University students' perceptions of designing mobile application prototypes for social innovation: Case study during a global pandemic

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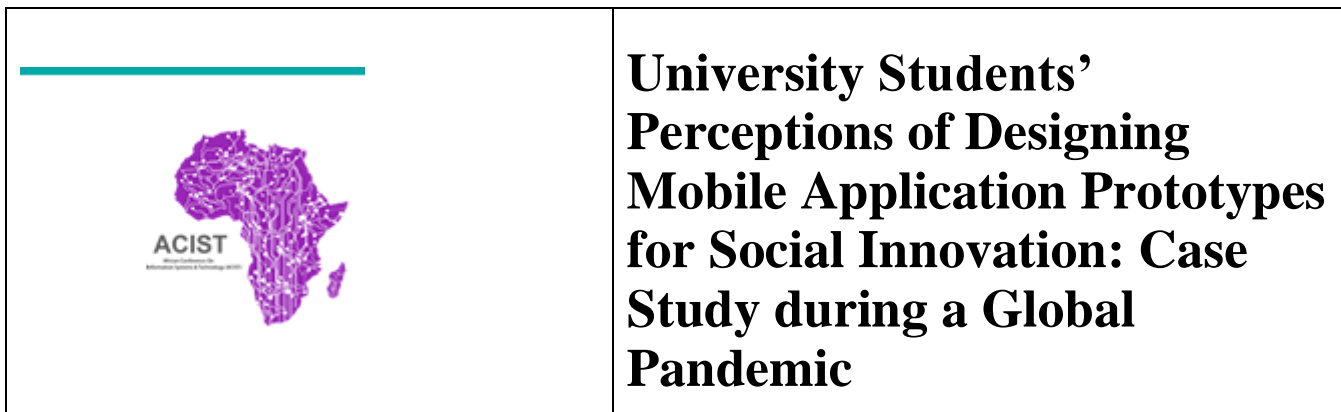*University of the Western Cape*, 3766790@myuwc.ac.za

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ABSTRACT

There is a growing need for social innovation to address social challenges. Therefore, Information Systems students at tertiary institutions need to develop problem-solving and co-design skills. These skills may improve the design of products, such as mobile applications, to address social challenges. This research used design thinking for social innovation during the Covid-19 pandemic. The research design used an exploratory case study with mixed methods. Data was collected via an online survey from 31 third-year Information Systems at the University of the Western Cape. Students' overall perceptions were positive for using design thinking for social innovation. The challenges were due to social distancing and performing all activities remotely. The findings may provide insights and recommendations to other universities planning to implement design thinking for social innovation.

Keywords
Design thinking, social innovation, students' perceptions, Information Systems

INTRODUCTION

There has been an increased need for social innovation, especially during the Covid-19 pandemic. Social innovation is any particular project that aims to bring social change and to meet social needs as a primary objective (Pieniazek, 2016). Social innovations are new solutions whether it be a product or a service, as well as also being a mindset and a process (Bond, 2016). It seeks to empower citizens and generate social benefits (Gupta, Kumar, & Karam, 2019).

Social innovation "typically address social challenges through systemic solutions that are focused on the user's needs" (Gupta et al., 2019 p.2). During the pandemic achieving Sustainable Development Goal (SDG) 2, zero hunger (UN General Assembly, 2015) was affected. The literature indicates the effect of lockdown on food security, especially for low-income groups (Arndt et al., 2020). Therefore, SDG 2 was particularly relevant during the pandemic due to lockdown restrictions, the rising number of unemployed individuals (Carlitz & Makhura, 2021) that impacted food security (Arndt et al., 2020).

Social innovation may use different forms of Information Communication and Technology (ICT). ICT includes the usage of mobile phones. Access to mobile phones has grown to 91% in 2019, up from 82% in 2018 (ICASA, 2020).

ICASA recorded 53.4 million smartphone subscriptions on 30 September 2019, nearly the size of the country's total population, South Africa's estimated population was 58.78 million, according to the 2019 mid-year population figure (Statistics South Africa, 2020). This implies that the use of smartphones with mobile applications may be a viable option within South Africa.

