Challenges for Implementing Design Thinking for Social Innovation: Case Study During Online Learning

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Abstract*:* Students can play a meaningful role in solving developmental challenges. Through online learning, Third-year Information Systems students were taught Stanford's five-phase design thinking (empathise, define, ideate, prototype and test). The process helps students develop solutions to assist with the South African electricity crisis. The case study identified the challenges of implementing design thinking to build mobile application prototypes to assist with Sustainable Development Goal 7: affordable and clean energy challenges during the COVID-19 pandemic. The case study used mixed methods. Qualitative and quantitative data were collected from 28 Information Systems students using an online survey. Quantitative data were analysed using descriptive statistics. Qualitative data were analysed using content analysis. During the empathise phase, challenges were due to a lack of meaningful communication: 57% of students indicated that defining the problem was a challenge. During the ideate phase, 68% of the students stated that they struggled to create a solution. Students were required to use the Justinmind tool to develop their prototypes. However, 91% of students indicated that they struggled using Justinmind. During the final testing phase, 49% of students indicated that obtaining and incorporating user feedback was problematic. The research will provide insights and recommendations for improving the use of design thinking for social innovation during online learning.

Keywords: Sustainable Development Goal (SDG) 7; design thinking; social innovation; Information Systems students; online learning

1. Introduction

"Students have the potential to play a meaningful role in contemporary society now (empowering the innovation processes that active minorities are generating) while simultaneously equipping themselves to be the leading designers of the future (when the problems, opportunities and design modalities that are emerging today will become the new standards)" (Manzini, 2011).

The world is faced with various complex challenges including increasing poverty, food insecurity, a lack of inclusive quality education and a lack of affordable and clean energy (UN General Assembly, 2015). Electricity is a basic service required for the wellbeing of citizens (Statistics South Africa, 2018). Black African-headed households, however, have lower electricity access levels than other South African population groups (Statistics South Africa, 2019). South Africa is experiencing an energy crisis that negatively affects meeting human needs and economic growth (Salvia and Brandli, 2020). Extensive scheduled electricity cuts in South Africa, known as load shedding (Czerniewicz *et al.*, 2020), negatively impact Sustainable Development Goal (SDG) 7: access to affordable and clean energy for all.

Sustainable development goals (SDGs) are a blueprint for achieving a better and more sustainable future for all. SDGs in their recent form are a universal set of goals, targets and indicators that UN member states will use to frame their agendas and policies over the next 15 years (Hák, Janoušková and Moldan, 2016). There are challenges for achieving SDGs, in particular SDG 7: affordable and clean energy. The achievement of SDG 7 requires innovative approaches to deliver reliable and sustainable energy to Africa, especially to those with low socio-economic status (Conway *et al.*, 2019). The generation of electricity also aggravates environmental issues such as climate change and poor air quality (Mccollum *et al.*, 2017).

These challenges cannot be addressed only by government interventions (Aksoy *et al.*, 2019). Social innovation is a concept significant in scientific research, business administration, public debate and ethical controversy. Research acknowledges that only a little is known about which SDGs social innovation already addresses (Gupta, Kumar and Karam, 2019). Even with limited research, social innovation has flourished recently as a promising mechanism. Social innovation tackles the inefficiency of the existing policies and models targeting the most pressing global issues (Hagedoorn *et al.*, 2022). The literature indicates that the public sector (Rizzo, Deserti and Cobanli, 2017) and tertiary education can contribute to this cause (McCowan, 2019).

Using technology, social innovation can focus on structural changes within a social context (Satalkina and Steiner, 2022). There is a growing need, then, for university Information Systems (IS) students to develop

problem-solving and co-design skills as these skills can assist in using technology for solving these challenges (Tschimmel, 2012). Understanding contexts and user needs are likely to lead to better-designed products such as mobile applications (De La Harpe, Korpela and Van Zyl, 2015).

Design thinking uses co-design principles where users are involved in designing solutions (Pieniazek, 2016). Design thinking has been used for social innovation to design innovations and solve societal problems (Sosa, 2015). Existing literature indicates that co-design can be used in IS and Computer Science courses (De La Harpe, Korpela and Van Zyl, 2015; Snow *et al.*, 2019). The implementation occurred during traditional face-to-face classroom sessions. Covid-19 forced tertiary institutions to shut down and switch to online learning (Mhlanga and Moloi, 2020) and therefore more research is required in this context.

