Interdisciplinary Collaboration: Using SDGs and Digital Social Innovations in Response to Local Community Challenges

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Abstract

There is an urgent need to embed Education for Sustainable Development with a special focus on community needs, within the university context. To respond to this, we combine Information Systems and Urban Planning students in an interdisciplinary collaborative student project that engages with local community challenges. We reflect on this student project from a pedagogical perspective to draw lessons for future curriculum interventions that can respond to our main research question: How can the SDGs be embedded in an IS curriculum to develop responsive digital social innovations? The method followed in this project is Design-Based Research (DBR) which uses several iterations to potentially develop and refine both theoretical insights and practical solutions to teaching and learning challenges. For this paper, we draw on data produced during one such iteration in the form of online reflections and project artefacts. The data was analysed by focusing on recurring themes that can provide insight into answering the research question. The application of design thinking that incorporates the value of local knowledge, diverse collaborative teams, embracing ambiguity and the potential of iteration and failure is recommended. Further recommendations to instil IS for sustainable development and societal good within the curriculum include shifting from Industry 4.0 to Society 5.0, multi-disciplinary to transdisciplinary learning, traditional critical thinking to design thinking and problem-solving to problem-engagement. In conclusion, we argue for bold shifts in the way students engage with complex, wicked societal problems to develop future thinkers that can act as agents of change in society.

Keywords: *Digital social innovation, design thinking, education for sustainable development, local lived knowledge, Sustainable Development Goals*

1. Introduction

There is a growing sense of urgency to address the future of societies and our planet during this time of transformative change driven by multiple economic, political and environmental pressures (EUA, 2021). Within this reality, there is an urgent call on universities to make sustainable development the main framework for driving impact to promote solutions in dialogue with society and local communities (Ibid).

Within the realities of such an interconnected future, we recognise the potential of digital transformation in both business and society, but also realise that technological innovations can pose negative consequences for socio-economic welfare. As such, we embarked on a longitudinal Design-Based Research (DBR) study between Information Systems (IS) and Urban Planning (URP). This study explores the potential of interdisciplinary collaborative student projects to implement digital social innovations to improve the quality of life and sustainability within local communities in Cape Town, South Africa.

This paper reports on iteration two of this study where student projects were focused on the exploration of problems in communities related to SDG 11 (pressing environmental problems in local communities). We reflect on the outcome from a pedagogical perspective to draw lessons for future curriculum interventions that can respond to our main research

question: How can the SDGs be embedded in an IS curriculum to develop responsive digital social innovations?

The SDGs represent complex, intersectional issues such as urban livelihood drivers and the direct dependency of urban dwellers on natural resources. The intersectional nature of the SDGs provides a complex reality for students and community members to collaboratively engage throughout the project phases, from a problem identification and understanding stage to developing real-world digital innovations. Some wicked challenges in our local context in Cape Town, as identified by communities, include urban flooding, informal settlement fires and the impact of different forms of pollution which are encapsulated in the SDGs. By transcending the typical subject and curriculum boundaries, this student project responds to a current gap of 'contextually unresponsiveness' in IS education. The 'contextually unresponsiveness' stems from a conventional technology-focused curriculum with limited engagement with real-world context and consequences. Universities are responsible to ensure that the impact of new technologies is studied and evaluated to equip graduates for labour markets that are changing due to digitalisation (EAU, 2021).

In this paper, we draw on several key concepts such as the SDGs, local lived knowledge and digital social innovation to frame the drivers of the student project. This discussion is followed by an overview of the student project phases and situating Design-Based Research (DBR) as the research method. After engaging our dataset, we conclude by proposing four distinct shifts for IS curriculum interventions that foreground sustainability and social good namely a shift in focus from Industry 4.0 to Society 5.0, multi-disciplinary to transdisciplinary learning interventions, traditional critical thinking to design thinking and an overemphasis on problem-solving to deeper problem-engagement.

2. Literature Review

2.1 Sustainable Development Goals and Curriculum Development

There is an urgent need to embed Education for Sustainable Development in higher education combined with wider collaborative partnerships to expand and mobilise practical action in communities. The COVID-19 pandemic has further accelerated the debate around targets for the Sustainable Development Goals (SDGs) and the key role of innovation in achieving the 2030 Agenda. "Green" and "Digital" have become twin concepts within the discourse about a sustainable future requiring deeper engagement with the impact of new technologies such as Artificial Intelligence (AI), biotech, nanotech, Internet of Things (IoT) and robotics, cloud computing and machine learning (Carayannis & Morawska-Jancelewicz, 2021).

