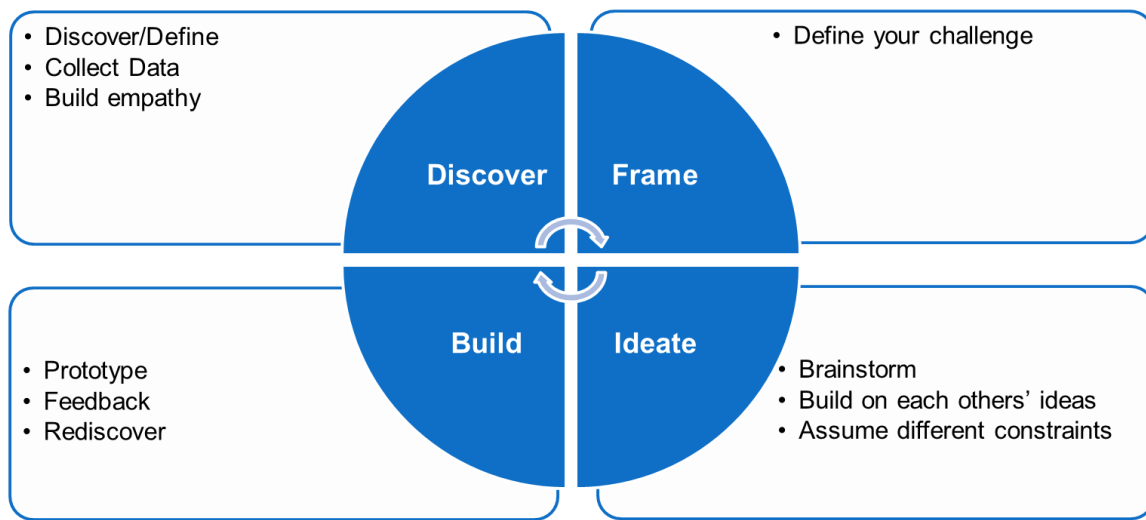

Figure 1: Four phases of Design Thinking (adapted from Philips, 2016).

Implementation of the course

The Health Innovation and Design course was first implemented over two semesters in 2015. Our first cohort of students consisted of a PhD student in human genetics, a master's student in occupational therapy, a PhD student in speech therapy and four master's students in biomedical engineering. In the first semester students were given formal lectures on design thinking and participated in a preliminary design challenge as a means of embedding the design thinking approach. They completed weekly learning logs which formed the basis of a final report. In the second semester, they were given the design challenge of addressing hearing loss in the elderly using the design thinking techniques that had been introduced the first semester. The community partner in this instance was an NGO providing housing and services to the elderly. The sections that follow describe the second-semester implementation.

Discover phase

After the students' introduction to the initial design challenge, which was to address the needs of the hearing-impaired for improved assistive devices, their first activity was to explore their personalised interpretations of the challenge. Since the students were from different academic

backgrounds, it was envisaged that the challenge would invoke different meanings. The students shared their emotions, biases, assumptions and prejudices related to the design challenge. The exercise enabled the students to appreciate the diversity of views and the richness emanating from multi-disciplinary teams. Team work would require them to have a shared meaning of the challenge from the outset.

Having done the groundwork of exploring the initial design challenge and identifying the stakeholders, the students engaged the project partner, the head of health at the NGO, for a brief introduction to the context of the challenge. To prepare students for their interactions with the residents, the class was addressed by a social anthropologist with experience in working with the hearing impaired and profoundly deaf people. The students were then ready to gather information on the initial design challenge, through observation and interviews. The interviews were semi-structured to enable flexibility in exploring interesting insights. The students interviewed residents and nurses of the NGO residential facility.

The questions posed to the residents were related to their age, how long they had lived at the NGO, how independent they were, their level of literacy, what their typical day was like, what they did for fun, what medical conditions they had, how long they had had hearing loss, what they found troublesome with hearing aids if they used them, and what it was like to live with hearing loss. Questions to the nurses were related to how residents were identified for hearing loss, and what it was like to deal with residents whose hearing was in decline. Students also interviewed an elderly person with a hearing aid, who was not part of the community supported by the NGO, in order to gain complementary insights from someone who had adapted to living with a hearing aid. This data collection was accompanied by a literature review on hearing loss in the elderly.

The students developed four major themes for the design challenge namely denial about hearing loss, lack of awareness of hearing loss by the residents, stigma, and the effect of the environment on hearing. These themes are in line with a study on hearing loss in the elderly by Wallhagen (2009), in which some participants noted the irrelevance of stigma, but still argued that it did exist, while others noted that the hearing aids were too visible and they did not want to be labelled as handicapped, noting that certain people "recoil" from physical or mental disability. It has been shown that in older adults who have already formed their self-identity, it is much more difficult to accept a diagnosis of hearing loss as part of who they are (Amieva, 2015). Participants in the study by Wallhagen (2009) did not want to acknowledge that they were becoming weaker and considered hearing aids a sign of aging. The reported findings echo responses of participants in our study. Interviewees also revealed that it was difficult to follow conversations in noisy and crowded environments.