The research question for this study is: What are the challenges of using design thinking for social innovation during online learning?

2. Research Model

The literature highlights that design thinking can help professionals solve complex problems (Overmyer and Carlson, 2019). Placing users at the centre of the design process improves the understanding of user experience. Testing ensures that users can discover errors and retain control over solving them (Paracha *et al.*, 2019). Research shows that user participation is increasingly important to design culture and appears to heighten user satisfaction and product success (Sánchez de la Guía, Puyuelo Cazorla and de-Miguel-Molina, 2017).

As displayed in **Figure 1**, the design thinking model developed by Stanford (d.school, 2013) was used as the basis for teaching social innovation online.

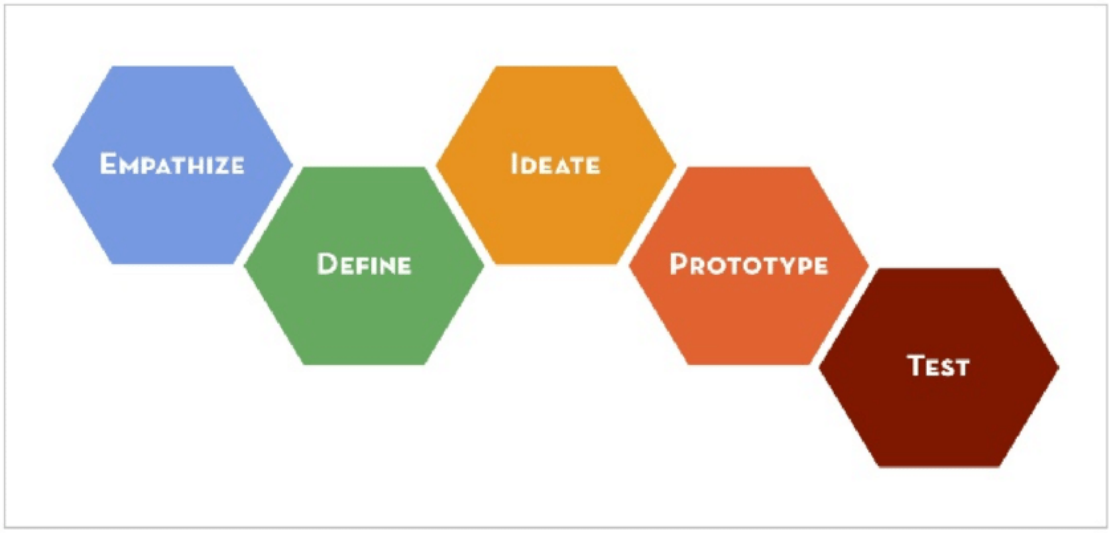

Figure 1: Design thinking (d.school, 2013)

Design thinking consists of five phases, as per the Stanford model (d.school, 2013):

1. *Empathise* – Students worked in groups of five using the institutional electronic learning management system based on the Sakai platform. Students were encouraged to recruit users from their households, as load shedding impacts most families. Empathy maps were created to identify how users feel, what they think, and what their challenges are. Students used this information to identify opportunities to meet their users' needs.
2. *Define* – Using an empathy map, students defined the scope of their project. The scope is succinctly described in a point of view (POV) statement. The POV statement serves as the basis for designing better solutions.
3. *Ideate* – Ideation means moving from obvious ideas to innovation. Students were encouraged to brainstorm to generate as many ideas as possible. Brainstorming can involve the use of sticky notes for writing ideas if conducted in a physical class. During online learning, however, students were encouraged to use a virtual board, Google Jamboard, to post electronic sticky notes.

4. *Prototype* – Unlike ideation, judgement is applied in this phase. This phase allowed students to select and develop ideas from the ideate phase that their users felt may work. The objective is to build a fast, low-cost version of the product so that if it fails, it will 'fail fast and fail cheap'. Prototyping prevented teams from spending significant time or money in efforts that do not meet their user requirements.
5. *Test* – Testing allows users to provide feedback on the prototypes developed. Feedback allowed prototypes to be improved through an iterative process. Changes to prototypes can be made quickly and with little cost.