Design thinking is regarded as a framework for social innovation (Brown & Katz, 2011). This is due to the focus on user needs through participatory co-design (Kummitha, 2019). Users should be involved in each phase of design thinking. Based on (d.school, 2013), design thinking consists of five phases:

1. Empathise – Allows students to understand the needs of their users. It is the foundation of human-centred design as students places themselves in their users' shoes.
2. Define – Students uses outputs from the empathise phase to create an "actionable problem statement" or a point of view (POV).
3. Ideate – Allows students to generate as many ideas as possible to try to solve the problem. Radical ideas are encouraged as ideas are not judged on whether they are implementable or not.
4. Prototype – Applies judgement to the ideas generated to see if they can work. Prototypes should be low-cost and to learn and explore ideas. Feedback from users allows students to generate other or improved ideas.
5. Test – Prototypes are placed in users' contexts. More user feedback is gathered to create more suitable solutions.

There is also a growing need for university Information Systems (IS) students to develop problem-solving and co-design skills (Tschimmel & Santos, 2018). Understanding contexts and user needs are likely to lead to better-designed products, such as mobile applications (De La Harpe, Korpela, & Van Zyl, 2015).

Despite literature for using co-design in IS and Computer Science courses (De La Harpe et al., 2015; Snow, Filipczuk, Viller, & Gomer, 2019), there is limited literature in introducing design thinking for social innovation during Covid-19. Therefore, the research question for this study was: *What are students' perceptions of designing mobile application prototypes for social innovation during a global pandemic?*

RESEARCH DESIGN AND METHODOLOGY

An exploratory case study with mixed methods (Yin, 2003) was used in a third-year Information Systems class at the University of the Western Cape. Students were taught design thinking principles, based on Stanford's d.school (d.school, 2013). Students signed up for groups on the university's electronic learning management system. Groups consisted of five students. Students were asked to develop a mobile application prototype to assist with the Sustainable Development Goal (SDG) 2 challenge, remotely.

Students had to apply the five phases, empathise, define, ideate, prototype and test, to develop a mobile application prototype. Given social restrictions during the lockdown, students were encouraged to interview their family members as level 5 lockdown restrictions affected everyone's ability to access food easily. Alternatively, they could communicate electronically with other users, such as their fellow students. Students could use Zoom, WhatsApp or Google Meets. Their final submission was a presentation, including screenshots of their prototypes. Students were encouraged to use the Justinmind application to build their prototypes.

Student quantitative and qualitative data were collected from 31 students via an online survey, during the pandemic. A 5-point Likert scale from strongly disagree/unimportant to strongly agree/very important was used to collect quantitative data. Qualitative data were collected via open-ended questions. Data were analysed using descriptive statistics and thematic content analysis. Ethical considerations included only the students who consented to have their responses used for research. Based on Dearden & Kleine (2018), all unique identifiers, such as student numbers, were removed to ensure anonymity.

FINDINGS

The demographic analysis from the 31 students, indicated that there were more female students (68%) than male students (32%). There were predominantly full-time students (87%) with 13% of the sample, part-time students. Therefore, female students may have the dominant view and higher percentages within the findings.