The addition of a new competency area in the new IS 2020 curriculum, ethics, use and implications for society, emphasises the growing importance of IS applications in solving global challenges (Leidig & Salmela, 2020). Graduates need to be exposed to the complexities that await in this uncertain, interconnected future. Students need much wider exposure to the complex or wicked problems embedded in sustainability challenges. This requires exposure to multiple perspectives, the questioning of viewpoints and routines, and the

production of socially robust knowledge and responses with scientists, governmental organisations, businesses, and civil society. Such spaces can become a source of collaborative, social, and transdisciplinary learning, and have the potential to contribute to societal transformation and sustainability.

Digital and social innovation are vital to the establishment of a sustainable society (Serpa, 2019), however, the drastic impact on conventional industries and increased social complexity inherent in digital transformation should be foregrounded (Fukuyama, 2018). For permanent innovation that addresses deep-rooted sustainability challenges, learning for change and flexibility are essential, and learning for technology does not suffice (Morrar et al., 2017). Within this context, the emergence of Society 5.0 following, to some extent, Industry 4.0 is presented. Whilst the focus of Industry 4.0 is on production, Society 5.0 seeks to put humans at the centre of innovation to harness technological integration for the improvement of the quality of life, social responsibility and sustainability (Ferreira & Serpa, 2018).

Industry 4.0 focuses on applying emerging technologies to improve organisational effectiveness, competitiveness and ultimately financial performance (Gladden, 2019). According to Ferreira and Sherpa (2018), the focus is too much on the economic and technological dimensions at the expense of the social impact. Society 5.0 initiatives seek to counterbalance a commercial emphasis by applying emerging technologies to qualitatively enhance the lives of individual human beings and to benefit society as a whole (Gladden, 2019). This is a very ambitious goal, but in a country with the most unequal society in the world, we need to expose students to systemic, wicked problems within societies. A new worldview is required where we create future thinkers that see possibilities within this complexity. One can argue that Society 5.0 ambitions may widen the chasm given current inequalities and the power dynamics of big data. There should, however, be a shift in the balance of power toward human and social development that values sustainability. We need to draw on the concept of "collective intelligence" as espoused by Martey et al., (2021). This involves participation from communities based on group interaction to improve communication and design human-centred solutions using technologies such as co-creation and crowdsourcing systems, digital citizen assemblies, and open innovation platforms (Nikiforova et al., 2021).

2.2 Local Lived Knowledge and a Transdisciplinary Approach

We consider local lived knowledge as a foundational resource when engaging with sustainable development challenges. Abbot and Wilson (2015, p 105) describe local knowledge as a "manifestation of lived experiences" which provides an authentic starting point to understanding complex wicket problems. As argued by Baek and Kim (2015), the active engagement by a community in the collaborative production of solutions to their own social problems creates a positive impact on society as a whole. Within a society such as South Africa with its constrained resources, it becomes imperative for communities to find creative solutions to challenging problems. But communities cannot do this on their own, just as IS students, as future professionals, cannot and should not find solutions in isolation. To this point, we draw on the conceptual model of Lang et al., (2012, p 40) where a transdisciplinary approach is "embedded in specific contexts" where contexts include voices from different role players. An opportunity to include communities as a source of diverse and intimate knowledge of the problem is created through a transdisciplinary approach.

A transdisciplinary approach provides an opportunity to move away from disciplinary silos and focus attention first and foremost on real-world, complex, wicked problems. It further

allows for multiple stakeholder engagement and collaboration (Serrao-Neumann et al., 2015) which builds on the fundamental SDG premise of partnerships.

2.3 Digital Social Innovation

As argued, the SDGs should be reflected in new curricula and research agendas. This calls for urgent action to develop solutions by different types of stakeholders in co-developed, co-created, co-delivered and co-experimented ways (Carayannis & Morawska-Jancelewicz, 2021). Within this premise, the application of digital social innovation (DSI) in interdisciplinary collaborative projects is proposed. Digital social innovation applies to projects that use digital technologies in conjunction with community engagement and collaboration, co-creation strategies and bottom-up approaches to address societal needs. This is in opposition to centralised proprietary solutions that are owned by a few companies (Cangiano et al., 2017).

