OurOS: A hybrid physical and digital tabletop game as a tool for rural community members to build sustainable communities

Submitted to OCAD University in partial fulfilment of the requirements for the degree of Master of Design in Digital Futures

Toronto, Ontario, Canada, 2023

Creative Commons

Abstract

Developmental organizations face challenges in ensuring the sustainability of their interventions in rural communities. Community knowledge and healthy social and political systems are essential in designing effective interventions. In this research I discuss the issue of limited access to essential technology among women from rural communities and the need to design technology from the end-users' perspective. Over the course of this thesis, I propose OurOS as a tool based on design justice principles that involve stakeholders, including community members, development professionals, and government employees, in co-designing innovative solutions to the wicked problem of sustaining community support. The tool is framed as a tabletop game that is played to facilitate discussions among stakeholders to co-create a plan of action for building a sustainable community. By constructing a collaborative approach that involves all community members, I argue that developmental organizations can create interventions that have a lasting impact on rural communities.

Keywords: Community development, Design Justice, Collaboration, game theory, projection, tactile interface, Bottom-up approach

Acknowledgements

To all the women who continue to fight for thriving communities

Dr. Emma Westecott and Prof. Michelle Gay, for their constant guidance and support

My mother, for giving me a good education

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Introduction

Developmental organizations play a pivotal role in transforming rural communities worldwide. Many such organizations have a standardized workflow while building a developmental project. This workflow involves fundraising with specific objectives, targets and outcomes, identifying a rural community and conducting an assessment to ensure that the community matches their goals, building the capacity of the target audience and assessing the impact of their intervention(s) with clear timelines dependent on budgets sanctioned. It becomes operationally challenging to ensure lifelong sustenance of the activities conducted unless the intervention is designed with sustainability in mind, even though they engage people constantly across all sectors, social groups, and genders. In many traditional developmental activities, people's needs and wishes are not considered even though they are the beneficiaries (Appleton 1995, p.10). Methodologies and solutions deployed should rely on community knowledge and healthy social and political systems (O'Farrell and Norris 1999, p.32).

According to O'Farrell and Norris (1999), women from lower economic groups tend to have limited access to essential technology despite having the greatest need for it. In addition, technology is often looked at with Western standards. It tends to be developed primarily from the designer's perspective rather than the end user's, as Anderson (2020) noted.
Solar-powered pumps have been designed to provide irrigation and water access to rural communities. However, if these pumps are not designed to meet the specific needs of the local community, they may be ineffective or underutilized. If the pumps are designed to be too expensive or complex for the local community to maintain, they may not be a sustainable solution. When technology is designed solely from the designer's viewpoint it may be challenging, unclear, or impractical for the intended user, leading to frustration, low adoption rates, or even abandonment of the technology. Hassenzahl (2010) argues that the design objective should be understanding and considering the transformation rules during design and evaluation. Hassenzahl refers to the transformation rules as the underlying principles and processes that guide how users interact with products or systems. They involve the transformation of user goals, motivations, and intentions into meaningful actions and outcomes through the design of interactive systems.

Naomi Miyake in “The social and interactive dimensions of collaborative learning” talks about social networks being essential for collaborative learning because they provide opportunities for learners to interact, communicate, and share knowledge. Miyake talks about social networks as platforms that enable people to connect with one another, share information and resources, and communicate through various forms of media. Miyake argues that these social networks allow learners to engage in "socially distributed cognition," meaning that learning is not limited to an individual's cognitive processes but is distributed across multiple individuals and the social network. By interacting and collaborating with others, learners can share knowledge, ideas, and perspectives that they might not have considered on their own.

By following the principles of “Design Justice” (Constanza-Chock 2020, p.6) that have emerged from a growing movement within design and technology communities that recognizes how these fields can perpetuate existing systems of power and inequality, I build a tool that has the potential to bring together stakeholders such as community members, development professionals, government employees, etc., as co-creators and co-designers to create innovative solutions backed by knowledge held by local community members. These community members have the capacity to identify problems in their vicinity and establish clear goals for building a sustainable community. By recreating a map of their community and designing elements of a tabletop game that facilitate discussions, stakeholders are able to explore the current state of education, health, sanitation, environment and finance in their community and thereafter create a plan of action that is widely understood and acknowledged by all community members.

Rationale

Women’s empowerment and gender equity are critical because they relate to human rights and are enshrined in a normative framework of international labour standards, laws and norms. Therefore, promoting gender equity and women’s empowerment go hand in hand, and both are important in ensuring that women enjoy their human rights and can play a role in contributing to inclusive and sustainable development through a thriving rural economy.

In order to understand how developmental organizations can create interventions that have a lasting impact on rural communities, the research aims to answer the following,

1. How might rural community members co-design and play a tabletop game to identify problems in their vicinity and establish clear goals for building a sustainable community?
2. How can systems of power be countered through acts of play and collaboration?
3. How can technology be reimagined to be used by marginalized communities?

Women at the heart of development

Women are often marginalized in decision-making processes at various levels. Women are excluded from decision-making on access to resources critical to their livelihoods (FAO, 2008). Women from rural communities have limited access to technology, knowledge and productive inputs. In the context of rural communities, productive inputs include things like land, labor, seeds, fertilizer, water, tools, and equipment, among others. These inputs are essential for agriculture and other forms of rural livelihoods, and are critical for generating income and improving the standard of living in rural communities. For instance, technologies for agricultural adaptation that may not be gender-friendly can increase the risks of social and economic maladaptation. (UNDP, 2016). Many agricultural machines and tools, such as tractors and plows, are designed for use by men and may be too large, heavy, or difficult for women to operate thereby limiting women's access to mechanization and lead to increased workload and physical strain. Improved seed varieties that increase crop yields and resilience, but may be less suitable for women farmers who often have different preferences and priorities in terms of taste, nutrition, and seed saving practices. Irrigation systems that are designed and managed by men may not take into account women's needs and preferences for water use and management that can limit women's access to water for irrigation and domestic use, and increase their workload and stress.

> Women’s empowerment is the capacity of women and men to participate in, contribute to and benefit from growth processes in ways that recognize the value of their contributions, respect their dignity and make it possible to negotiate a fairer distribution of the benefits of growth. Women’s economic empowerment increases women’s access to economic resources and opportunities, including jobs, financial

> services, property and other productive assets, skills development and market information. Women's economic participation and empowerment are fundamental to strengthening their rights and enabling them to control their lives and influence society. (OECD, 2011).

Despite the wealth of information and experience women hold, there remains a gap in connecting them with the planning and implementation of developmental activities. Recently, ICTs have been added to the women and gender equality debate. ICTs are being presented as a tool having the potential to benefit women's empowerment', and many ICT projects that specifically target women have been established in several developed and underdeveloped countries. Information and communication technology (ICT) are existing and widely deployed technologies that can be mobilized to accelerate the pace and scale of transformation. ICT can play a role in delivering innovative, integrated, cross-sectional and sustainable development goals. ICT can increase connectivity and productivity and strengthen the resilience of crucial infrastructure to help overcome social and economic exclusion. Sustainable Development Solutions Network, a UN agency, discusses how ICT can help deliver last-mile programmes (ICT & SDGs 2016, p.1). The report highlights that ICT can secure last-mile delivery of food, medicine and disaster relief, promoting a sustainable resource management system. The term "last-mile" refers to the final stage of delivery in the supply chain, where goods or services are transported from a central hub or distribution center to their final destination, which is often a remote or hard-to-reach location (UNDP 2016, p.8). ICTs can provide timely information and solutions to extend agricultural and business development services. Through inclusive digital financial services, we can reach people who have not benefited from banking services. ICT can help map and monitor the needs and support development initiatives to improve opportunities and facilities for the poor. Online work and education opportunities can promote inclusive innovation and better education and jobs for the poor. ICTs can help transform services, making them accessible and responsive to the poor. Modern technologies like mobile phones that host applications to provide daily information relevant to economic livelihood can enhance people's daily lives by connecting them to opportunities to market their produce. (Gamser 1988, p.45).

However, women from lower economic groups often have the least access to crucial technology yet they have the greatest need (O'Farrell and Norris 1999, p.32). The literature often associates technology with western standards. Conventionally, technology is developed

from the point of view of its designer rather than the end-user (Anderson 2020, p.3). Mobile apps that provide information on weather, crop prices, and farming techniques can be helpful for rural communities. However, if these apps are not designed with the local community's needs and capabilities in mind, they may not be effective. If the app requires a high-speed internet connection or the latest smartphone models, it may not be accessible to many people in rural areas. When technology is designed solely from the perspective of its designer, there is a risk of creating products that are difficult to use, confusing, or simply not practical for the intended user. It can lead to frustration, poor adoption rates, and even abandonment of the technology altogether. As long as the experience is our design goal, the task is clear: to better understand and consider the underlying principles and processes that guide how users interact with products or systems while designing and evaluating. (Hassenzahl 2010, p.11)

The development and transfer of western-based technologies do not consider the needs of marginalized groups, and in particular, projects involving technologies have historically lacked gender sensitivity (Appleton 1995, p.10). While suggesting the optimization of resources and maximizing the impact of development activities by piggybacking on ICT networks, the crucial support mechanism that revolves around women that can genuinely ensure the long-term sustainability of activities is often left out.