Figure 1 shows that most students (90.32%) believed that design thinking was an effective approach for social innovation. A small percentage of females (9.68%) were undecided, but no students disagreed or strongly disagreed.
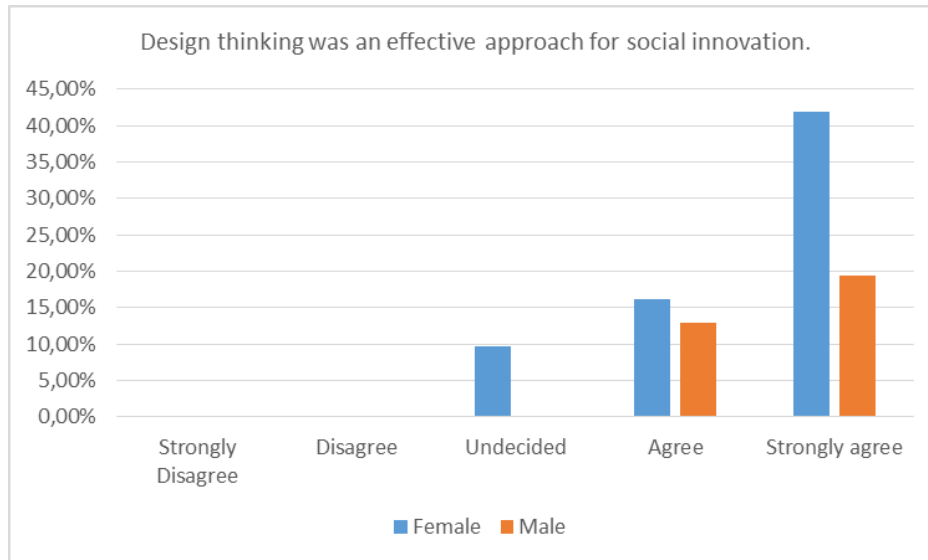

Figure 1 The overall perception of using design thinking for social innovation

The first phase of design thinking is the empathise phase. Students created an empathy map. Empathy maps are a graphical representation of users' feelings and thoughts (Tschimmel, 2012). It allows students to identify their users' needs obtained by observation or interviews. During the pandemic and social distancing, observations would be more difficult to execute. In Figure 2., data from the Likert scale shows that 84% of students strongly agreed that the empathise phase of design thinking was very important none believed that it was not helpful or important. This finding would indicate that this phase was necessary for the success of design thinking for social innovation.

The quantitative findings in the graph are supported by the fact that 68% of the students found that it was empathising with the user was the most effective part of this phase. As stated by a student this phase helps by *"getting to know our users' feelings and emotions towards the problems worked in helping us understand it from their point of view"* (full-time student, female). Nineteen per cent of the students found it helpful when dealing with issues that are likely to arise when developing applications. This allowed students to plan better for the future development of mobile applications.
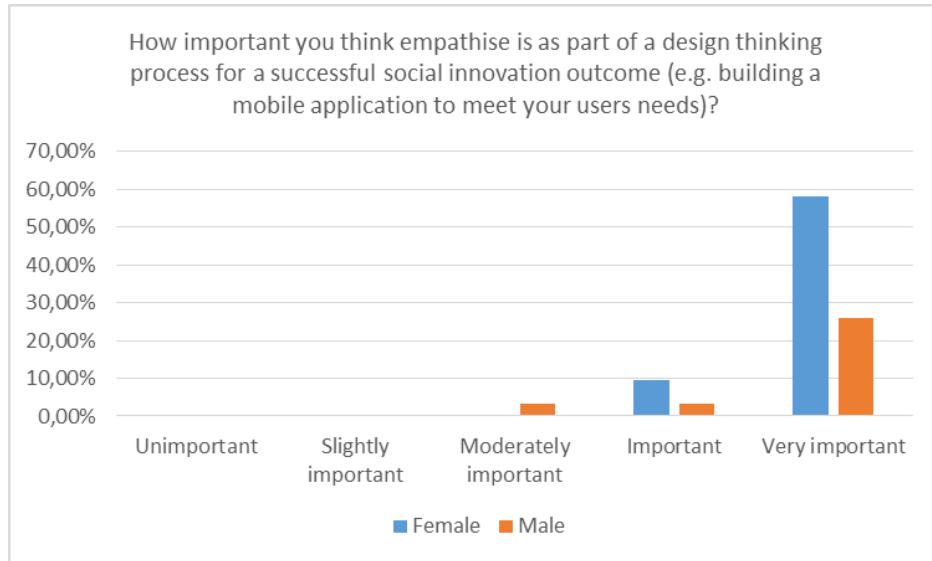
Figure 2 Empathise phase results

The biggest obstacle experienced by students (32%) in this phase was the lack of face-to-face contact with the participants, this would be because of the social distancing regulations due to the Coronavirus. The students found difficulty in communicating during this time of social distancing. Students were unable to read body language and facial expressions which are key factors in conducting interviews. It was more challenging to identify their users' perspectives through online interviews. With the communication limitations, it is understandable why students also found that finding commonalities between different users challenging. this made it difficult to create questions for more than one person.