According to Ferreira and Serpa, (2019, p.11–12), "DSI emphasises the intersection of three elements: the innovation process, the social world and the digital ecosystem". As argued by Carayannis and Morawska-Jancelewicz (2021), technology is not the key element, but rather the tool to address social challenges. The underlying purpose of innovative ideas should be the solution to a specific problem and a change for the better.

From experience, one of the major challenges faced in real-life or authentic student projects is students' underlying fear of failure and thus an over-reliance on familiar technical solutions. With digital social innovation, the focus needs to shift from a superficial understanding of a problem and the application of known technical solutions to a deeper engagement with the problem area. As such the facilitation of an interdisciplinary approach combining different actors and competencies is recommended in a process of finding innovative, effective and sustainable solutions to pressing societal challenges, such as those listed in sustainable development goals (SDGs). Digital social innovations are not predictable but exploratory and their focus is on experimentation (Serpa, 2019).

Within the broader paradigm of design science research, we apply a process of design thinking (Brown, 2008) to open the space for DSI. The application of design thinking aids in a shift from traditional critical thinking applied in problem-solving to open up the space for deeper problem exploration as required for engagement in wicked problems. It follows a human-centred approach by involving different stakeholders, including the end-users in the process of designing solutions (Shahrasbi et al., 2021). Developing the capability to continually change the perspective adopted and thus reframe the problem and solution over time enable diverging and converging and ultimately creating value (Magistretti, 2021).

3. An Overview of Student Projects

This paper reports on the outcome of student projects during the second iteration of a wider longitudinal Design-Based Research study. The wider study was initiated in 2020 to develop design principles for interdisciplinary collaborative learning spaces. The focus of student projects during the second iteration was on collaborative partnerships

between Information Systems and Urban Planning students to explore environmental issues related to SDGs in their local communities.

The scope was to apply digital social innovations related to SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable. The projects were framed within the context of the impact of rapid digitisation resulting in new opportunities to re-think how cities are organised and function. Aspects around the availability, type and quality of data have an essential impact on urban decision-making, but also that the 'smartification' of cities imposes a risk of supporting a purely technocratic and top-down approach to urban governance.

The project opened up a space for students from IS and URP to gain a multi-perspective understanding of the complex wicked problems related to SDG 11 in their local communities. Student groups were selected from the two disciplines in an attempt to have an equal distribution of IS and URP students per group. Most groups consisted of six students, but in some groups, there were more IS students due to slightly higher class sizes. The groups were tasked to focus on one of the following three themes:

1. Community challenges/vulnerabilities with regards to the local natural environment: What is the most pressing environmental hazard or challenge in your community?
2. Community challenges/vulnerabilities with regards to resilience: What are the issue(s) your community struggles with as an obstacle to their resilience? (the ability to cope with challenges and pressures) Issues to consider such as climate change, flooding risks, drought, fires etc.
3. Community challenges/vulnerabilities with regards to COVID-19: What are the issue(s) your community struggles with most during the pandemic period? Issues to consider such as access to basic services, access to technology, access to basic education, safe and healthy outdoor community spaces, the connection between nature and human health etc.

We are using the Design Thinking phases (Brown, 2008) to guide and structure this assignment through the following phases:

Phase 1: Empathize and Define: In-depth contextualisation of the community problem. The focus is on reconfiguring the problem and better framing it in a structured process that supports the design of future solutions that will respond to needs (Magistretti, 2021).

Student groups collectively identify and develop a problem statement from one of the themes that apply to their local community. The problem statement was accompanied by an in-depth literature review to discuss the consequences of the problem if not addressed. The role of the government, NGO or private sector in a review of the policy framework and relevant legislation formed part of the literature review. Because this phase forms the

the foundation of the rest of the project, it takes up to two weeks with a continuous review from facilitators and peers to get a clear understanding of the problem area.

The next activity included the development of questionnaires and interviews with members of the community to get a deeper understanding of the problem and potential solutions. The data from the interviews are used to develop two personas that represent the community. This leads to the design of digital stories that depict the problem area from the perspective of a persona within the community.

During this phase, a strong emphasis is placed on the value of local lived knowledge. The value of co-creation is embedded in the process to break down the "us vs them" mentality and adopting "us with them" practices (Brown, 2008).

The IS students often find this phase challenging and it is necessary to sensitise them to the importance of developing a tolerance for ambiguity. IS professionals work in a complex profession and it is often not possible to completely understand an IS and the system's relationships with other entities and people. Hence, IS professionals must be adept and working with and adapting to ambiguous situations with incomplete information. Individual foundational competencies associated with managing and adapting to complex environments with incomplete information are required (Leidig & Salmela, 2020).