Examining the relationship between rural women, technology use, and implementation is essential, as gender dynamics are prevalent in rural communities. Traditional and local knowledge is crucial when examining women and technology in rural communities. Knowledge has evolved within a particular community influenced by cultural context and is often passed orally from generation to generation. Gertjan Van Stam led an eleven-year action research since 2000 in rural Zimbabwe and in rural Zambia, to identify and inspire local talent to introduce Information and Communications Technologies (ICT) and participatory oral research methodology to build the necessary capacity and intent for community-led activities to yield sustainable human development outcomes (Van Stam 2013, p.8). Van Stam found that the cultural specificity of text-based, English-language and overly-rational methodologies are ill-suited for interpreting realities in rural Macha in Zambia (Van Stam 2013, p.9). At the same time, significant benefits are shown when data is kept in the oral, traditional realm. Also, it was found that when data was kept in oral-culture equivalents, it

produces worthwhile outcomes. The advantage of technology developed with the consultation of community members in the economies of developing countries is that it provides employment and income-generating opportunities to rural women on a sustainable basis, thus multiplying the contribution to the national income. Besides, a reduction in drudgeries offers scope for supplementing the family income. If certain labor-intensive or time-consuming tasks, such as household chores or agricultural work, are made easier or more efficient through technology or other means, it can free up time and energy for individuals to pursue other income-generating activities. The potential benefits of rural technology diffusion, among others, include a reduction in drudgeries, optimum utilization of resources, and balanced and inclusive growth that leads to female empowerment. Particularly in South Asia, when new concepts and tools are brought into the community, where cultural and religious norms, and gender roles can inhibit women's effective participation in technology development and decision-making processes. These norms dictate a sense of modesty that forbids women from expressing their technology needs and impairs their effective participation particularly in the presence of men. (FAO 2000)

African governments, in particular, recognize ICT as a significant leverage in efficiency and services improvement in public sector reforms and tend to heavily push delivery of these services through rigid colonial organization structures, stemming mainly from the technology-driven, top-down approaches to ICT being used and deployed (Kiely, G. and Fitzgerald, B 2005, p.7). For example, many African countries inherited centralized bureaucracies from their colonial past, which can be slow, inefficient, and unresponsive to local needs and priorities. This can make it difficult for citizens to access essential services like healthcare, education, and water and sanitation (Brinkerhoff 2015, p.15). In many African countries, decisions related to public service delivery are often made at the national level, with limited input from local communities or civil society organizations. This can result in policies and programs that are not well-tailored to local needs and realities that may not be sustainable over the long term (Andrews 2013, p.3). A lack of citizen participation and engagement characterizes many traditional, colonial-era structures for delivering public services in Africa. This can make it difficult for citizens to have a say in decisions that affect their lives and can limit opportunities for feedback and accountability (Ribot 2009, p.23). Public services are often delivered through structures that were designed during the colonial

period and may not reflect the needs or preferences of the local population. Many of these structures were designed to be hierarchical, centralized, and top-down, with little input or feedback from local communities. This can lead to a lack of trust in public institutions and a feeling of disengagement among citizens, who may feel that their needs and concerns are not being heard or addressed.

The top-down approaches do not incorporate beneficiaries' interactions with an ICT tool nor possible changes in their views and agendas over time that determine the programme's overall success determined by the extent to which the programme has made a positive impact on the target population, such as improving their lives, increasing their income or productivity, or improving their health or education outcomes and continue delivering its intended outcomes over time, even after external funding or support has ended while ensuring stakeholders, such as beneficiaries, partners, or funders, are satisfied with the program's outcomes and delivery. ICT system implementation is often viewed as a top-down process, with predetermined decisions regarding role and purpose, relying on complexity reduction through functional simplification and closure (Kallinikos, J. 2005, p.19), not including the ground elements they were initially meant to address. In many cases, decisions about the role and purpose of ICT systems are made at the organizational or governmental level, without sufficient input or consultation from the end-users who will be affected by the system. This can lead to ICT systems that are not aligned with the needs and preferences of the end-users, and that may be difficult to use or not fit for purpose.

This thesis works against this top-down approach by empowering community members to participate in the design and decision-making process. By involving community members as co-creators and co-designers, my approach looks to ensure that the solutions are informed by local knowledge and tailored to the community's specific needs and challenges. In addition, this approach can help to build trust and ownership among community members, which is critical for the long-term sustainability of the solutions developed.

By using a tabletop game to facilitate discussions, the research creates an accessible and engaging platform for community members to participate in the design process. This can help overcome some of the barriers that may exist for community members who may need more technical expertise or feel intimidated or excluded from more traditional design processes.

Literature and Contextual Review

The research draws on design justice principles, collaborative work, and game theory to develop solutions that address community needs and challenges. Design justice is crucial for the research as it helps ensure that the project is designed in a way that is equitable, inclusive, and responsive to the community's needs. By incorporating the principles of design justice into the project, I hope to address power imbalances and create a more participatory and democratic design process that engages the community in a meaningful and ongoing way. The design justice principles seek to use design to sustain, heal, and empower communities, and to seek liberation from exploitative and oppressive systems. These principles prioritize the voices and agency of those directly impacted by the design process, and view the designer's role as a facilitator rather than an expert. They prioritize sustainable, community-led and controlled outcomes, and seek non-exploitative solutions that honor and uplift traditional, indigenous, and local knowledge and practices.

Collaboration and co-creation is crucial to this research, as it brings together various perspectives, knowledge, and expertise. By collaborating with community members, development professionals, government employees, and other stakeholders, we can identify and prioritize community needs and challenges and develop more creative and innovative solutions tailored to the specific context. In addition, collaborative work helps to foster trust, build relationships, and create a shared sense of ownership over the project, which can help to ensure its success.

Modern game theory is also an essential tool in research, as it provides a framework for analyzing strategic decision-making in situations where the outcome depends on the decisions of multiple individuals or groups (Easley & Kleinberg 2019, p.6). Game theory can design incentives encouraging community members to participate in the design process and adopt and implement the developed solutions. By analyzing the potential outcomes of different scenarios, modern game theory can help to identify potential pitfalls and to develop strategies for mitigating risks. By analyzing the strategic interactions between different stakeholders, game theory can also help to identify situations where power imbalances exist and to develop strategies for addressing them.

My research seeks to develop solutions that are responsive to the community's needs and challenges while promoting equity, inclusivity, and democratic decision-making. By drawing on the principles of design justice, collaborative work, and game theory, we co-develop solutions that are sustainable, effective and empowering for all members of the community.

Design Justice

Decolonization is often used as a metaphor or a buzzword rather than a meaningful process of structural change. True decolonization involves repatriating land, resources, and cultural artifacts taken through colonial violence and exploitation. Decolonization requires the recognition of the ongoing legacies of colonialism and the ways in which indigenous communities continue to be oppressed. Decolonization rests on the repatriation of Indigenous land and life; it is not a metaphor for other things we want to do to improve our societies and schools (Garba & Sorentino 2020, p.1)

Adversarial design is an approach to design that seeks to challenge the status quo and promote social justice through critical and creative practices. Rather than simply creating products or services that reinforce existing power structures and cultural norms, adversarial designers seek to subvert and disrupt these structures to create more equitable and just outcomes. Since the turn of the twenty-first century, there has been an increased interest in how the practices and products of design shape and contribute to public discourse and civic life. Evidence of this can be found in various conferences and conference themes, trade publications, and reports promoting so-called social design, design for democracy, social innovation, and the like (DiSalvo 2015, p.3). Adversarial design emphasizes collaboration, critique, and activism. It encourages designers to work closely with communities and stakeholders to understand their needs and perspectives and to develop solutions that respond to their concerns. It also involves a rigorous process of critique, in which designers continuously question and challenge their assumptions and biases, as well as those of the broader culture and society.

In the book “Design Justice,” Sasha Costanza-Chock says that design “...too often contributes to the reproduction of systemic oppression” (Constanza-Chock 2020, p.xvii) and challenges the popular design narrative by questioning the relation of design, power and social justice.

Costanza-Chock defines *design justice* as “an approach to design led by marginalized communities, which aims explicitly to challenge, rather than reproduce structural inequalities.” (Constanza-Chock 2020, p.52). This alternative to traditional design processes places marginalized people at the center and uses collaborative, creative practices to address communities' challenges.

Constanza-Chock suggests that practitioners follow these ten principles:

> 1. We use design to sustain, heal, and empower our communities, as well as to seek liberation from exploitative and oppressive systems.
>
> 2. We center the voices of those who are directly impacted by the outcomes of the design process.
>
> 3. We prioritize design’s impact on the community over the intentions of the designer.
>
> 4. We view change as emergent from an accountable, accessible, and collaborative process, rather than as a point at the end of a process.
>
> 5. We see the role of the designer as a facilitator rather than an expert.
>
> 6. We believe that everyone is an expert based on their own lived experience, and that we all have unique and brilliant contributions to bring to a design process.
>
> 7. We share design knowledge and tools with our communities.
>
> 8. We work towards sustainable, community-led and controlled outcomes.
>
> 9. We work towards non-exploitative solutions that reconnect us to the earth and to each other.
>
> 10. Before seeking new design solutions, we look for what is already working at the community level. We honor and uplift traditional, indigenous, and local knowledge and practices. (Constanza-Chock 2020, p.2)

The action from these principles leads a designer to distance themself from extracting information from users or practices and moving into the territory of being organically part of the process leading to participants contributing uniquely to give rise to new imaginations.

Constanza-Chock says, "Reasoning through design is a mode of knowledge production that is neither primarily deductive nor inductive, but rather abductive and speculative. Where deduction reasons from the general to the specific and induction reasons from the specific to the general, abduction suggest the best prediction given incomplete observations." (Constanza-Chock 2020, p.6). Abductive reasoning involves making educated guesses or hypotheses based on incomplete or limited information. This differs from deductive reasoning, which moves from general principles to specific conclusions, and inductive reasoning, which moves from specific observations to general principles. Abductive reasoning in this thesis research is used to hypothesize what the specific needs and challenges are for the community based on initial observations. This hypothesis could then be tested and refined through collaboration with community members and other stakeholders, using the hybrid physical and digital tabletop game. By starting with incomplete information and generating hypotheses, this thesis research leads to produce the hybrid physical and digital tabletop game to serve as a platform to explore a range of possibilities and test them through an iterative design process that involves ongoing feedback and input from community members and other stakeholders. This can help ensure that the final solution is responsive to the needs and values of the community, and is grounded in the knowledge and experiences of those who are most affected by the design outcome.