As evidenced in Fig.3, the results found this phase was helpful and necessary for the success of design thinking for social innovation. Most students (97%) found this phase important or very important. Only 3% of the students found this phase moderately important for the success of social innovation as an outcome.

The quantitative findings in the graph are further supported by the fact that 61% of the students answered that the phase was effective in getting the users' point of view. This was highlighted with the following quote: *"Understanding what our users' needs were and gaining more in-depth insight"* (part-time student, female).

The phase helped students by simplifying the providing focus areas. By defining the POV, users' needs were better understood and so was the root cause of the problem. This assisted students to identify which solution would be the most applicable in their users' environment and circumstances.
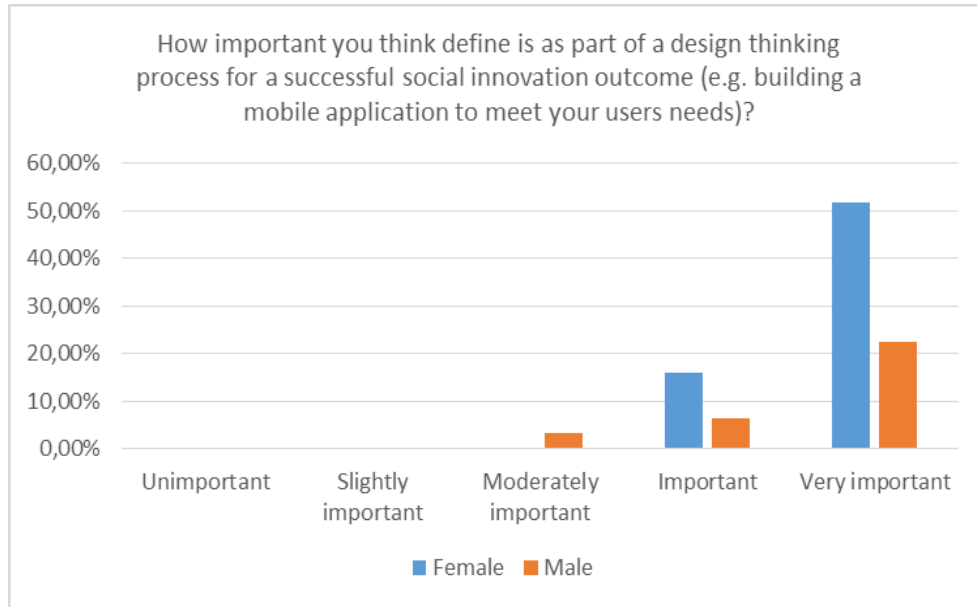
Figure 3 Define phase results

In the ideation phase, Figure 4 shows that 90.32% of the students believed that this phase has significant importance in building a mobile application to meet user needs.

The qualitative data indicated that 58% of students believed that using brainstorming was helpful and useful in this phase. The result is summarised by the quote: *"Brainstorming worked well as we were able to be creative, innovative and it allowed us to think outside of the box"* (Full-time, female).