Conversations with the nurse at the NGO clarified the referral process for obtaining hearing aids. The students learned that because hearing loss was not sufficiently acknowledged by the elderly, the affected residents would not identify themselves as candidates needing intervention. Therefore, interventions were not received when needed, often resulting in a postponement in addressing the hearing problem with a healthcare practitioner. The vast

majority of residents were still very active, independent and self-sufficient individuals who were generally literate. They may not have considered hearing loss a major health problem compared to other more life-threatening challenges such as heart disease and diabetes, as participants felt that they could manage their routine with diminished hearing.

The students used a journey map (Figure 2) (Komninos, 2019) also known as an experience flow (Philips, 2014) to describe an experience from a user's perspective by examining what they are doing, thinking and feeling, and to identify high points and low points of their activities. The "Key Activities" may be easier to articulate as these are observable or may be clearly expressed by the user. "Think" and "Feel" may have to be inferred as users may not clearly express their feelings and perceptions. The assumptions made in completing the journey map are evaluated and tested at the build phase where the prototype is tested. The low points present opportunities for further exploration by improving negative experiences, while positive experiences may be emphasised or enhanced.

Figure 2: Journey map template (Philips, 2014).

Key activities are entered under "Do", while "Think" and "Feel" are inferred by the person completing the journey map from the information provided by the user. "Stakeholder B" is any stakeholder with whom the user interacts.

Frame phase

Following the Discover phase, where the data collected during the interviews and observations had been synthesised and discussed, a vision statement was created. This activity helps refocus the findings and thereafter new framed challenges are developed to guide the group's creativity.

The vision statement is an important step to ensure that consensus is reached on the most important challenge for the users. The vision statement created by the students was:

Improving the attitude towards and acknowledgement of hearing loss – making hearing loss more socially acceptable and highlighting the importance of screening.

Improving quality of life – adjusting a contained environment to improve hearing.

The framed challenges were:

- "How do we promote the acceptance of hearing loss?"
- "How do we promote the understanding of hearing loss?"
- "How do we disguise hearing aids?"
- "How do we promote the use of assistive devices and other solutions"
- "How do we adjust the contained environment (i.e. indoors where the environment is more predictable) to be more conducive to communication?"

The "patient-centeredness" (Santos, 2014) that is essential to effective health innovation is highlighted in the frame phase.

Ideate phase

During ideation, the solution space is expanded by generating as many ideas as possible that could help in solving the new framed challenges in an innovative way. The students grouped and rearranged many of their ideas, then also carried out a vetting process, which is part of the design thinking methodology. The students completed an "idea template" (Figure 3) which took into consideration what resources were required and which stakeholders' input would be required for the ideas to be implemented. This activity gives the students the opportunity to consider the critical function of the idea and what is needed to make it a reality. They then rated these ideas according to user needs and likelihood of implementation. They decided to retain four of their final solutions as they were unwilling to discard ideas, because they wanted to show the users their work hoping that these solutions might be beneficial.

IDEA Template

Idea *Catchy name and tagline* **"Check Me Out/ Feel Good"**	

What is it? *Describe the key principle of the idea*

- Health promotion
- Screening for health problems – emphasis on hearing loss / health screening
- Providing access to appropriate treatment for health problems

Why is it a good idea? *Explain the benefits and added value for key customer*

- Identify health problems among NGO residents
- Identify health problems common in this elderly community
- Provide access to appropriate treatment/ advice for identified problems
- Let residents know that NGO is taking care of them
- Position NGO as hub for screening with services available to external users
- Improve quality of life for NGO individuals

How does it work? *Explain the ecosystem of stakeholders and touch points*	**What is needed for success?** *Describe which key factors and capabilities are needed to make this real*

Healthcare providers will have various testing stations, each with its own speciality. Audiology and hearing screens will be embedded in a range of health tests. Referral processes can be activated if the health care provider cannot assist.
Additionally, private companies could exhibit products such as hearing aids.
	• Funding
	• Co-operation from participants and healthcare professionals
	• Ability to address typical health problems, eg
	  • Hearing loss
	  • Blood pressure
	  • Headache
	  • Arthritis

Figure 3: Example of an idea template completed by students after their initial ideation round (adapted from Philips, 2014).

Ultimately, the students selected ideas targeted at promoting an understanding and acceptance of hearing loss and adjusting the environment to be more conducive to communication. The first idea (and the one depicted in Figure 3) was a "Health Awareness Day", at which multiple health conditions would be tested, with the inclusion of hearing screening. This would counter the denial and stigma that might be associated with a specific hearing screening day. Sufficient medical information would be available for the residents to learn about hearing loss and assistive devices in addition to general medical information. The second idea, an "Acoustic Audit", would aim to improve the acoustics of the living areas of the residents in order to improve their hearing without relying on assistive devices. Rather than putting the responsibility of carrying a device on a person who has hearing difficulty, the students preferred to make their living environment more suitable for effective communication. This would compensate for the reluctance of the elderly to seek medical advice and wear assistive devices such as hearing aids.