Further, "Design is thus also speculative: it is about envisioning and manipulating the future" (Constanza-Chock 2020, p.27). Designers often propose, predict, advocate for, or warn against visions of the future through their work. This speculative nature of design raises essential questions and provocations, particularly in the context of design justice, which seeks to ensure that the benefits and burdens of design are fairly distributed among all members of society.

The design justice approach is intentionally provocative, advocating for a radical divergence away from how many designers might conceive the purpose and role of their work. Costanza-Chock's discussions highlight issues of unconscious bias leading to the design of

biased, unfair and disadvantaging systems. Many designers undoubtedly consider themselves as liberal citizens, well-aware of social justice imperatives, and perhaps even an ally to marginalized groups, but often end up producing a design that has unconscious bias as the primary consumer of technology is the institution rather than the individuals within it. Technologies designed to increase agricultural productivity and efficiency, such as irrigation systems, crop-dusting drones, or genetically modified seeds, may be developed with the primary aim of benefiting large-scale agribusinesses or government agencies, rather than small-scale farmers or rural communities (Ruzzante et al. 2021, p. 2). Another example of this unconscious bias is the chat feature in any digital communications tool like Google Docs that allows co-writing of text. From a design justice point of view, these presumed affordances or perceived uses of communication are not universally experienced but depend on each person's circumstances and context. An object's affordances are never equally perceptible to all, and never equally available to all; a given affordance is always more perceptible, more available, or both, to some kinds of people (Constanza-Chock 2020, p.39). This notion of 'perceptibility' relates to the issue of whether the user can see, hear and decode what the technology is offering. For example, is text visible to different forms of sightedness or written in a script that the user can decode? Similarly, affordance 'availability' raises the issue that many digital objects are not equally available to all.

Similarly, many collaborative tools exist in the rural-developmental industry that aim to include the marginalized in planning and managing activities through fancy mobile phone applications that reduce the activity into preset instructions. However, questions still need to be answered if these fancy tools include people in the planning or create a sphere of exclusion where certain individuals are excluded from participating in a particular activity or accessing certain resources due to various barriers, such as social, economic, or technological. Mobile based agricultural information systems provide information and advice to farmers through mobile phone applications. However, they can be exclusionary for farmers who do not have access to smartphones or reliable internet connectivity. Will these tools require users to be global-north literate or have numeric proficiency or technological literacy while not being relevant for the user in their natural habitat?

The matrix of domination describes how different forms of oppression intersect and reinforce each other. It refers to how systems of oppression, such as racism, sexism, heterosexism, ableism, and classism, intersect and create complex and interconnected forms of oppression that affect individuals and groups differently (Hill, 2002). It highlights how these different forms of oppression cannot be understood in isolation but must be examined as part of a more extensive system of power and inequality. It emphasizes the importance of understanding individuals' multiple and intersecting identities and experiences and the need for social justice movements to address and challenge all forms of oppression.

> One characteristic feature of this domain is its emphasis on large-scale, interlocking social institutions. An impressive array of U.S. social institutions lies at the heart of the structural domain of power. Historically, in the United States, the policies and procedures of the U.S. legal system, labor markets, schools, the housing industry, banking, insurance, the news media, and other social institutions as interdependent entities have worked to disadvantage African-American women. For example, Black women's long-standing exclusion from the best jobs, schools, health care, and housing illustrates the broad array of social policies designed to exclude Black women from full citizenship rights (Hill 2002, p.277)

Understanding the matrix of domination is crucial for advancing social justice and equity. It requires us to recognize how different forms of oppression intersect, create complex and intersecting systems of power and inequality, and develop strategies that address these interlocking systems of oppression comprehensively and holistically. It also requires us to center marginalized individuals' and communities' voices and experiences in our efforts to challenge and transform oppressive systems.

Costanza-Chock highlights the need to work with community groups, activists and others already involved in tackling the issues to which any techno-social object is designed to address, with the reasoning that any designer is very unlikely to be the first person to have identified a problem. Wherever there is a problem, there are likely to be people acting on it in some fashion. Therefore, the critical starting point for any design intervention is engaging with these pre-existing actions and working to develop a rich understanding of what people are already doing. This can be done by identifying and building relationships with key stakeholders in the community who are involved in addressing the issue that the techno-social object is designed to address. This might include community-based organizations, activists, educators, health care workers, or other groups. Once the relationship is established with key

partners it is important to listen to their perspectives and learn from their experiences by gathering data to better understand the issue and the community's needs. Through co-creation workshops or other participatory design processes, a rich understanding of the community's needs and perspectives is developed. This is especially important in identifying likely forms of contextually-appropriate technology use. Costanza-Chock points out that many effective forms of new technologies and technology-based practices are first imagined and initiated within marginalized communities, activist groups and other social movement networks. Paying attention to how people have already developed technology products and practices 'on the ground' is therefore crucial. The benefit of working with community organizations, social movements and local activists lies in the opportunity to explore resistant, subversive and oppositional forms of technology appropriation.

As Costanza-Chock puts it, 'Resistance Is Fertile.' Technological innovation can often arise from how lay people 'misuse' systems and appropriate technologies for alternate purposes and generally bend the rules and expectations of how technologies can be used. As such, "...those whose needs have long been marginalized within the matrix of domination have a strong information advantage when it comes to anticipating those needs and developing possible solutions" (Constanza-Chock 2020, p.111). That said, designers must enter knowledge exchange and ideas ethically and respectfully. Design justice is not a case of designers looking to appropriate, borrow or steal ideas. Instead, design justice involves designers working with marginalized design practices, attributing fairly and collaborating with lay people as genuine co-designers and co-owners. Technology design has a shameful history of co-opting resistant practices and stripping them of their political intent (as has been the case with the mainstream adoption of hackathons, hack labs and maker spaces as one example). Instead, designers should strive to support the existing ideals of grassroots innovation, convivial tools that promote human autonomy and creativity, alt-tech, and other forms of locally relevant and 'socially useful production.' As Costanza-Chock concludes: "The most valuable ingredient in design justice is the full inclusion of, accountability to, and control by people with direct lived experience of the conditions designers claim they are trying to change". (Constanza-Chock 2020, p.25) Accountability in design can be achieved by involving diverse stakeholders in the design process, creating transparency around decision-making and power structures, and using participatory methods to ensure that the

voices and needs of marginalized communities are heard and valued. It is crucial to evaluate and reflect continuously to ensure that design solutions continue to meet the needs of the communities over time.

Design justice compels designers to explicitly acknowledge and work to counter collective disadvantage and discrimination. This requires designers to move away from the temptation to adopt an approach that deliberately sets out to ignore issues – as is the case with 'colour-blind' or 'gender-blind' design or buying into the logic of 'individualized equality' or 'symmetrical treatment.' In contrast, design justice does not aim to eliminate bias and unfairness somehow but actively and intentionally address it. As Costanza-Chock puts it, "racial hierarchies can only be dismantled by actively antiracist system design, not by pretending they do not exist" (Constanza-Chock 2020, p.62). This suggests that designers should foster deliberately antagonistic relationships with issues of oppression. Rather than striving to treat all users as equal and attempting to erase differences and deny discrimination, designers need to explicitly identify disadvantage and oppression, call it out and act upon them. This requires designers to actively address issues of oppression in their designs.

Designers have a responsibility to address marginalization and oppression in their designs. This means moving beyond a focus on technical functionality and taking into account the broader social and political implications and engaging decisions, engaging with communities that have been historically marginalized or oppressed to ensure that their voices and needs are heard and incorporated into the design process. Design justice frameworks guide designers seeking to prioritize equity and inclusion in their work.

Design justice explicitly urges designers to adopt social justice values, to work against the unequal distribution of design's benefits and burdens, and to attempt to understand and counter white supremacy, cis heteropatriarchy, capitalism, ableism, and settler colonialism (Constanza-Chock 2020, p.68).

Design justice emphasizes the importance of co-creation in design processes, particularly with communities often excluded or marginalized. This co-creation approach challenges the traditional top-down design approach that often fails to consider the needs and experiences of

those most affected by design. In addition, co-creation can help build trust and understanding between designers and communities, leading to more equitable and just outcomes.

Collaboration and Co-creation

Educational theorist Ronald Barnett explores what it means to learn for an unknown future (Barnett 2012, p.2). Barnett suggests that traditional learning models are ill-equipped to prepare students for an unknown future. They tend to emphasize acquiring knowledge and skills rather than cultivating broader capacities such as creativity and innovation. Instead, he proposes a new model of learning that emphasizes the importance of "epistemological reflexivity" or the ability to reflect critically on our assumptions and beliefs.

Barnett suggests that by developing these broader capacities, we can create a new paradigm of learning better suited to the challenges of an unknown future. He argues that this paradigm must be co-created by learners and educators and constantly evolve in response to society's changing needs.

Barnett describes context through the notion of super complexity. A super complex world is characterized by uncertainty, unpredictability, contestability, and changeability, and its complexity arises from a multiplicity of frameworks. Barnett notes that the future has never been known but that the sense of the unknown has never been vivid.

What does the super complex world, with its multiplicity of frameworks, mean for design? How are the platforms, approaches, and design processes shifting to meet the needs of this changing world? The Global Agenda Council for Design Innovation recognizes that the complex environment in which we live requires that we “...constantly readjust our mindsets to tackle its dynamic forces and describes design and innovation as drivers for a creative and sustainable future” (WEF 2013, p.15). To address future global challenges, the Council asserts that design and innovation must “...act as systems of collaboration that encourage inclusive, accessible, multifunctional, and sustainable ways of thinking.”