The five design thinking phases are more likely to occur iteratively than sequentially. For example, after obtaining feedback from users in testing, students may go back to the ideation phase to create better ideas.

3. Research Method

This case study was used to identify the challenges of implementing design thinking to develop solutions for SDG 7: affordable and clean energy challenges. The case study was conducted at a historically disadvantaged tertiary institution in South Africa during the COVID lockdown. Students at the institution are predominantly students of colour from lower socio-economic status (University of the Western Cape, 2021). The tertiary institution was not able to conduct face-to-face lectures due to COVID-19 social distancing restrictions. Virtual classes via Zoom were limited due to the high cost of data. The lecturer encouraged the use of WhatsApp or the data-free Moya instant messenger so that group members could work together, despite data challenges. The third-year Information Systems students were encouraged to incorporate the use of mobile applications or technology as part of their social innovation. This is due to increasing number of South Africans having access to mobile phones (Statistics South Africa, 2019). Technology could also be used to overcome social distancing restrictions during COVID-19.

Qualitative data were collected using open-ended questions. Content analysis was used to analyse the qualitative data. Qualitative and quantitative data were collected via an online survey from 28 third-year Information Systems students.

Content analysis is a research method used to systematically analyse qualitative data to identify patterns, themes, and categories within the data. The following steps were used:

- Data Preparation: The qualitative data collected from the online survey used open-ended questions that were compiled and organised for analysis.
- Familiarisation: Researchers familiarized themselves with the data by reading through the responses multiple times. This helped gain a comprehensive understanding of the students' perspectives and experiences regarding the challenges faced during the design thinking process.
- Coding: Researchers then applied codes to the data by using a predefined code book. The code book involved assigning labels to specific portions of the data that correspond to certain concepts, ideas, or themes. In this case, the codes were related to the challenges encountered during each phase of the design thinking process (empathise, define, ideate, prototype, and test).
- Categorisation: Once the coding process was complete, researchers organised the coded segments into broader categories or themes. These categories represent higher-level concepts that emerged from the data, capturing the main challenges students faced during each phase of the design thinking process.
- Data Analysis: Researchers analysed the categorised data to identify patterns and trends. They examined the frequency of different codes or categories to determine the prevalence of specific challenges. Descriptive statistics was used to summarise the findings.

Quantitative data were collected via a 5-point Likert scale from unimportant to very important. Descriptive statistics were used to analyse quantitative data. Ethical considerations from the University of the Western Cape were observed. Students had to provide consent for their data to be used for research purposes. Unique identifiers, such as student names and numbers, were removed to ensure anonymity. Data was stored in a secured file. The file was only shared with the research team to maintain data privacy.

4. Results and Discussion

The demographic analysis in **Figure 2** indicates that most respondents were male (82%) while 18% were female.

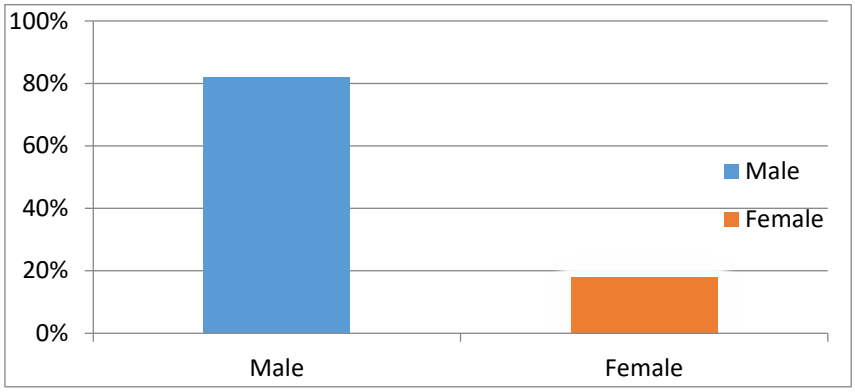

Figure 2: Student demographics

4.1 Empathise Phase

Based on the quantitative data, most students (92%) indicated that the empathise phase is an important (35%) or very important (57%) part of the design thinking process for a successful social innovation outcome. The remaining 8% of students were neutral.