Phase 2: Ideate and Prototype: This phase includes conceptual interventions and responses to the community problem. This phase takes place during Maker Week where groups of students brainstorm ideas. During the brainstorming, student groups are encouraged to break away from traditional critical thinking where problem-solving is focused on ways to make the problem go away via a process of weeding out bad ideas in search of good ones. The focus should not be on convention and best practices, which can only make things as good as they currently are. The brainstorming sessions should avoid best practices and rather start from a blue-sky standpoint that seeks to build ideas from the bottom up. The focus is on potential solutions that no one has thought of before. The design thinking process is rooted in debating, embracing criticism, and building on the ideas of others. In this way, ideas will be reconfigured by adopting techniques for questioning and valuing different perspectives (Magistretti, 2021).

Student groups are then required to use a decision matrix to funnel the ideas and identify four potentials that can be prototyped.

Phase 3: Test - At the end of the Maker Week, prototypes are presented to a panel consisting of the lecturers and stakeholders from outside organisations such as NGOs and government stakeholders for further feedback.

4. Research Methodology

The application of Design-Based Research (DBR) was deemed to be the most suitable for the larger research study because it encourages collaboration between stakeholders (e.g., researchers, IS and URP students, community members) which is a central premise of the research. Within a DBR study, both new theoretical insights and practical solutions to teaching and learning challenges can be developed (Mckenney & Reeves, 2020).

A DBR study is longitudinal and consists of a collection of sub-studies that are reported separately, with this paper discussing the second iteration as part of Phase 3 of the overall DBR study see Figure 1. The study was initiated in 2020 with the identification of problems in the learning environments and ways of incorporating interdisciplinary collaborative student projects to address systemic problems in communities (van den Berg & Verster, 2020; Verster & van den Berg, 2021).

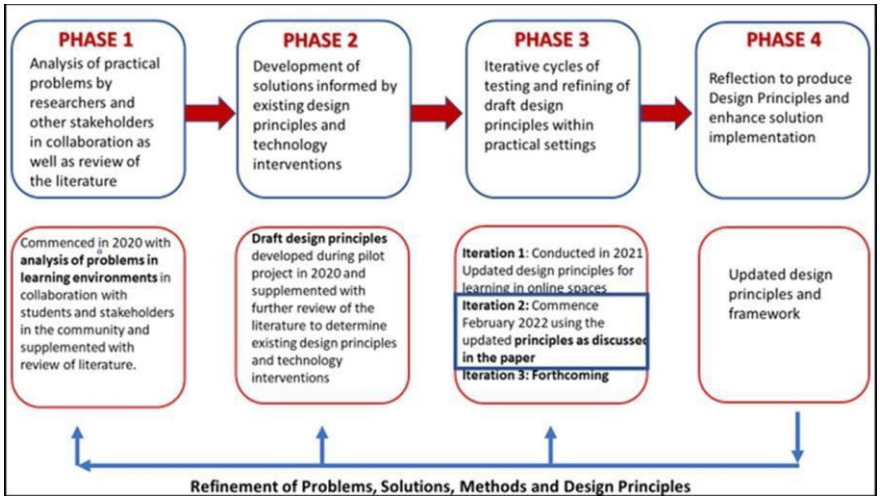

Figure 1: Design-Based Research Process (Source: Adapted from Reeves, 2006)

4.1 Participation

The second iteration took place in 2022 during the first semester and the joint project consisted of 30 students from the Honours group in IS at one university and 24 URP students doing the Advanced Diploma at another university. The two groups represented the full student complement enrolled for these courses. The group project was part of the overall learning outcomes and assessments of both modules. Permission to have their findings and reflections, during the roll-out of their group project, included in the data was obtained from students via a signed information sheet that contains details about the study. Both universities also obtained ethical approval for the overall study.

4.2 Data Collection

Data was collected from a pre-and post-course reflective questionnaire using Google Forms that tested students' perceptions of the learning environment. The questionnaires were specifically designed to test the students' perceptions of an interdisciplinary collaborative learning environment and their engagement with their local communities. Field notes and reflections made by the researchers during the project rollout were also consulted. Data from project artefacts produced during the interdisciplinary project was further reviewed.