Collaboration is the process of working together to achieve a common goal. It involves sharing ideas, resources, and responsibilities and the willingness to listen to and consider the

perspectives of others. Co-design aims to create more relevant, effective, and sustainable solutions by considering the stakeholders' needs, priorities, and experiences. Under *Designing for the 21st Century Research Initiative*, Tom Inns identifies six emerging roles for designers, including a facilitator of thinking, a mediator between stakeholders, a coordinator of exploration, a visualizer of intangibles, a navigator of complexity, and a negotiator of value. However, a role under-explored in the literature is that of a co-creator. (Inns 2021, p.xxx)

In the book Massive Change, Bruce Mau and Jennifer Leonard describe the future of global design as fundamentally collaborative. (Mau 2010, p.3). Designers and design firms must play an active role in developing tools and cultures to support collaboration. Addressing design in public and social innovation, Mulgan suggests that designers "need to recognize that they are most likely to achieve their best within teams bringing together complementary skills." (Nesta 2014, p.2). In describing emerging roles for design, Young views design as an "inter-discipline" in terms of its ability to mediate opportunities, interpret meaning and increase capacity across disciplines.

In a 2022 study by The National Centre for Collaboration in Indigenous Education (NCCIE) called *A Community First Approach to Indigenous Research,* it was reported that collaboration could have a significant positive impact on student achievement, particularly for students from disadvantaged backgrounds. Collaborative practices, such as shared decision-making, professional learning communities, and cross-functional teams, were associated with increased student achievement and engagement. This research shows that collaboration improved teacher satisfaction and retention, providing opportunities for professional development, support, and teamwork. In addition, the study found that collaboration can improve school culture by promoting trust, communication, and a shared sense of purpose among staff and students.

Collaboration in developmental activities is critical in fully serving their intended target audience. In development work, collaboration can involve different actors such as donors, non-governmental organizations, governments, and community members. When these actors work together, they can bring different perspectives, expertise, and resources to a project, leading to more effective and sustainable outcomes. We often see tools being designed without the end user who is only brought in for user testing or implementation. By involving

end users as co-creators, developmental tools can be built upon the rich knowledge that is cognizant of all local practices and cultures.

Gameplay for Teamwork

Constance Steinkuehler et al., in *Games, Learning, and Society: Learning and Meaning in the Digital Age* highlight the diverse range of applications for learning through games. The articles showcase examples of games that teach various subjects, including science, mathematics, and social studies. The articles highlight the potential for games to engage learners in critical thinking, problem-solving, and collaboration. In *Quest Atlantis*, the player learns science by moving through the game world to specific locations and engaging in explicit inquiry activities at those locations (Steinkuehler et al. 2012, p.280). In the game, players play the *Atlanteans*, who explore a virtual world and complete inquiry-based missions and quests related to science, social studies, and other topics. For example, in one of the levels, players investigate a fictional oil spill and must work together to clean up the spill and prevent future disasters. The game incorporates social elements into the gameplay by letting players communicate with each other and virtual characters through a chat system, to collaborate on missions and quests.

Playing for Keeps is a program that uses games and sports to promote social inclusion and positive youth development. To engage in pre-existing actions and develop a rich understanding of what people are already doing, the program works with community groups, youth organizations, and schools to identify local needs and opportunities. They then collaborate with local partners to design and implement programs that are tailored to the specific needs and interests of the community. Programs like Playing for Keeps can be powerful tools for promoting diversity and inclusion in schools and communities, encouraging students to explore and celebrate their differences. In addition, promoting positive interactions between students from different backgrounds can help create more inclusive and welcoming learning environments.

> The reason we started [Playing for Keeps] was that we saw games as a form of youth media, that they are just another form of communication that young people are experiencing all the time as consumers and that we wanted to put them in the spot to see what would happen if they were the creators. - Barry Joseph, 2010

Elisa Mekler in *Towards understanding the effects of individual gamification elements on intrinsic motivation and performance*, investigated the effects of gamification elements, such as collaborative gameplay and competition, on players' intrinsic motivation and performance in games. The results suggest that gamification elements increase players' intrinsic motivation and game performance. Specifically, collaborative gameplay is found to increase players' motivation to continue playing, while competition is found to improve players' performance in the game.

In *The social and interactive dimensions of collaborative learning* Paul Kirschner argues that social groups are essential for collaborative learning because they provide opportunities for learners to interact, communicate, and share knowledge. They discuss various social groups, including small and more extensive networks involving multiple groups or organizations. Kirschner has argued that these groups can help support collaborative learning, particularly in small groups where individuals can work together to solve problems and share knowledge. He notes that such social interactions can be particularly effective when students are given straightforward tasks and roles to help structure their collaboration. In addition, when group participants believe that they understand each other, even if their understandings are incomplete, it can enhance social interaction. For example, when a speaker receives some indication from partners that they are not being understood, they tend to stop talking and silently explore their understanding allowing the listener to begin talking. This role exchange and the incomplete understandings are almost always potentially constructive in nature (Kirschner 2014, p.430). Kirschner suggests that social networks can support various learning goals, including problem-solving, creativity, and communication skills, and that they can effectively engage learners and promote learning outcomes.

In traditional game theory, games are classified into two main categories: cooperative and non-cooperative. Cooperative games are those in which players can form coalitions and coordinate their actions to achieve a joint outcome that benefits all of them. Non-cooperative games are those in which players act independently and choose their actions based on their objectives (Fudenberg 2005, p.3). Modern game theory is a continuation of traditional game theory, focusing on more complex and dynamic settings. It expands on the concepts and models of traditional game theory and incorporates new ideas and methods from other fields,

such as computer science, statistics, and machine learning (Easley & Kleinberg 2019, p.6). It is beneficial for understanding how behaviour evolves and how it is affected by the structure of the environment.

Easley & Kleinberg introduce game theory in the context of complex networks and social systems. In a cooperative game, players can form coalitions and work together to achieve a joint outcome that maximizes their collective welfare (Easley & Kleinberg 2019, p.320). Cooperative games can be used to model situations where players have a shared interest, such as negotiating a business deal or dividing resources fairly among a group. Venkatesh and Sanjeev in *A Non-Cooperative Model of Network Formation* talk about how in a non-cooperative game, players act independently and pursue their self-interest. Non-cooperative games can be used to model situations where players conflict with each other, such as in a competitive market or a strategic interaction between two countries.

Easley & Kleinberg cover cooperative and non-cooperative games and their applications in various fields, including economics, sociology, and computer science. They emphasize using empirical methods for studying complex networks while providing examples of how game theory can be used to analyze real-world data on social networks, such as the spread of information or the emergence of social norms. They use game theory to study the phenomenon of 'tipping points' in social networks, which occur when a slight change in the behaviour of a few individuals can lead to a large-scale shift in the behaviour of the entire network. Easley and Kleinberg explore the role of social norms in shaping behaviour in social networks and how game theory can be used to model the emergence and evolution of these norms. The authors provide examples of how social norms can arise from repeated individual interactions and how they can be maintained even without external enforcement mechanisms.

One such example is the iterative version of the prisoner's dilemma (Dawkins, 1989). In this game, two individuals are arrested for a crime and are given the opportunity to cooperate or defect. If both cooperate, they both receive a light sentence. If both defect, they both receive a heavy sentence. However, if one cooperates and the other defects, the defector goes free while the cooperator receives the heaviest sentence. Repeated interactions between the same individuals can lead to the emergence of a social norm of cooperation, even though defection would be the dominant strategy in a single round of the game. This is because individuals

who cooperate in the first round are more likely to be cooperated in subsequent rounds, leading to a mutual benefit for both players if they both cooperate.

A game that reaffirms collaboration can add a contrasting view toward traditional rural development practices. By following Sasha Costanza-Chock's ten principles under Design Justice, I aim to build a tool that alleviates the problems arising from following traditional rural developmental practices.

Related Projects

There has been a growing recognition of the potential of gameplay to promote collaboration and community-led practices in the design and development of sustainable communities. The following examples provide a brief synopsis of some of these approaches:

Placeable: Place-based learning is a game that encourages players to explore and learn about their local communities and environments. Players gain a deeper understanding of their local environments and challenges through gameplay. This can help create tools to facilitate community participation and collaboration in the design and development of sustainable communities.

One way to create such tools is by following the principles engrained in games like Grow-a-Game, which emphasize creativity and critical thinking. In addition, we can promote community participation and ownership in sustainable community development by involving local communities in the design process. This approach empowers community members to shape their communities' future actively and creates solutions grounded in local knowledge and expertise.

The Naranpur Express game designed by IRMA shares some similarities with the platform built as part of this research. It aims to engage community members in a collaborative and interactive problem-solving and decision-making process. The difference is that the Naranpur Express game is a board game played in an entirely physical setting. The tabletop game built as part of this research is designed to be played digitally and physically.

Placeable

Aaron D. Knochel in *Placeable: Place-based learning* discusses an educational approach emphasizing the importance of learning about and from one's local community and environment. Placeable is a an interdisciplinary approach to education that encourages students to explore concepts of intersectionality that focuses on three core constructs: seeking place-based knowledge to incorporate community assets that are relevant to the arts and humanities, using connective mobile making to allow for on-site rich media production, and employing co-design strategies to engage in the critical intervention (Knochel 2017, p.289).

The concept of Placeable is based on the idea that places are not fixed but rather are constantly being shaped and reshaped by the people who inhabit them. Placeable suggests that we have the power to shape our environments and create meaningful experiences that connect us to the places we live in. Placeable activates interaction design, qualitative research methods, and community asset mapping to intersect humanities inquiry with doing practices (Knochel 2017, p.289).

Knochel suggests that the process of co-design,

1. Provides political and social capital for stakeholders to have a voice in the design process
2. Break down barriers of designer/user, creator/audience, maker/thinker, and student/teacher; and
3. commit to collaboration as a process of refinement, revision, and reflection (Knochel 2017, p.294)

Fig. 1. Grid of images representing the placeable curriculum, this grid of images provides a survey of different co-design practices in mobile making, including prototyping, sketching, participatory asset mapping, critiques, and user-feedback sessions. Courtesy of Aaron D. Knochel and Amy Papaelias.