Content analysis indicated that students faced many challenges during this phase. The largest percentage of students (32%) indicated that communication with users was a challenge for them. Responses to accentuate this included: *"Not being able to physically interview the user to get a better understanding of their thoughts and feelings"* (female student) and *"The design process was a bit of a struggle as we are currently in lockdown and people who we actually wanted to get information from could not be contacted due to data concerns"* (male student).

Other challenges included choosing which questions to ask users (43% of students). Getting user feedback was also indicated as a challenge by 14% of students; and 3% of students highlighted logistics and that meeting all project requirements was challenging. The literature indicates that taking the initiative to contact potential users and observing them was difficult initially (Fabri, 2015). However, this study was not conducted during a stage when social distancing was required.

The qualitative data also evidenced what students believed worked well during the empathise phase. **Figure 3** highlights that 39% of students believed that the interview worked well. Half the students (50%) indicated that it allowed them to understand their users better. This finding is supported by the literature (Wolcott *et al.*, 2021): the empathise phase allows students to understand the user experience.

A smaller number of students (7%) stated that communication with users worked well. The smallest number of students (3%) indicated that data gathering worked well during this phase.

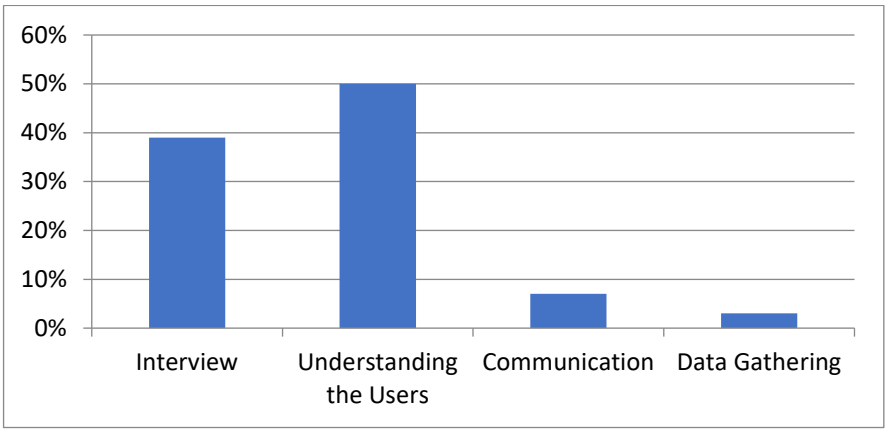

Figure 3: What worked during the emphasise phase

The students provided suggestions to improve the empathise phase: 32% stated that they would prefer to have face-to-face communication with their users. The literature supports the need for open communication (Corbera, 2018). A few students (3%) indicated that they needed more time during this phase. The same percentage of students (3%) indicated that they needed more help constructing a proper empathy map and that there should be more group meetings.

4.2 Define Phase

Most of the students (89%) highlighted that the define phase is a very important or important part of the design thinking process for a successful social innovation outcome. A small percentage of students (11%) were neutral.