5. Discussion

As discussed, the roll-out of the project followed the process of design thinking and particular emphasis was placed on the initial phase to enable a deep, multifaceted interpretation of systemic wicked problems that plague local communities in Cape Town. As such, student teams embarked on an iterative process of brainstorming, problem identification, community interviews, the creation of personas and digital storytelling. The objective was to co-create (between IS and URP students) prototypes of potential digital social innovations that will have long-term benefits. Although the ideal would be to include community members in the co-creation process, this was not possible in this iteration because of COVID-19 lockdown restrictions. Limited community engagement had to be undertaken via the students and with their direct family, friends and neighbours as networks.

During the second phase, groups were exposed to brainstorming techniques to facilitate ideation, the application of decision matrices to determine potential viable DSI and techniques to create prototypes. During the final phase of the interdisciplinary project, prototypes were tested and refined.

Phase 1

During the first phase, students are familiarised with concepts such as human-centred design, digital social innovation, design thinking, and SDGs and introduced to broader philosophical concepts rooted in ethics and sustainability as well as the emergence of Society 5.0. The interdisciplinary groups need to find their problem areas and also ways of co-creating and collaborating across disciplines.

The recommendation is to spend some time with students to enable a deep engagement with the problem area and not rush the initial phase. There is typically a sense of unease during the initial phase as students are unfamiliar with interdisciplinary group work. The IS students have limited experience with SDG challenges and community engagement and tend to resort to traditional critical thinking in their approach to problem-solving. As such, more coaching is required for a deeper understanding of social innovation and socio-technical affordances. Some extracts from student reflections capture this:

An important learning was not to disregard the "local voice" of communities or the area you are working in. With the collaboration of the URP students, I was able to see how people from a completely different department think about solutions and how they differ from students in the IS department (Nom)

I enjoyed working with the URP students, they really helped us a lot with understanding our problem statement before going to the solution (Jus).

My biggest highlight with the Interdisciplinary assignment was learning how to view a problem in different ways. It was second nature to view the problem from an IS point of view, but when the urban planning students came aboard, they helped us rethink our approach to the assignment (Ash).

It made me realise that you might think you understand the problem and rush to solutions without including the people affected by that environmental problem therefore you need to analyse and break down the problem to understand its core before attempting to solve it (Mni).

As an IS student I got to understand the environmental problem due to understanding different policies and literature review that I was taught by my urban planning colleagues. I was also able to view the problem in another perspective different from the usual technology way (Bin).

Student teams conducted interviews with community members and captured their findings during brainstorming sessions as depicted in Figure 2.

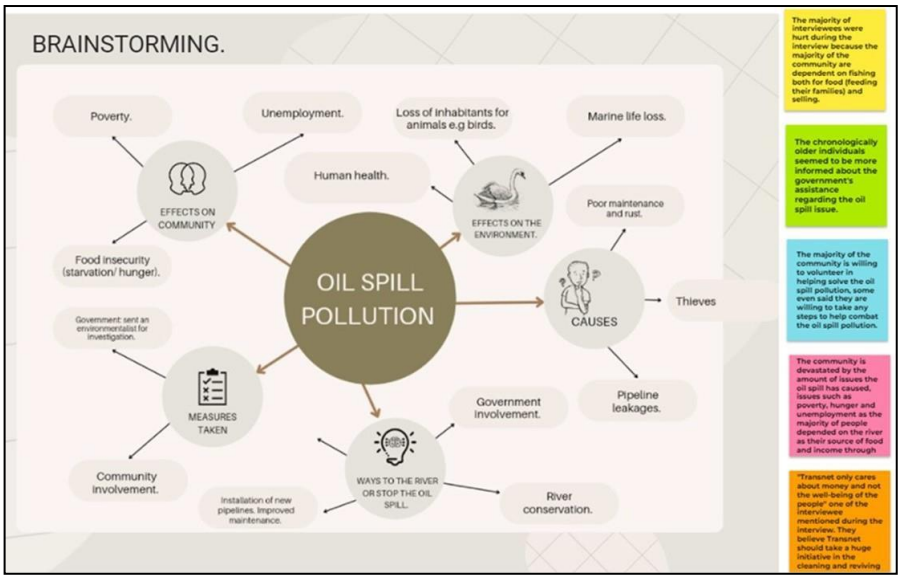

Figure **2**: Brainstorming Interview Findings

From the interviews, teams were required to create Personas of two or more archetypes within the community and their perceptions about the problem were captured in digital stories as seen in Figure 3 and 4.