The most common challenge was that 54% of students found it difficult to eliminate excess ideas generated. This is further supported by the quote: *"Selecting which ideas to use. We had multiple ideas from brainstorming and choosing which ones to use was a bit of a struggle"* (Full-time student, female).
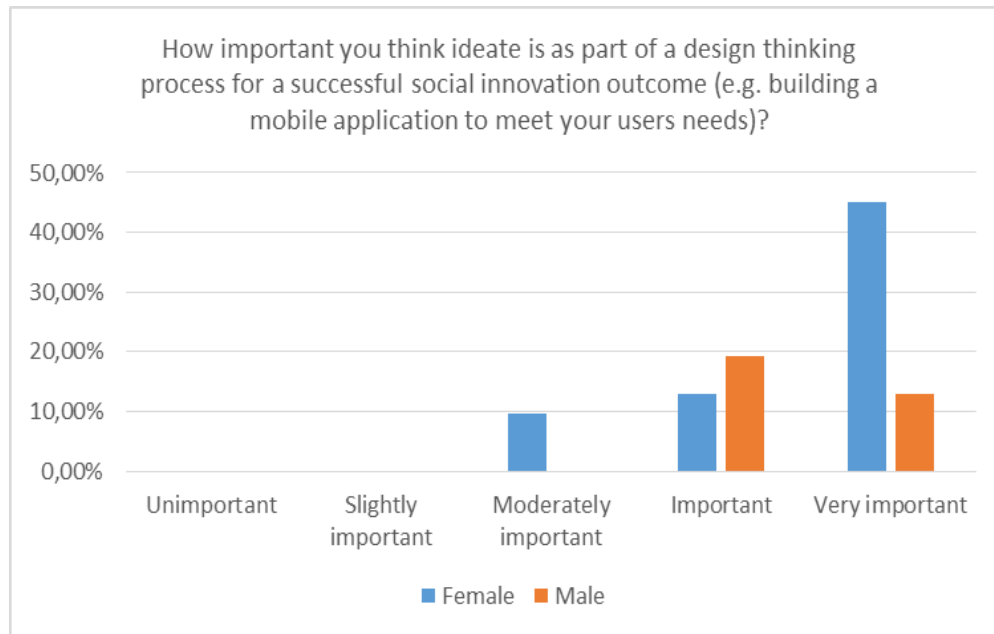
Figure 4 Ideate phase results

Figure5 shows that 100% of students agreed or strongly agreed with the importance of this phase. The qualitative data supports this finding from the quantitative findings with 77% of the students finding that the most helpful part of this phase was the prototype development. This was a practical development phase that needed students to properly empathise with their users to properly address the problem at hand. The students also found the tools that were suggested to be of great help. This is highlighted by the quote: "*The prototype is ultimately designed for the user and their needs so this stage allows the students insight on the users' thoughts*" (Full-time student, female).

Only 6% of students specifically found feedback to be the most helpful aspect. All of the students who mentioned the prototype noted that it was easy to adjustable the prototype based on users' feedback. The feedback in this stage is more crucial than the prototype itself, it's the feedback from the users that lets the students know if they are addressing the issue at hand. Communicating with the users was found to be difficult during the lockdown and social distancing, this played a role in why such few students found it to be the most helpful part.
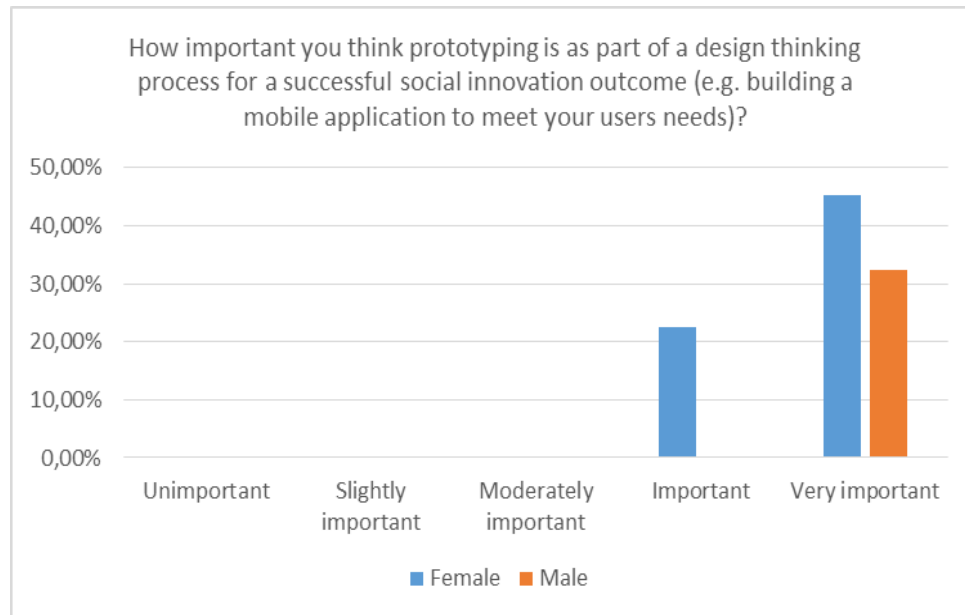
Figure 5 Prototyping phase results