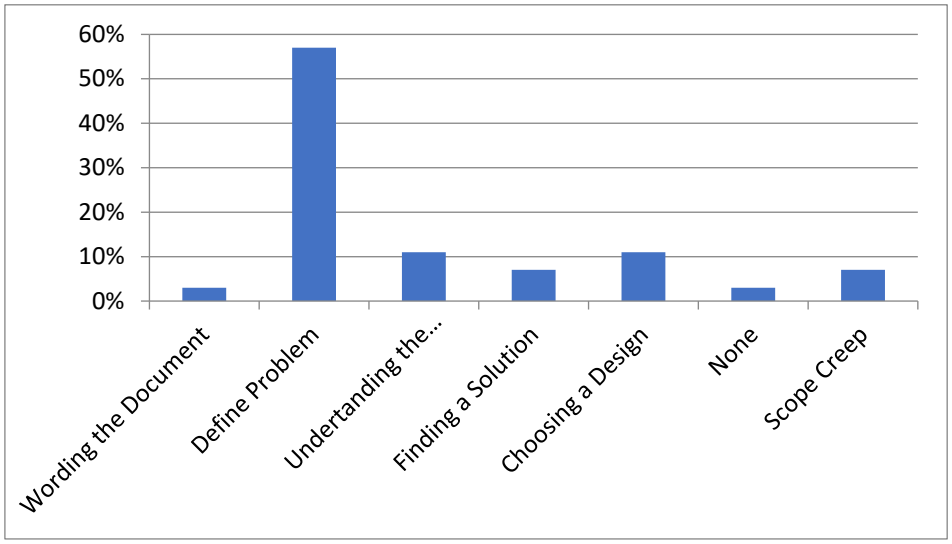

Figure 4: Define phase challenges

As displayed in **Figure 4**, about half the students (57%) highlighted challenges during this phase, including defining the problem. This was evident in responses like, *"Coming to a joint consensus of what we believed to be the most effective and accurate POV (point of view) for our collection of users, this was a challenge as in all group things when trying to reach a consensus more time is required than if one were to have full control as an individual"* (male student) and, *"Defining the problem and figuring out solutions. It was a challenge to connect clean energy, load shedding and coronavirus"* (male student).

According to 11% of the students, choosing a design was a challenge and understanding the questions that were asked in the assignment was a challenge. Scope creep and finding a solution were challenging for 7% of students; 3% indicated that wording the document correctly was a challenge; and 3% had no challenges.

Students also identified what worked well during this phase, with 86% indicating that defining the users' problem worked well. A small percentage of students (3%) stated that the following worked well:

- Delegating member roles,
- Choosing a design,
- Group communication and
- Data analysis.

Students offered several suggestions to improve this phase: 11% recommended that user needs must be properly understood and that students should focus on more than one user; and 7% of students suggested the following:

- Focus on one issue,
- Add one more step in the define phase and
- Have more than one solution.

Only a few students (3%) stated that the layout of the define phase in the assignment should be improved. Another 3% indicated that a tutorial should be added on how to do this phase correctly. Another 3% recommended that focus be on more than one issue.

4.3 Ideate Phase

Responses on the importance of the ideate phase as part of a design thinking process for a social innovation outcome were mostly positive (71%). Many students (57%) expressed that this phase was very important; 21% stated that it was important; and the remaining students were neutral.

As per **Figure 5**, students faced several challenges during this phase. Interestingly, 68% of the students highlighted that they struggled to come up with a solution. This finding is supported by the following response: *"Creating various viable solutions to make sense and solve the problem as well as asking the user the right questions and making them understand it. The challenge was communicating our ideas and solutions to the user"* (male student). The literature emphasises that generating new ideas is a critical part of social innovation (Goi and Tan, 2021).

Only 3% of students stated that the mind map was the most challenging part, while 7% indicated that they struggled with communication and completing the opportunity analysis canvas.