Placeable involves engaging with and exploring a particular place's unique features, history, culture, and resources through discussions and using this knowledge to address local issues and challenges. Co-design paradigms involve the participation of various stakeholders, including community members, in developing products, services, or systems. The involvement of community members in the co-design process can take various forms, such as conducting focus groups, surveys, interviews, or workshops to gather input and feedback on the needs and preferences of the target audience. By involving community members in the design process, educators and designers can gain insights into the unique characteristics of the local environment and culture and the needs and interests of the target audience.

Combining place-based learning and co-design encourages learning and engagement with one's local community by co-designing solutions to local issues. It emphasizes the

importance of collaboration, inclusivity, and empowerment in the design process and aims to create more equitable and sustainable outcomes.

Knochel work emphasizes the importance of engaging with local communities and environments in the design of educational experiences. By involving local community members, educators, and students in co-designing learning experiences, we can create meaningful and relevant educational opportunities grounded in the local environment's unique characteristics.

Grow-A-Game

Grow-A-Game is a co-design tool developed as part of the Values at Play project, a research initiative exploring how values can be incorporated into the design and development of digital games. The game facilitates values-conscious design and analysis of digital games.

A deck of cards is classified into Values, Verbs, Games and Issues. Two or more category cards are used to set the parameters of a design challenge (ex., How can simcity be modded to talk about global warming while affirming the value of equality?) The tool highlights how participants can explore values incorporated in the game's design. By using the game to evaluate the values that are promoted or explored in the game, designers and stakeholders can ensure that the game is aligned with their shared values and ethical principles (Belman et al. 2011, p.5).

Using the game as a co-design tool, stakeholders can share their perspectives and ideas, identify potential conflicts or ethical issues, and develop shared values that guide the design and development of the game.

An important takeaway for participants is that values are "at play" in mechanics and narrative/ representational elements. Games are comparable to other creative media, like literature and film, in that they embody values. (Belman et al. 2011, p.13).

Just as literature and film can express and promote certain values, such as honesty or justice, games can embody values through gameplay mechanics, narrative elements, and other design features. Games can express various values, from social justice to environmental

sustainability. By recognizing that games are a form of media that embodies values, designers can create games that align with their ethical principles and the values they wish to promote. However, they are distinct in partially conveying meaning through the rule-based systems that define their gameplay experiences.

Naranpur Express

Naranpur Express is a board game developed by India's Institute of Rural Management Anand (IRMA). It is designed to teach participants about rural transportation and logistics management complexities and the challenges farmers face in getting their produce to market (Naranpur Express, n.d.)

The game is set in the fictional town of Naranpur, where players take on the role of farmers and transporters. Players must navigate challenges like poor road conditions, limited transportation options, and fluctuating market prices. The game is designed to be played in groups of 5-7 players and can be adapted to different levels of complexity depending on the players' experience.

The game's objective is to transport goods from the town to the market and make a profit. Players must make strategic decisions about which crops to grow, when to harvest them, and how to transport them to market. The game also incorporates elements of chance, such as weather events and unexpected equipment breakdowns.

It also seeks to simulate, under some simplifying assumptions, how decisions taken by large farmers influence the fortunes of small farmers and landless labourers. Finally, the game can also simulate the effects of interventions, such as those implied by the government machinery, on the rural poor and help to develop a better understanding of conditions under which such interventions would produce the best results.

The Naranpur Express game and this research share a common goal of empowering rural communities and involving community members in problem-solving and decision-making. By building on the insights and experiences of community members, these tools have the potential to create more inclusive and sustainable solutions to the challenges faced by rural communities.

The examples above highlight the potential of gameplay to promote collaboration and community-led practices in sustainable community development. This thesis research is informed by games like Placeable that follow Place-based learning to allow players to gain a deeper understanding of their local environments and challenges, which can help facilitate community participation and collaboration in sustainable community design and development. Additionally, following the principles of games like Grow-a-Game can promote creativity and critical thinking in community members, allowing them to actively shape their communities' future and create solutions based on their local knowledge and expertise.

Games like The Naranpur Express inspire the development of the tabletop game designed as part of this research, as it aims to engage community members in a collaborative and interactive problem-solving and decision-making process. The use of gameplay can be a valuable tool for promoting community participation and ownership in sustainable community development, allowing community members to actively shape their own futures and create solutions that are grounded in their local knowledge and expertise.

Methodology

Research through Design (RtD) was selected as a methodology for my research project as it emphasizes the importance of design and prototyping in generating transferable knowledge. By creating prototypes and constantly refining them through an iterative process, we can gain insights and knowledge that can be applied to other contexts and situations. This is particularly useful when dealing with complex and ill-defined problems, such as promoting positive social impact through human-computer interaction (HCI), which is the focus of my research. In addition, mockups play a crucial role in my research process by allowing stakeholders to visualize and interact with the elements of the tabletop game, map, and other design elements before they are fully realized. This can help identify potential issues or areas for improvement before investing significant resources into implementation.

By using co-design workshops, my research looked to ensure that the tool has been developed with the input of those who will be using it and that it addresses the needs and challenges of the community more inclusively and equitably. Co-design workshops encourage creative collaboration, where all stakeholders are considered creative contributors

to the design process. The workshops are rooted in participatory and user-centred design and aimed to involve stakeholders in the fuzzy front end of the design process. By involving participants in ongoing dialogues and discussions, the research continued to refine and improve the tool's design throughout the development process.

By building a hybrid physical and digital game, the research offers unique advantages over purely physical or digital games. In my research this hybridity has been aimed at providing a more immersive,interactive and persistent experience than purely physical games, allowing players to interact with tangible objects and materials. Digital game elements can also incorporate real-time data gathering or multimedia content to enhance the gameplay experience. In the context of community development and sustainability, hybrid games can uniquely engage community members in problem-solving and decision-making. They can provide a fun and engaging way to explore complex issues facing communities while maintaining a tangible and interactive connection to the physical environment.

Research through Design (RtD)

Research through design is a methodological approach foundational for practice-based inquiry to generate transferable knowledge. At the heart of research employed in RtD is the design and development of prototypes that serve as tangible manifestations of research ideas, concepts, and hypotheses. It brings the design process into part of research that produces different forms of knowledge (Zimmerman 2007, p.493). In this approach, the designer’s output, usually prototypes, contributes to the knowledge outcome. These prototypes constantly undergo an iterative, trial-and-error process of experimentation. The process of experimentation works by having the designer create a sequence of prototypes in steps, with each piece of information gained informing the next decision and, at the same time, addressing different parts of the research question.

In *Research through design as a method for interaction design research in HCI* Zimmerman acknowledges the struggle of academic institutions that have attempted to integrate design with technology and behavioral science in support of HCI education and research. Zimmerman talks about the pitfalls of not having a research model that integrates design and research. “While there has been great excitement about the benefits of integrating design, we

quickly realized that no agreed-upon research model existed for interaction designers to make research contributions other than developing and evaluating new design methods." (Zimmerman 2007, p.494). Zimmerman talks about the lack of a unified vision of what design researchers can contribute to HCI research and proposes a model of interaction design research designed to benefit the HCI research and practice communities along with evaluation criteria based on Frayling's research through design (Frayling, 1993).

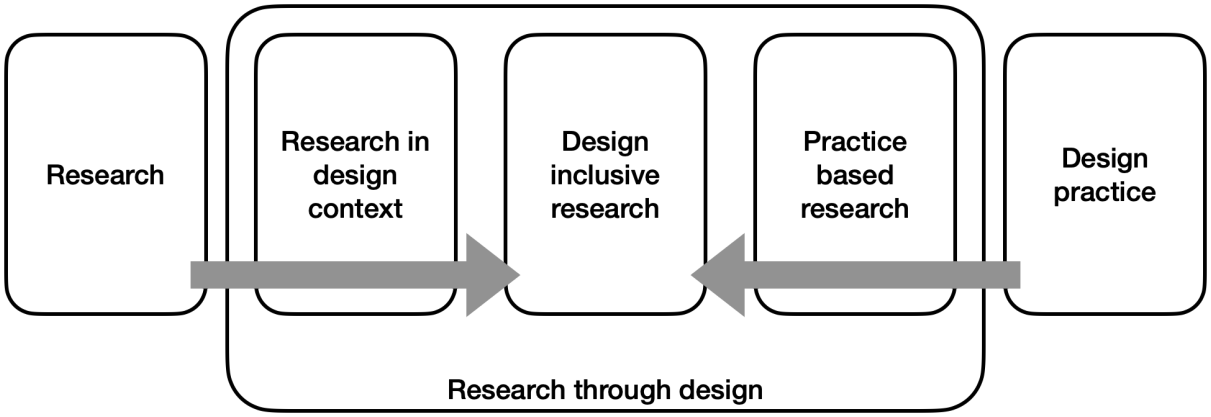

Fig. 2. Research through design model

In this model, interaction design researchers engage wicked problems in HCI that are complex and often ill-defined problems that are difficult to solve due to incomplete, contradictory, and changing requirements like in the case of promoting positive social impact through HCI involves considering the ethical and social implications of design decisions, such as the impact on marginalized communities and the environment. The designers integrate knowledge from other models and theories with how knowledge arises from the technical opportunities that engineers demonstrate. Through an active process of ideating, iterating and critiquing solutions, design researchers continuously reframe the objectives as they continue to solve the more significant wicked problem. Interaction design researchers can create works that provide concrete embodiments of theory and technical opportunities if they follow Zimmerman's model. "Through exposure to the ideas in the artifacts, the practice community can more easily observe the value of different theories, models, and technology, and this motivates them to follow the threads back to the original research that most impact their work." (Zimmerman 2007, p.498). The output from these interaction design researchers becomes an appropriate conduit for transferring HCI research to the practice community.