Based on the qualitative data, the biggest challenge experienced by students (71%) was building the prototype. Using tools that were unfamiliar to students was the initial challenge. The finding is supported by the student's quote: *"The development of the prototype. To develop the prototype, we had to use the Justinmind application we had not used before, and it took quite some time for us to familiarise ourselves with the application"* (full-time student, female).

After enough use students were able to familiarise themselves with the application. However, 6% of the students' computers were slowed down due to the tools required. When asked about methods to better this phase in design thinking there were two dominating answers among the 31 respondents. Students mentioned that a more user-friendly layout could have been used or instructions to use these tools. Responses included *"I would suggest providing a tutorial video on how exactly to use Justinmind"* (full-time student, female).

Quantitative data in Figure 6 indicates that 97% of the students found the testing phase of significant value to the success of the design thinking methodology for social innovation.
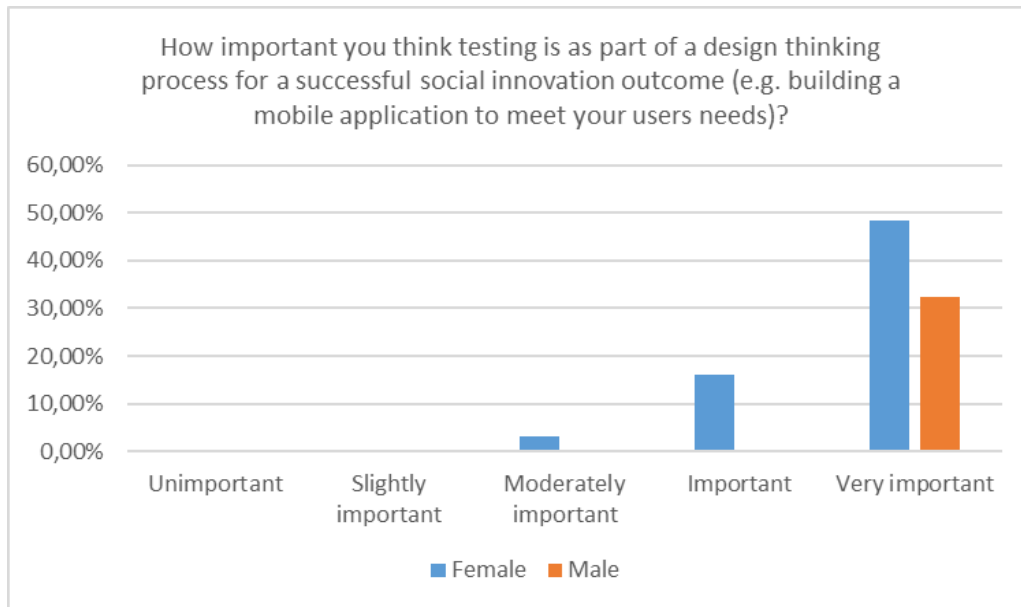
Figure 6 Testing phase results

Qualitative findings indicate that 84% of the students found that it was effective getting the users' feedback when asked what the most effective step in this phase was. The testing phase is known to be useful when being user inclusive, it helps refine the prototype by using the feedback of the users. This lets students know how well they are addressing the problem of the users; this was a milestone for social innovation.

Involving the users helped correct errors as stated, *"Correcting errors in our solutions, because of the feedback from users"* (Full-time student, male). Being user inclusive is why design thinking is so effective for social innovation and the qualitative data supports that. Students (16%) found that trial and error when designing the prototype was more helpful than anything else. A student stated, *"Testing the prototype many times over to weed out kinks"* (Full-time student, male).