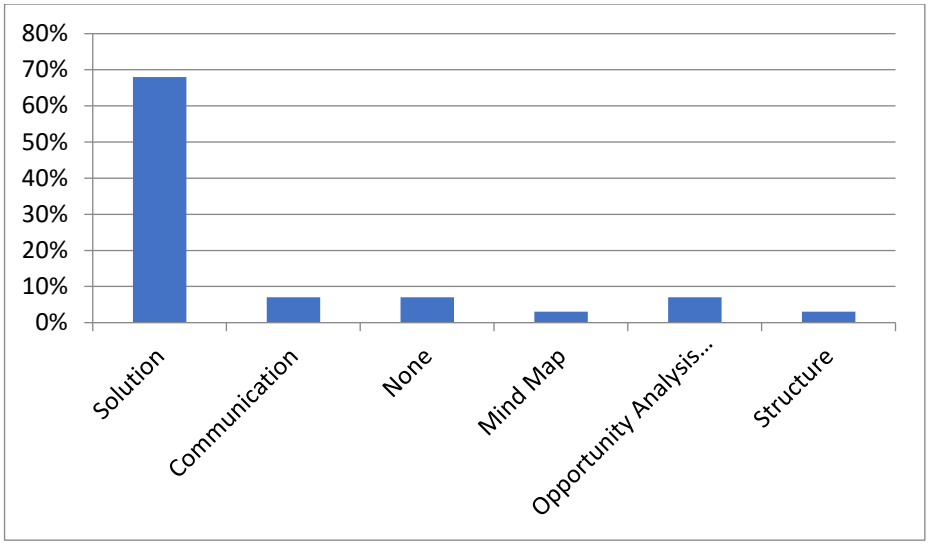

Figure 5: Ideate phase challenges

However, some items worked very well during this phase. Just over half (54%) stated that coming up with a solution worked well during this phase. As brainstorming serves idea generation (Fabri, 2015), 36% indicated that brainstorming worked during this stage. Only a small percentage (7%) indicated that mind maps worked well. The opportunity analysis canvas was used to identify opportunities and constraints. The idea is to select ideas that are more suitable for implementation. However, only 3% said that the opportunity analysis canvas worked well during this phase.

Students provided suggestions to improve the ideate phase: 11% indicated that the instruction was inadequate for doing this part properly, so more instruction should be provided. Students expressed their desire for more face-to-face communication during this phase; 18% suggested that there be a limit to the number of ideas one can generate; and 7% of the students provided multiple suggestion:

- There should be more than one idea.
- Users should be involved more during this phase.
- Brainstorming in this phase would be beneficial.
- Applying the 'keep it simple stupid' (KISS) principle during this phase would simplify the work.

4.4 Prototype Phase

Prototyping is identified as a method to generate and test innovative ideas (Braz *et al.*, 2019). There was little consensus on the importance of this phase of the design thinking process: 68% said it was very important; 18% said it was important; 3% were neutral; and 11% indicated that it was unimportant.

As per **Figure 6**, students faced one major challenge: 91% stated that they struggled to use the required prototyping tool, as highlighted by the following quote: *"Just let us use any prototyping tool that we may without having to justify why we used a different prototyping tool so there can be more freedom in the designing of the*

prototype, as this would've saved time during this stage instead of spending so much time in figuring out Justinmind and struggling with internet or just give us a free prototyping tool that won't give problems" (male student).

Minor challenges were raised by 3% of students:

- They struggled to come up with a solution.
- They struggled to obtain proper user feedback.
- They struggled with time management in this phase.

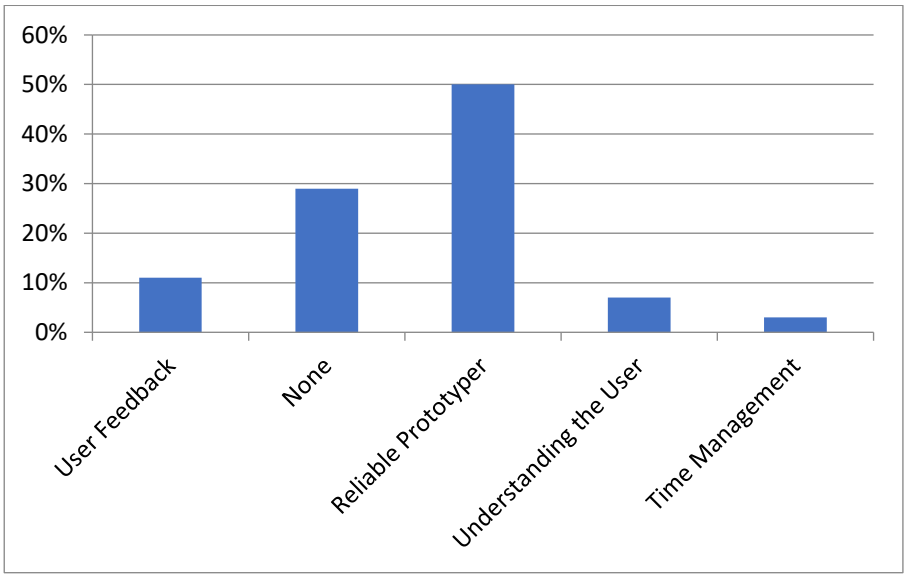

Figure 6: Recommendations to improve the prototype phase

According to the students, there were a few things that worked during this phase: 14% indicated that finding a solution during this phase worked well; 67% stated that using a reliable prototyping tool worked well for them during this phase; and a small number of students (3%) indicated that communication worked for them. Another 3% admitted that critical thinking worked well for them during this phase. But only 3% indicated that the execution of the project worked and defining group member roles during this phase worked well for them.