This model results in a holistic research contribution that reveals the framing of the problem and the balance the researchers have made between the intersecting and conflicting perspectives. The idea of contributing as a whole closely resembles the work of systems engineers in HCI who focus on building whole systems.

The importance of this methodology in this research is that it allows for rapid prototyping and experimentation. In addition, this method allows for testing different configurations to find what best works for the tabletop game to serve as a base for further co-design with research participants to address both conceptual and pragmatic design goals to achieve a shared vision and purpose while maintaining practicality and usability.

Mockups

A mockup is a prototype that demonstrates a feature(s) of a system or product concept in an abstract, high-level way. Although mockups may only approximate a system's or product's actual physical behaviour, they are instrumental and may be more practical in some stages of development (Otto and Wood, 2001). Techniques in this category (storytelling, vignettes, cartoons, and amateur videos) can also be more holistic and touch on several points simultaneously (Blomkvist and Holmlid, 2010). They can also incorporate the designer's play-acting usage scenarios (and components) by the designer, such as IDEO's bodystorming (Buchenau and Suri 2000, p.424). Scenario methods can be enhanced with preconceived action prompts to guide the scenario or with requirements for quantitative observation, such as note-taking at timed intervals (Buchenau and Suri 2000, p.424-433).

Fig. 3. Paper mockup of OurOS platform

As part of the research, a physical card-based prototype was designed such that the mechanics of the game could be identified. The prototype involved coloured cards placed on a table to recreate a village environment. Wooden blocks were resources for the participants to contribute to the board. Challenges and solutions were written on yellow card sheets.

Scenarios can be explored through a narrative to achieve novel predictive modeling results. The designer constructs a narrative to introduce the design to various potential future scenarios (Grimshaw and Burgess, 2014, p.5-14). This method enables an immersive experience of the design that might be otherwise impossible (Roberts and Middleton, 2014, p.15-28), as well as encourages precognitive analysis of the design's interaction with people and circumstances to make discoveries (Grimshaw and Burgess, 2014, p.5-14). It is effectively cognition-based usability testing.

Mockups can also represent a partitioned effort. For instance, paper mockups could represent the functionality of different design subsystems, e.g. software and hardware are each represented with distinct mockups (Yamazaki, 2009, p.367-373). Paper mockups were roughly equivalent to virtual prototypes for obtaining usability feedback in a software interface design experiment. Mockups may be particularly useful when capabilities do not permit the fabrication of a functional form or if modifications are desired from non-experts (Sefelin et al., 2003, p.778-779). An experimental study of website menu design found that paper prototyping encouraged meta-discussion of the grouping of menu topics (Slegers and Donoso, 2012, p.351-357). This may be because low-fidelity prototypes encourage high-level discussion, as only the basic concept is present (Wong, 1992, p.83-84).

In the case of this research, mockups played a crucial role in the process. They allowed stakeholders to visualize and interact with the elements of the OurOS tabletop game, map, and other design elements before they were fully realized. This helped identify potential issues or areas for improvement before investing significant resources into implementation. The mockups provided a tangible design representation and allowed stakeholders to provide feedback, ask questions, and suggest changes. Mockups helped create a shared understanding between the researcher and the stakeholders. As the participants interacted with the mockups, they were able to provide feedback on the usability and practicality of the design. This feedback was used to refine and improve the design, ensuring that it met the needs and expectations of the stakeholders.

Through this iterative design process, the OurOS tabletop game was refined and improved, resulting in a tool co-designed with stakeholders' input and better suited to serve the needs of the rural community.

Co-design

Fig. 4. Women discussing problems in a community in Guatemala

Co-design workshops are a space for creative collaboration. They are rooted in participatory and user-centred design and aim to involve stakeholders in the early phases of the design process — often referred to as the *fuzzy front end*. The phrase fuzzy front end refers to the initial phase of the design process, often characterized by uncertainty, exploration, and iteration (Smith & Reinertsen, 1991). The level of involvement can vary from informing the project to having the role of 'user-as-a-partner' in designing, based on the idea that everyone is creative. The emphasis is more on designing with the people than designing for the people. It is a tool for discovering and exploring opportunities rather than producing final solutions. It aims to start a discussion among stakeholders and guide design decisions, for example, by building concepts which inform what should be designed and for whom. Usually, design

practitioners facilitate co-design workshops by guiding participants through the design process and leveraging their expertise in the given topic.

The co-design workshops are a critical component of the community-led practices approach to sustainable community development. Drawing on the principles of Design Justice by Costanza-Chock, these workshops brought together all stakeholders in the design and development process, including community members, development professionals,, and other relevant actors. The goal of the workshops was to create a space for participants to engage in open dialogue and collaboration, fostering a sense of ownership and shared responsibility for the development of sustainable communities.

One of the key features of the co-design workshops was their informal and relaxed setting. The workshops were designed to take place in a comfortable space that encourages participants to relax and enjoy the process of exploring solutions. By creating a safe and inviting environment, the workshops aimed to promote a sense of openness and trust among participants, which can facilitate more effective collaboration and problem-solving.

During the workshops, participants used game tiles to recreate their lived environment, providing a visual representation of their community and its challenges. This activity served as a starting point for participants to identify their challenges and aspirations for a developed community space. By working collaboratively and engaging in ongoing dialogue, participants were able to identify key challenges and opportunities for their community.

Once the challenges and aspirations had been identified, each one was translated into a playable game card that required contributions from all participants. This approach encouraged group decision-making and collaborative action, promoting a sense of shared ownership and responsibility for the development of sustainable communities. Through this process, participants were able to explore innovative solutions that are grounded in local knowledge and expertise.

The co-design workshops recognized that the participants were the specialists and experts of their own experience and environment. By engaging community members in ongoing dialogues and discussions, the workshops aimed to foster a sense of agency and

empowerment, encouraging participants to take an active role in shaping their communities' future.

By engaging all stakeholders in the design and development process, the co-design workshops promoted a sense of shared ownership and responsibility, these workshops created a space for innovative solutions that are grounded in local knowledge and expertise. Through ongoing dialogue and collaboration, participants are able to foster a sense of agency and empowerment, contributed to the creation of sustainable and resilient communities.

OurOS

The purpose of this research project is to co-create a physical game with participants within their rural community so that they can use the game design process to identify problems in their vicinity and establish clear goals for building a sustainable community. Participants are able to explore the current state of education, health, sanitation, environment and finance in their community, and thereafter they would be able to create a plan of action that is widely understood and acknowledged by all community members.

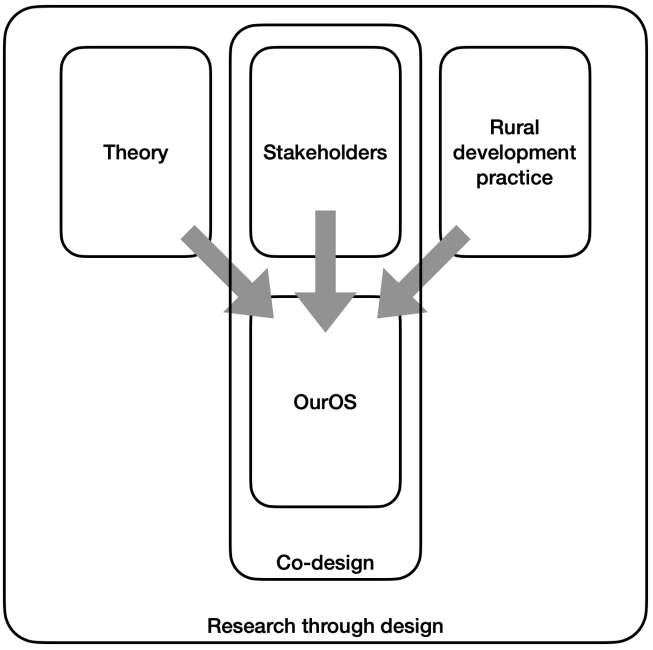

Fig. 5. OurOS following Research through Design method

This was done through a co-design gameplay workshop, where participants:

1. Utilize game elements to create a community map.
2. Create game elements (challenge cards and solution cards) while sharing information about their community and their utilization of resources.
3. Play test the game to refine the challenge and solution cards and create a documented action plan.

In Guatemala and Senegal, ten participants each were shortlisted from an applicant pool comprising diverse socio-economic backgrounds with employment in farming, trading, labour, education and medicine.

The hypothesis has been that physical tabletop games provide flexibility and allow sharing of knowledge, thoughts and ideas by creating a channel for visualization and imagination. One of the key advantages of using tabletop games is the ability to create a channel for visualization and imagination. By engaging in these games, participants can explore complex topics and visualize potential outcomes, making it easier to develop actionable solutions. This can be particularly valuable in communities where there are limited opportunities for collaboration and communication. Physical tabletop games can be used to address a range of issues related to education, health, sanitation, environment, and finance. Games can be used to facilitate discussions on improving educational outcomes, developing sustainable solutions for waste management, or improving access to financial services. These games provide a platform for participants to develop a common understanding and collaborate on solutions. By working together, individuals from diverse backgrounds can contribute their perspectives and expertise, leading to more inclusive and effective solutions.

The use of physical tabletop games offers a promising approach to community development and collaboration. By creating a space for visualization and imagination, these games can help to identify and address complex issues, leading to more inclusive and effective solutions.

Research Design

A community-elected representative (an informal role and not part of the formal governance processes of the country) was chosen as a source for a village-level survey that helps the research inform the challenges faced to serve as a comparison. The community practices appointing village elders as their representatives when any developmental agency wishes to discuss with the community members. The representative chosen is one of these elders who practices farming and other trades. This representative is well aware of all customs and is often sought out to learn about the culture.

For the game-play workshops, people were invited into the community space to participate in the events. All members gathered in the community space were aware of the people who apply to be participants. All members were aware of the contribution they make to the thesis study, in order to reduce social risks. It was communicated that the study is not evaluating their contribution to the development of the village but is to understand how collaborative action is perceived by them, how it can be facilitated to take better decisions and impact developmental activities at large. This was done through several discussions during the invitation process and during the start of every game-play workshop event.