The qualitative data gathered has shown that 32% of the students found it challenging getting user feedback. With the social distancing, the communication was done through messaging, emails and voice notes. it became significantly difficult to communicate efficiently. A full-time student, male stated, *"It was a large group, so we faced some difficulty keeping up with them"*.

Of the students who obtained user feedback, 29% found difficulty in rectifying the mistakes they made in their initial prototype.

DISCUSSION

Students' perceptions of designing mobile application prototypes for social innovation using design thinking received an overall favourable response. The findings were supported by a study that also used design thinking to create behavioural change interventions in the final year of a UK university course (Fabri, 2015). However, given that South African universities may be lower resourced the finding contributes to the existing body of knowledge.

Students noted the difficulties posed by social distancing and being required to complete design thinking phases remotely. The empathising phase was noted as important for social innovation (Wolcott, McLaughlin, Hubbard, Williams, & Kiser, 2021). Getting to know the users and seeing things from their perspective makes the users' needs clearer. Students may rarely solve the problems they experience. Empathising with the users enables students to understand what the specific problem at hand is and what they are attempting to solve. The view of using design thinking as a creative method of problem-solving is supported by (Foster, 2019).

It was also emphasised that the empathy mapping done in design thinking is a useful tool when understanding the users' needs for the mobile application (Valentim, Silva, & Conte, 2017). The result is supported by (Souleles, 2017) who indicates that using empathy allows for the design of social change.

The use of brainstorming in the ideate phase is supported by (Pieniazek, 2016). Brainstorming is the process of attempting to create a variety of ideas and to create solutions (Foster, 2019) that will assist users. Students are encouraged to create up with as many ideas as possible. Brainstorming works best when there are no judgements as the intention is to leverage collective thinking as a group (d.school, 2013).

These prototypes should specifically be designed using empathy (d.school, 2013) and human-centred design. Using this method allows prototypes to be created for social innovation. The qualitative data suggest that the most effective phase of design thinking among these respondents was the prototype phase. Students found that creating a functional prototype using a co-design method gave them a better understanding of what the users require. When meeting their users' needs, co-design has the potential to improve the design of mobile applications.

The testing phase was deemed to be very important by most students. Despite design thinking being an iterative, rather than a linear process (Park & McKilligan, 2018), it may be more difficult for students to revert to users several times during social distancing.

CONCLUSION

The research assessed students' perceptions of designing mobile application prototypes for social innovation during a global pandemic. The findings add to the body of knowledge by identifying challenges in executing design thinking phases that required user engagement. The challenges were due to social distancing and performing all activities remotely. Despite the challenges in implementation, students perceived using design thinking for social innovation as favourable overall.

Due to the pandemic, engagement with students was also limited and data was collected via an online form only. Due to the limitations in the research design, the results of this study may not be generalised. However, it may provide insights and recommendations to other universities planning to implement design thinking for social innovation.

ACKNOWLEDGEMENTS

REFERENCES

1. Arndt, C., Davies, R., Gabriel, S., Harris, L., Makrelov, K., Robinson, S., … Anderson, L. (2020). Covid-19 lockdowns, income distribution, and food security: An analysis for South Africa. *Global Food Security*, *26*, 100410. https://doi.org/10.1016/j.gfs.2020.100410

2. Bond. (2016). *An introduction to social innovation for NGOs* . London. Retrieved from https://www.bond.org.uk/sites/default/files/resource-documents/introduction-to-social-innovation-0416.pdf

3. Brown, T., & Katz, B. (2011). Change by design. *Journal of Product Innovation Management*, *28*(3), 381–383. https://doi.org/10.1111/j.1540-5885.2011.00806.x

4. Carlitz, R. D., & Makhura, M. N. (2021). Life under lockdown: Illustrating tradeoffs in South Africa's response to COVID-19.