Students provided interesting suggestions to improve this phase: 50% suggested that a better prototyping tool should be given to them to use, or they should be able to select the one to use; 11% indicated that user feedback should be prioritised during this phase, expressing that users were not given enough time to use the prototypes before sending in their responses. A small percentage of students (7%) indicated that understanding the user should be a priority during this phase, while 3% needed more time to complete this phase. However, 29% said that the phase is fine the way it is, offering no suggestions for improvement.

4.5 Test Phase

Data indicate that the test phase was the most important of all the phases. The responses as to the importance of this phase were very good: 75% stated that it was very important and 25% stated that it was important. Testing can prepare Information Systems students for user testing in their future careers (Paracha *et al.*, 2019).

User feedback during this phase was very well received by the students: 86% highlighted that user feedback worked very well during this phase, and 14% indicated that the technical overview worked very well and helped them during this phase.

About half the students (49%) highlighted that getting and using user feedback was a challenge for them. According to one student, *"The feedback helped but some points made by the users were vague"* (male student). This comment is supported by another male student: *"We couldn't understand user's suggestions because they weren't clear enough"*.

The technical overview was a challenge for 14% of the students during this phase, with 7% stating that using the prototyping tool they were assigned was a challenge for them. Only 3% of the students indicated the following

challenges: adding new features to the prototype and finding their target market for their prototype. However, a larger percentage (21%) expressed that they faced no challenges during this phase.

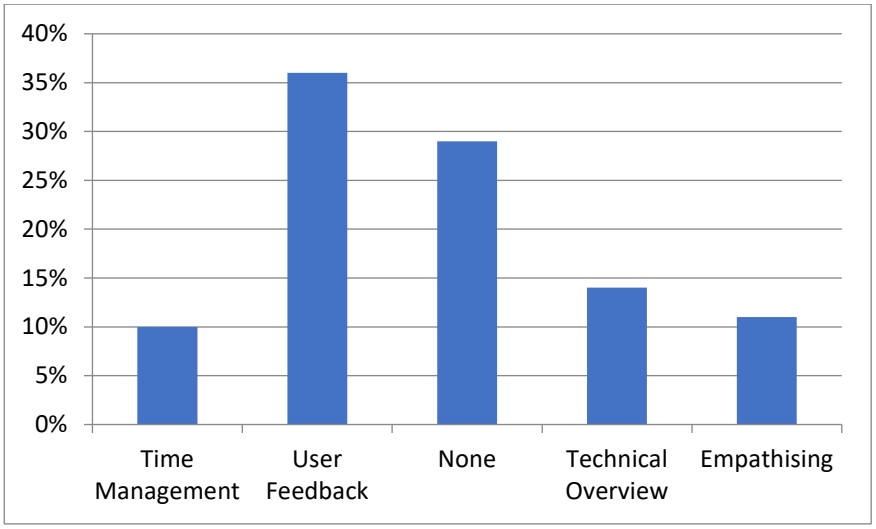

Figure 7: Suggestions to improve the test phase

As per **Figure 7**, suggestions were provided to improve this phase: 36% believed that understanding the user should be prioritised during this phase; 10% stated they should be given more time during this phase; 14% believed that the technical overview should be explained better and in more detail; 11% indicated that empathising with the users is important and should be prioritised during this phase. However, 29% were happy with this phase and gave no suggestions.

5. Conclusion

To objectives of this study were to identify the challenges of implementing design thinking for social innovation during online learning. The study also makes recommendations to improve design thinking to ensure a successful social innovation outcome.

This study found that students believe that all steps of the design thinking process are important, helping students to implement a successful social innovation outcome. The study also confirmed the importance of communication with teams and users during the design thinking process. A lack of communication, especially with users, dampened the level of experience during some of the phases of the design thinking process. Students faced several common challenges, with most of the challenges encountered during the prototype phase.

The study showed that the test phase was the phase most enjoyed by the students, verifying the eagerness of students to implement the final product of their designs. Most students agreed that design thinking is an effective approach for social innovation. Students confirmed that the development of their social innovation output was successful.

The study contributes to identifying challenges for using design thinking for social innovation for achieving SDG 7. Due to the limited sample size, more research should be completed to allow for greater generalisability.

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