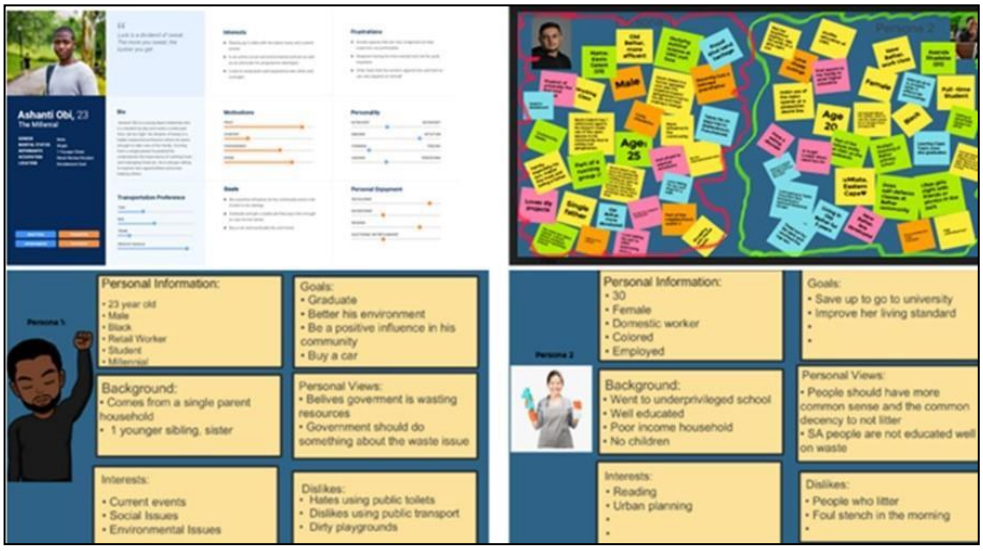

Figure **3**: Creation of Personas

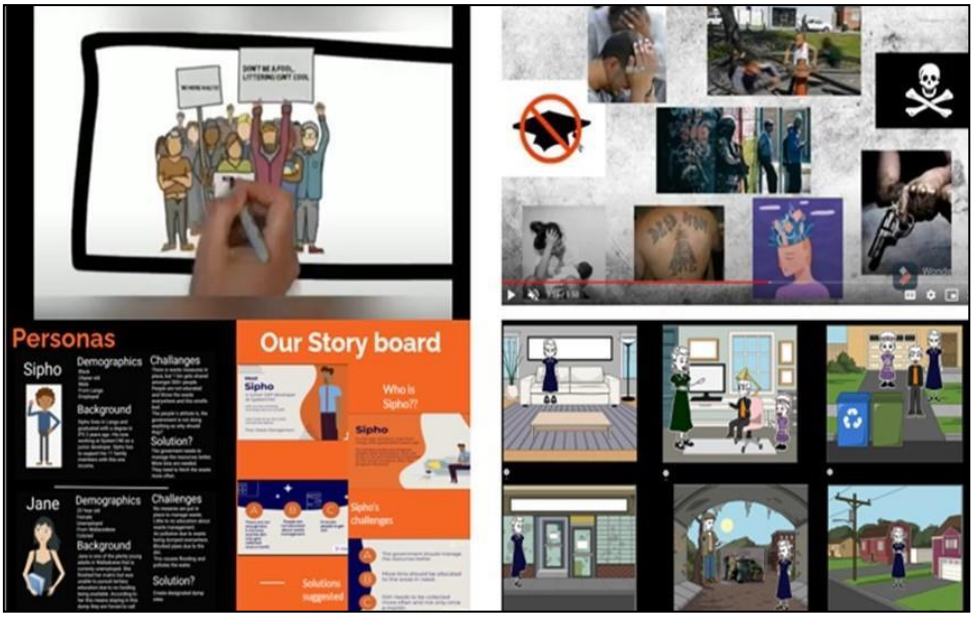

Figure **4**: Digital Stories

Phase 2:

A Maker Week to stimulate ideation takes place during the second phase of the project roll-out. Students are supported through coaching sessions to help facilitate brainstorming using a variety of online platforms such as Jamboards and Padlets. The central premise of the ideation phase is to defer judgement, encourage wild ideas, build on the ideas of others, be visual and go for quantity in brainstorming. This student reflection describes the experience:

The ideation lecture was practically helpful as it tasked us to use our Jamboard and come up with a host of ideas at a quick pace which took a lot of quick collaborative creative thinking and greatly helped develop this skill. I feel that this is a valuable lesson as it would pay off within the working environment too as it would often require you to work in groups with individuals you have not met before and you would need to learn how to form a collaborative creative thinking team very quickly (Su)

Figure 5 depicts some extracts from Jamboards during ideation. Teams were required to select the top ideas to prototype by using a decision matrix as illustrated in Figure 6. Some of the initial prototypes as shown in Figure 7.