Build phase

Having generated potential solution ideas during the ideation, the students moved to the Build phase. Since the solutions were non-physical in nature, a conventional touch-and-feel prototype was not appropriate. The students presented their ideas to the residents of the NGO and other

invited stakeholders and guests in the form of a skit to demonstrate the need for self-diagnosis of hearing loss as well as the need for emotional support. To demonstrate the need for an acoustic audit of the environment, the group showed how different materials change the acoustics of the room. They received positive feedback from the audience overall. One invited guest, who was external to the class and the NGO, but had an interest in innovation and was in a similar age group as the elderly participants, appreciated that the solutions were not focused on individuals with the hearing loss, but rather on the environment and general activities to improve their quality of life.

Student assessment

Two methods of assessment were used to evaluate the students' understanding of the course material and the solutions they had produced. First, the students were required to present their chosen solution formally to the various stakeholders and end-user participants. The presentations allowed the students to describe briefly the design thinking process and its importance in health innovation. More importantly, the presentation formed part of the iterative process of improving solutions based on the feedback from the stakeholders. The students also presented to interdisciplinary intermediaries namely medical practitioners, academics and healthcare providers prior to the final presentation; this helped them refine their ideas. The final presentations were graded on creativity and effectiveness of communication to the audience.

The students were also required to write a report, which included a critical reflection on the design thinking theory covered in the course and the outcomes of the innovation process. Similar to the presentation, the report was used to gauge the students' understanding of the course material. More significantly, their critical reflection on the innovation process provided useful insights into the limitations and benefits of the techniques, how well the students adopted the design thinking mind-set, and the effectiveness of the delivery of the material by the facilitators. Ultimately, the report assessed whether or not their understanding of the design process had significantly changed through interacting with the end-user.

In line with university quality assurance requirements, a suitably qualified and experienced external examiner was appointed to moderate the course assessments and attend the presentation of the solutions.

Student experiences

One of the students' most important realisations was that they had gone to the interviews with their own assumptions; such as "hearing loss is big a problem," "hearing aids are big and uncomfortable", "there is a stigma associated with wearing hearing aids", and "hearing aids are expensive". They learned that the reality was slightly different. They discovered that many of the difficulties related to communication and hearing were of environmental origin and that there was denial about hearing loss. Their interactions did however confirm the stigma associated with wearing hearing aids.

After the first phase of design thinking where students attempted to observe and understand the elderly residents, they had already realised the benefits of truly engaging with their 'clients' in a meaningful way. At this point, they realised that a technological intervention, such as an assistive device, would probably not be the most appropriate intervention for the clients. The students reported that they had experienced empathy through engagements that centred on the users and that this had changed their views on what an appropriate solution might be.

The students noted that when they tried to ideate towards a solution for the hearing impaired, they would often realise that the broader special needs community may benefit as well. Another interesting observation was that those students who missed the interviews had a different perception of what the underlying problems of the elderly might be. For example, the students who conducted interviews became aware how important their appearance was to the residents, whereas others, who did not have first-hand experience with the residents, considered appearance a minor concern. Kilko (2015) argues that empathy allows the observers to use the behaviours of the people under inquiry to draw on emotive language that ultimately informs the observers' conclusions.

One student had been a software engineer before enrolling for his masters' degree and had many times created products for clients which the latter ultimately did not like. After a client would reject a product, it was a common in the company to proclaim that the "client does not know what he/she wants." Having completed the Health Innovation and Design course, the student realised that the company might not have understood the clients' needs. He now refers to himself as "a systems engineer with a changed mind-set about clients, requirements analysis, product design and delivery." In general, students reported that design thinking had changed the way they see problems and provided them with a novel way of finding solutions.

Conclusion

We have shown in this chapter that design thinking, by virtue of being user-centred, can be harnessed effectively to engender empathy and an appreciation of context during the development of health innovations. The positioning of the user/client at the centre of product and service development is crucial to understanding health problems through the lens of those affected. By involving the users in finding solutions, design thinking makes the user experience accessible to the students working on a challenge, thereby allowing them to conceive of designing experiences rather than designing services or products. The use of multi-disciplinary teams in solving challenges provides access to diverse experiences and skill sets. To enhance the effectiveness of design thinking as an approach to problem solving, reflexivity regarding learning experiences and achievement of the outcomes of the curricula is required on the part of students and teachers.

Although the innovations developed during the course were not technological, the biomedical engineering students in the course benefited by learning about the health context and became familiar with design thinking as an approach to understanding and addressing user needs. The

skills acquired would be useful in needs assessment for, and development of, the technological solutions that are more typically designed by biomedical engineers.

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