OCAP principles were practiced to handle any data that was primarily collected in four instances (village-level survey, Pre-tabletop development survey, game-play workshops, and Post-tabletop development survey). It was established that the community owns any community-related data that was collected post-appointment of the representative. It was also established that the community continues to own the data and can access it from the workplace beyond the thesis study. Data that is generated from the game-play workshops would also be available to access by all community members and that in-order for the participants to access any data collected and generated, it would be printed in a softbound book format in English and Spanish.

The OurOS game is designed with a design justice perspective that prioritizes the inclusion of marginalized voices and the co-design of solutions with community members. The game's design justice framework ensures that marginalized design practices are included, and lay people are seen as genuine co-designers and co-owners. The use of a community-elected

representative in the village-level survey and the involvement of village elders in discussions with developmental agencies are examples of how local knowledge and perspectives can be incorporated into decision-making processes. The use of participatory research methods, such as game-play workshops, also helps to build trust with the community and ensure that community members feel comfortable participating in the research process. The community's ownership of the data and the availability of data in printed format in both English and Spanish also promotes transparency and accessibility.

Game Design

The OurOS game development process was based on a co-design approach that allowed participants to actively engage in the creation of the game. The prototyping process began with building a game board that could be used to map the participants' specific local community. The abstraction of physical location in the game board allowed it to be used in multiple locations in various ways, making it adaptable to the specific needs of different communities. The game world and other elements of the game were co-created with constant feedback from the participants, ensuring that their diverse perspectives and knowledge were incorporated into the game design.

If the participants felt that any changes in design or layout were required, they were immediately addressed in the next iteration to ensure the design justice framework was followed. This iterative process of co-design and feedback allowed for the game's development to be a collaborative effort between the participants and the designers, promoting a sense of ownership and empowerment among the community members. The game's design justice framework ensured that marginalized design practices were included, and that lay people were seen as genuine co-designers and co-owners.

By involving the participants in the co-development of the game, the OurOS game now belongs to the community. The participants have taken ownership of the process and continue to co-develop and use the game. This approach to game development is a powerful example of how technology can be reimagined to be used by marginalized communities. It highlights the importance of participatory approaches that empower communities to co-design and take ownership of solutions that are better suited to serve their needs.

Game World

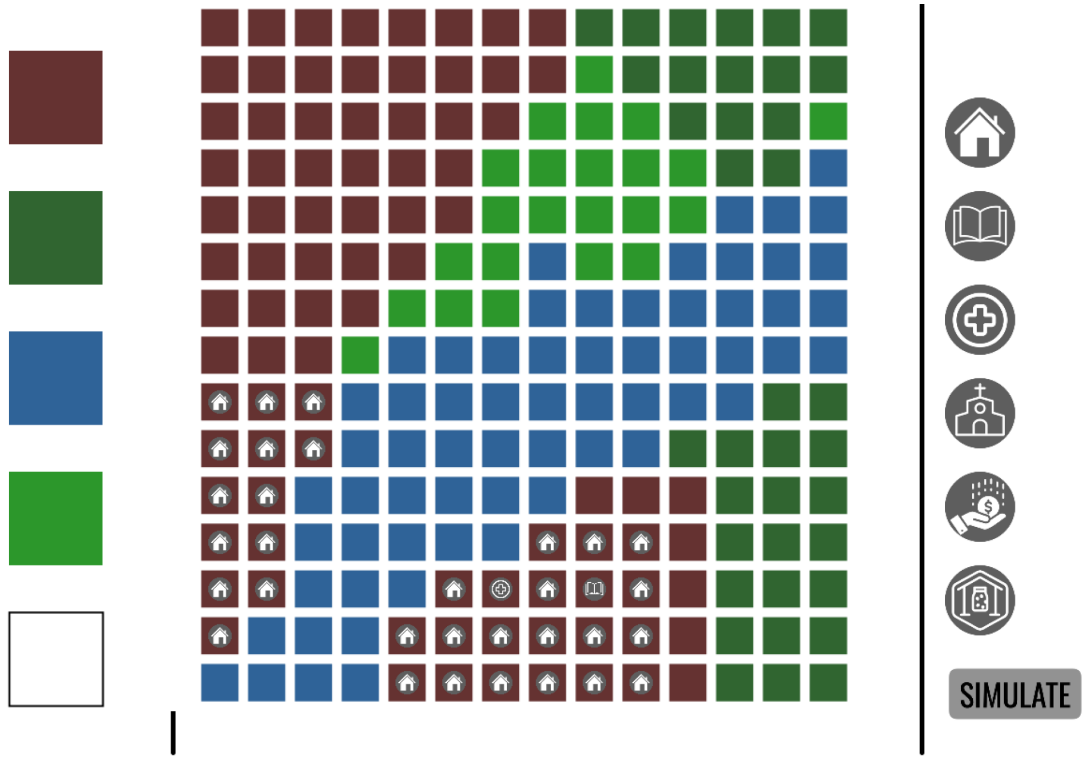

Fig. 6. Game World of OurOS

The tabletop game was coded on a tool called Processing, a free and open-source programming language and development environment for creating visual art, animations, and interactive applications. (Processing, n.d.). A digital interface was created instead of a physical board since the objectives of the OurOS platform is to ensure the knowledge generated during playing is capturable. Although a physical board could have facilitated discussions to yield similar problem identification and solution generation results, the data could have been lost once the session ended. As part of future works, the objective is to also facilitate collaboration between multiple communities across different linguistic and cultural borders.

The game world of this mapping tool - mocked up as a game board - is designed to represent the community, focusing on natural resources, infrastructure, and the challenges faced by the community. Players are engaged in designing and building a sustainable community by using game elements, such as selecting colours to represent resources and selecting infrastructure to place on the map. Players recreate a map of their community by picking a colour from the left column that indicates a natural resource. The red block represents land where participants can place their houses or other infrastructure. The dark green block represents forest cover, whereas the light green block represents agricultural land. The blue block can represent water bodies. The players can select any infrastructure, such as houses, schools, hospitals, financial institutions, seed banks, and churches, from the right column. Once the infrastructure is selected, the players can select any block on the map to place the infrastructure.

The digital turn-based game board simulation encourages player involvement and collaboration as they work together to address the problems faced by the community and design solutions that use the available resources. The use of physical cards with graphic designs provided players with the opportunity to express their interpretations of the challenges faced by the community and the solutions they envision. There are there types of physical cards–

1. Problem cards

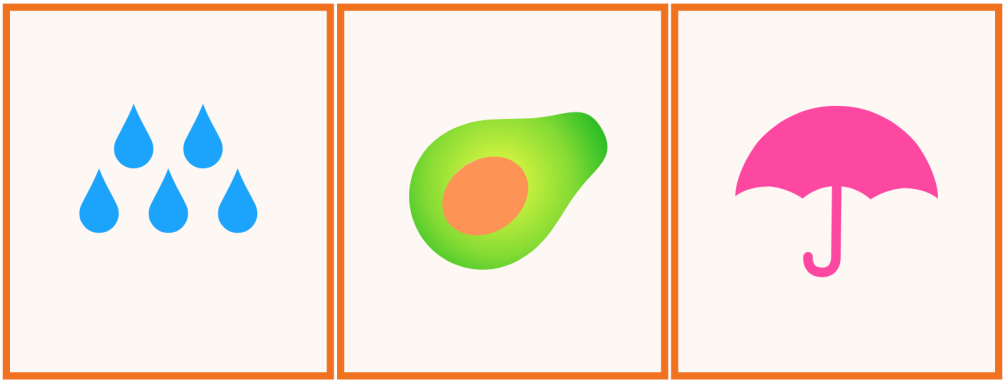

Fig. 7. Problem cards

These cards are graphic and allow for any interpretation by the players. For example, the first card with blue water drops could indicate that the community either faces an

abundance of rain that causes flooding or could also indicate that the community faces a lack of water, causing a drought.

The players are also given blank problem cards to take inspiration from sample cards to draw out their problems and add to the game.

2. Solution cards

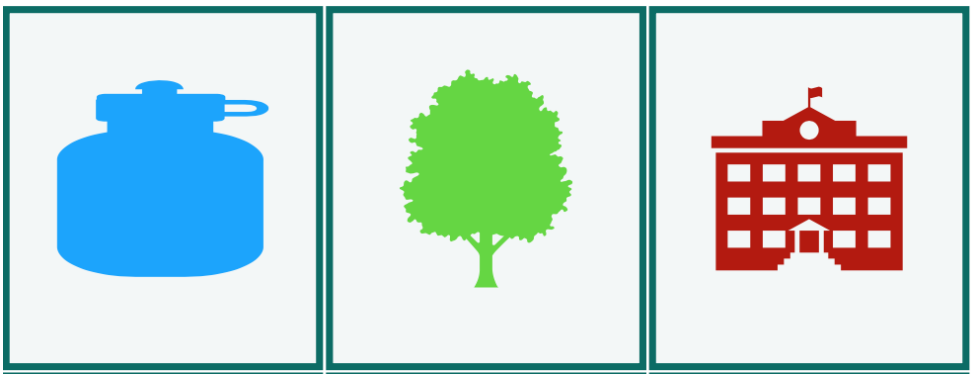

Fig. 8. Solution cards (Front)

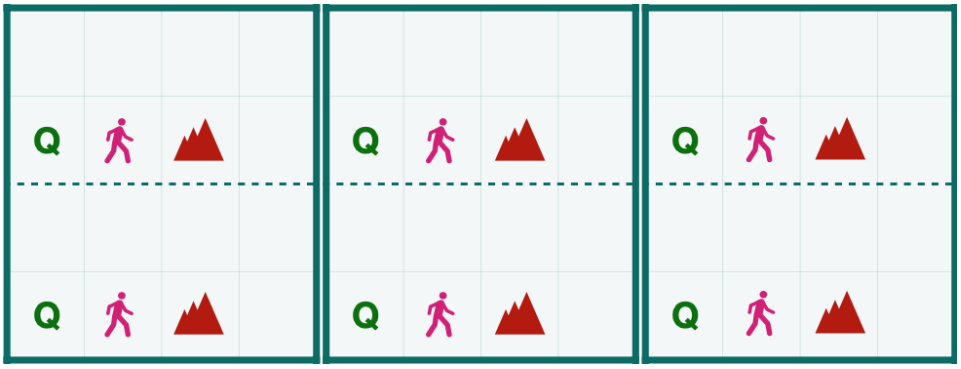

Fig. 9. Solution cards (Back)

These double-sided cards are used to design solutions. On the front side, the graphic allows for player interpretation. For example, the first card has a blue water bottle. It could mean that the players are looking at building a water tank on top of their houses or are collaboratively building a large water body in their community.