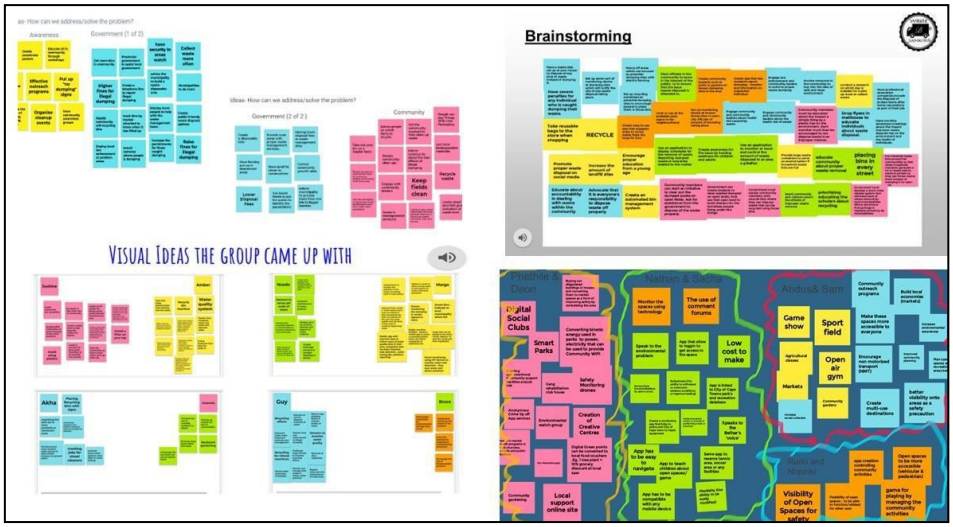

Figure **5**: Ideation

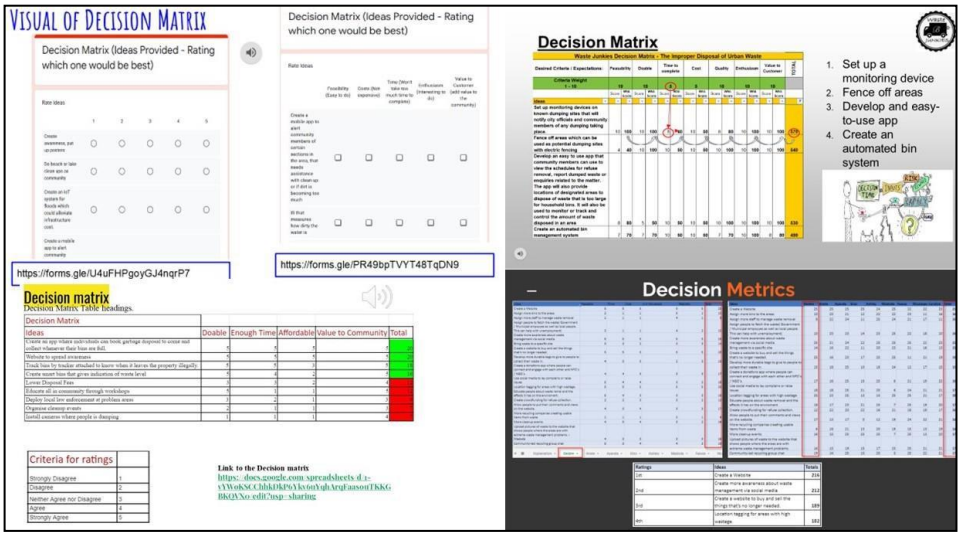

Figure **6**: Decision Matrix

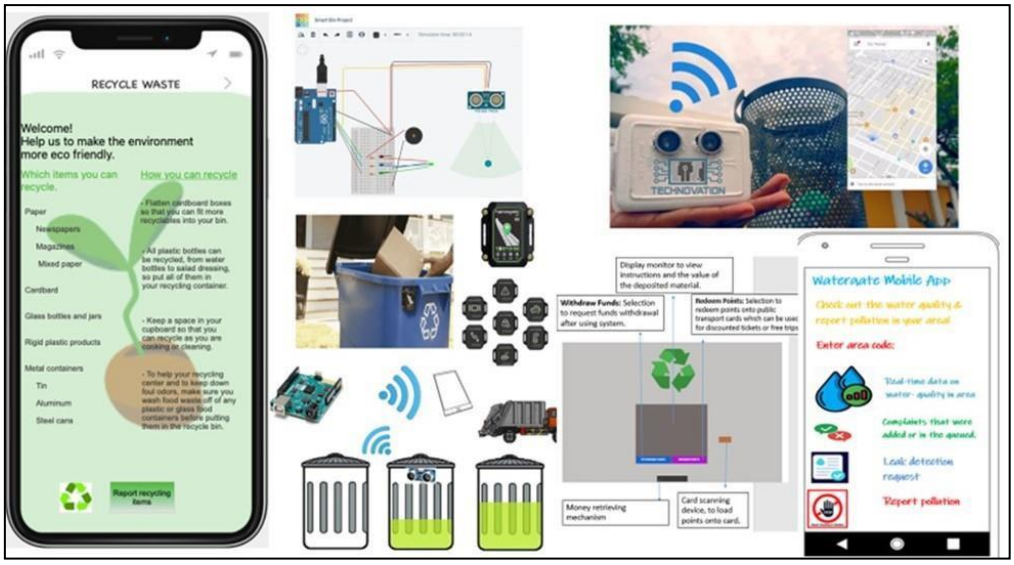

Figure **7**: Prototypes

During the project's final phase, prototypes were tested using formal test cases and further refined. Groups selected one prototype based on feedback received and the IS students further developed the prototypes to be workable solutions such as a fully functional app or database.

6. Conclusion and Recommendation

This paper presented findings from the second iteration of a longitudinal DBR study. During this iteration, student projects were focused on the exploration of problems in communities related to SDG 11 to operationalise the highly complex SDGs in the local South African context. The limitation of this paper is that it only presents findings from a part of the bigger study and should be seen in the context of the student project presented here versus the bigger DBR study. A further limitation is the limited engagement with the community role players as COVID19 restrictions were still in place.

The central question posed during this iteration was: How can the SDGs be embedded in an IS curriculum to develop responsive digital social innovations? The question stems from the urgency of embedding Education for Sustainable Development with a special focus on community, within the university context. The paper presented a high-level review of literature of the Sustainable Development Goals, the concept of local lived knowledge and the impact of digital social innovations.

After reflecting on the project and drawing from data, we propose the following recommendations to instil 'IS for sustainable development and societal good' within the curriculum:

Shifting the focus of discussion and engagement from the "so-called" Fourth Industrial Revolution (4IR) to the inclusion of Society 5.0. The 4IR perspective is predominantly situated in organisational effectiveness/efficiency, and financial performance whilst Society 5.0