5. *World Development*, *137*, 105168. https://doi.org/10.1016/j.worlddev.2020.105168

6. d.school. (2013). Design Thinking Bootleg. Stanford University. Retrieved from https://dschool.stanford.edu/resources/design- thinking-bootleg

7. De La Harpe, R., Korpela, M., & Van Zyl, I. (2015). Co-design for development: Lessons learnt from an information systems project in underserved communities. In *Lecture Notes in Business Information Processing* (Vol. 223, pp. 61–74). Springer Verlag. https://doi.org/10.1007/978-3-319-21783-3_5

8. Dearden, A., & Kleine, D. (2018). *A proposal for minimum ethical standards in ICTD/ICT4D research.*

9. Fabri, M. (2015). Thinking with a new purpose: Lessons learned from teaching design thinking skills to creative technology students. In *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)* (Vol. 9186, pp. 32–43). Springer Verlag. https://doi.org/10.1007/978-3-319-20886-2_4

10. Foster, M. K. (2019). Design Thinking: A Creative Approach to Problem Solving. *Management Teaching Review*, 237929811987146. https://doi.org/10.1177/2379298119871468

11. Gupta, S., Kumar, V., & Karam, E. (2019). New-age technologies-driven social innovation: What, how, where, and why? https://doi.org/10.1016/j.indmarman.2019.09.009

12. ICASA. (2020). The state of the ICT sector in South Africa. *Independent Communications Authority of South Africa*, (March), 83.

13. Kummitha, R. K. R. (2019). Design thinking in social organizations: Understanding the role of user engagement. *Creativity and Innovation Management*, *28*(1), 101–112. https://doi.org/10.1111/caim.12300

14. Park, H., & McKilligan, S. (2018). *A Systematic Literature Review for Human-Computer Interaction and Design Thinking Process Integration*. Springer International Publishing. https://doi.org/10.1007/978-3-319-91797-9

15. Pieniazek, M. (2016). Design thinking for social innovation. In C. Durkin & R. Gunn (Eds.), *Social Entrepreneurship: A Skills Approach* (Second, pp. 65–70). Policy Press, University of Bristol: Bristol, UK. https://doi.org/10.2307/j.ctt1t8917t.13

16. Snow, S., Filipczuk, D., Viller, S., & Gomer, R. (2019). Design jam as a pedagogy: Teaching design thinking to computer science students at scale. In *ACM International Conference Proceeding Series* (pp. 128–137). ACM. https://doi.org/10.1145/3369457.3369468

17. Souleles, N. (2017). Design for social change and design education: Social challenges versus teacher-centred pedagogies. *The Design Journal*, *20*(sup1), S927–S936. https://doi.org/10.1080/14606925.2017.1353037

18. Statistics South Africa. (2020). Mid-year Population Estimate 2019. *Statistics South Africa*, (July), 24. Retrieved from https://www.statssa.gov.za/publications/P0302/P03022019.pdf

19. Tschimmel, K. (2012). Design Thinking as an effective Toolkit for Innovation. In *Proceedings of the XXIII ISPIM Conference: Action for Innovation: Innovating from Experience*. Barcelona.

20. Tschimmel, K., & Santos, J. (2018). D-Think , a European Project for Innovating Educational Systems, 209–213.

21. UN General Assembly. (2015). Transforming our world : the 2030 Agenda for Sustainable Development. *UN General Assembly*. https://doi.org/10.1080/02513625.2015.1038080

22. Valentim, N. M. C., Silva, W., & Conte, T. (2017). The students' perspectives on applying design thinking for the design of mobile applications. In *Proceedings - 2017 IEEE/ACM 39th International Conference on Software Engineering: Software Engineering and Education Track, ICSE-SEET 2017* (pp. 77–86). Institute of Electrical and Electronics Engineers Inc. https://doi.org/10.1109/ICSE-SEET.2017.10

23. Wolcott, M. D., McLaughlin, J. E., Hubbard, D. K., Williams, C. R., & Kiser, S. N. (2021). Using Design Thinking to Explore Rural Experiential Education Barriers and Opportunities. *Journal of Medical Education and Curricular Development*, *8*, 2382120521992333. https://doi.org/10.1177/2382120521992333

24. Yin, R. K. (2003). *Case study research : design and methods*. Sage Publications.