initiatives seek to counterbalance a commercial emphasis to that of enhancing the lives of society as a whole. The inclusion of the SDGs and exposure of students to the plights of communities is a step towards this bigger initiative.

A further recommendation is that students need to be exposed to interdisciplinary perspectives and ultimately shift to transdisciplinary learning. The complex and interconnected nature of real-life problems requires students to engage in cross-cutting forms of inquiry. Whilst disciplinary specialisation remains relevant, interdisciplinary inquiry and ultimately transdisciplinary learning can enable students to work towards cross-fertilisation of disciplinary and also practical knowledge to address complex interconnected current challenges. The third iteration to commence in 2023 will attempt a shift to a transdisciplinary learning environment that includes stakeholders from local government as well as more role-players from local community organisations.

A further perspective is to shift from a focus on traditional critical thinking to include a human-centred design thinking perspective. The inclusion of a design thinking methodology applied in the student projects enables this. The interdisciplinary perspectives of mixing different professions in the projects also enabled students to form a more nuanced perspective of broader societal problems.

Another recommendation is a shift from an overt focus on problem-solving with a linear focus on the outcome to a broader perspective of problem engagement. This implies that there may be multiple solutions and that students should be open to experimentation and willing to change and adapt the design of solutions. This should be part of the overall assessment strategy where projects are assessed on the process followed throughout as opposed to the final outcome.

In conclusion, we recommend a comprehensive conceptual foundation for further research into the many ethical, philosophical, cultural, security and risk-management questions related to sustainable development in IS for the following phases in this DBR study.

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