On the other side of the card, the players can list the resources the solution will require. Note that the fourth column is blank, indicating that the participants can design their resource card to fit into the solution.

Fig. 10. Filled Solution cards (Back)

3. Resource cards

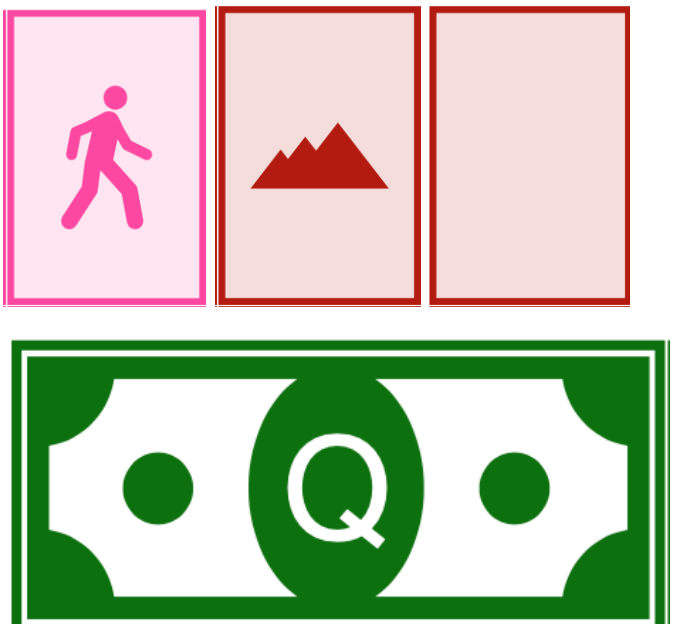

Fig. 11. Resource cards for work units, land, money and blank for player customization

These cards indicate each participant's resources - work units, land, money and a blank resource.

Game Mechanics

Having a mix of players with different skill sets can enhance the collaborative problem-solving process. For example, including players with expertise in fields such as, farming, technician, gardener, social development practitioner, etc., can provide different perspectives and skills that can contribute to finding effective solutions.

In addition to professional diversity, it is important to consider cultural and social diversity when selecting players. Including members from different cultural and ethnic backgrounds can help ensure that the game reflects the perspectives and experiences of the wider community. Players with different social backgrounds can also bring valuable insights into the unique challenges and strengths of their communities.

Players experience the game in simple steps as follows:

1. Players create their community map using the coloured blocks.
2. Players place infrastructure they recognize on the coloured blocks.
3. The session leader shows the resource cards and allows players to self-organize and distribute the resources as they deem fit.
4. The session leader shows the problem cards to the players and asks them if they face any problems. Then, the facilitator explains the presence of abstract images and how they can create their problem card if none of the samples are suitable.
5. The session leader highlights that collaborative action requires distributed resources and group decision-making.
6. The session leader facilitates group discussion so all players can voice their opinions.
7. The players create a priority list based on the problems they have identified.
8. The session leader shows the solution cards to the players and inquires whether any solutions fit their problems. Finally, the facilitator explains the presence of abstract images and how they can create their solution card if none of the samples are suitable.
9. The session leader facilitates group discussion so all players can voice their opinions.
10. The session leader now asks the players to value the solutions based on the number of resources they will require
11. The session leader reminds the players to create resource cards if needed.
12. The players now collaboratively decide the way forward for the community through acts of negotiation.
13. Once a group decision is made, then the solution card is placed in a suitable location on the map to indicate where it will be implemented.
14. This process repeats until all problems are resolved.

Each play session is expected to last over three hours to collaboratively design the community map, come up with the list of all problems, and their solutions.

Preparing for Play Testing

The playtesting research was carried out as follows,

1. Conducted a village-level baseline survey to understand the socio-economic conditions, challenges faced and opportunities realized by community members
2. Ten invited rural community members completed a pre-Tabletop game design survey
3. Ten invited rural community members participated in multi-day game-play workshops
4. Ten invited rural community members completed a post-Tabletop game design survey

Fig. 12. Women in Guatemala identifying resources needed for the solutions proposed

As a rural development practitioner, I have worked with non-profit and grassroots organizations to build curriculum, clean energy and agro-livelihood programmes in several global south countries. Based on this experience and professional relationships, I have identified Guatemala and Senegal as ideal locations for conducting these workshops.

Guatemala offers rich Mayan insights, and Senegal offers knowledge from displaced communities. The findings from the surveys and workshops are laid out further in page 53 of this thesis document.

For the play-testing workshops, a hybrid digital-physical interaction was constructed for the co-design workshops conducted at Batzul in Guatemala and for the women from Casamance in Senegal . It involved using a projector mounted on the side wall that projects onto a carpet on the floor.

Fig. 13. Play-testing workshop setup showing a projection of OurOS game world on the floor

Workshop 1: Guatemala

The first workshop was conducted in Batzul, a rural community in Guatemala primarily inhabited by the indigenous Ixil people, who are the descendants of the Mayan civilization.

People of Ixil

The Ixil culture, like other Indigenous cultures in the Americas, has been irreparably impacted by colonial subjugation since 1500 AD. To break from the feudal labour systems forcibly introduced by the Spaniards, democratically elected president Jacobo Árbenz Guzmán implemented land reforms in the early 1950s, resulting in an armed conflict (primarily funded by the United States) which raged throughout Guatemala from 1960 to 1996. (Handy 1988, p.4)

The Armed Conflict hit the Ixil region harder than others; 70% and 90% of Ixil villages were razed, and 60% of the population in the highland region was forced to flee. By 1996, it was estimated that some 7,000 Maya Ixil had been killed, and at least 29,000 had been forcibly displaced. In all of Guatemala, the conflict resulted in the deaths of at least 200,000 indigenous peoples. Since the armed conflict, the violence against the Ixil people has been tried in national courts and recognized as genocide (Ball 1999, p.32).

During the armed conflict, model villages forcibly formed by the Guatemalan military created new urban centers in the Ixil region. However, the region's economy remains predominantly agricultural, with small businesses newly present in the region's larger cities. In addition, climate change and lack of opportunities in the region have led to the recent widespread migration of Ixil people, primarily to the United States.

The invitation to participate in the workshop was given at a common community meeting where men, women and children were present. However, only women participated in the workshops at the time and place. The objective of this workshop was not only to test the prototype and co-design the game elements and storyline but to understand the Ixil way of thinking and to see if the tabletop game complements indigenous development principles - self-determination, identity, and resistance.

The current oligarchy completely rejects Mayan culture and its worldview. Demetrio Cojtí in *The Politics of Maya Revindication* notes, “To lay the foundation for assimilation, the mixed-race colonizer proposes, cultivates, and maintains projects in society as if development and modernization are what Guatemalans need. Such development and modernization

demand, as a pre-requisite, the death of Indigenous culture because, according to the colonizer, it is the cause of under-development among Indigenous Peoples and the cause of backwardness in the country as a whole." Additionally, the colonizer labels the indigenous as incapable and ignorant, disregarding their right to be different and their right to a decent life through conserving the sacred mother earth and vital natural resources such as water.

In the pre-workshop surveys, the participants discussed water being the fountain for all human beings' survival. They talked about how several indigenous community leaders have shed blood to defend it so that it would not be spilled out like a product to be bought and sold. The Ixil people consider water not only the fountain of life but also a living entity with its own rights, something intrinsic to Mayan spirituality. Regrettably, the right to protect and defend our practices and ideas regarding water is being privatized by governmental policies and laws that benefit the elitist economy. For example, mining companies use water as a resource by re-directing river flow for hydroelectric projects. Moreover, in other cases, they promote "friendly" projects whose underlying purpose is water appropriation privatization. This is a seriously worrisome issue for communities.

Deep-dive through play

The women participants of the workshop identified the control of mining companies and energy companies, and lack of water as their primary roadblock toward making their community sustainable. The women in their pre-workshop interviews highlighted that the environment is held close to heart. In traditional Maya culture, the natural world is seen as sacred and imbued with spiritual power. They talked about trees as living beings that provide essential resources and play an important role in the cultural and spiritual practices of the Maya people. They indicated that the community holds monthly meetings to discuss and solve their issues collaboratively. However, further inquiry indicated that men were primarily the discussion leaders and decision-makers while women agreed to the opinions of their husbands, fathers, brothers or sons. It was also mentioned that there was no practice of informally meeting other women in the evenings to discuss general life activities. It became clear that hosting the workshops for only women would bring out valuable insights that show

their thought processes and, more importantly, initiate a process for hosting informal meetings.

Since it was the women's first time working on a computer system, a brief introduction to using a mouse was given. The women started by colouring the blank tiles to indicate their house and neighbours' location. Any small mistake was not overlooked and was immediately corrected, indicating that the women wanted an accurate representation of their community space.

Fig. 14. Women in Guatemala co-creating a map of their community

As the map was being filled up, the women identified an issue of not being able to indicate terrain, which is a drawback of the current prototype and something to address in a future version.

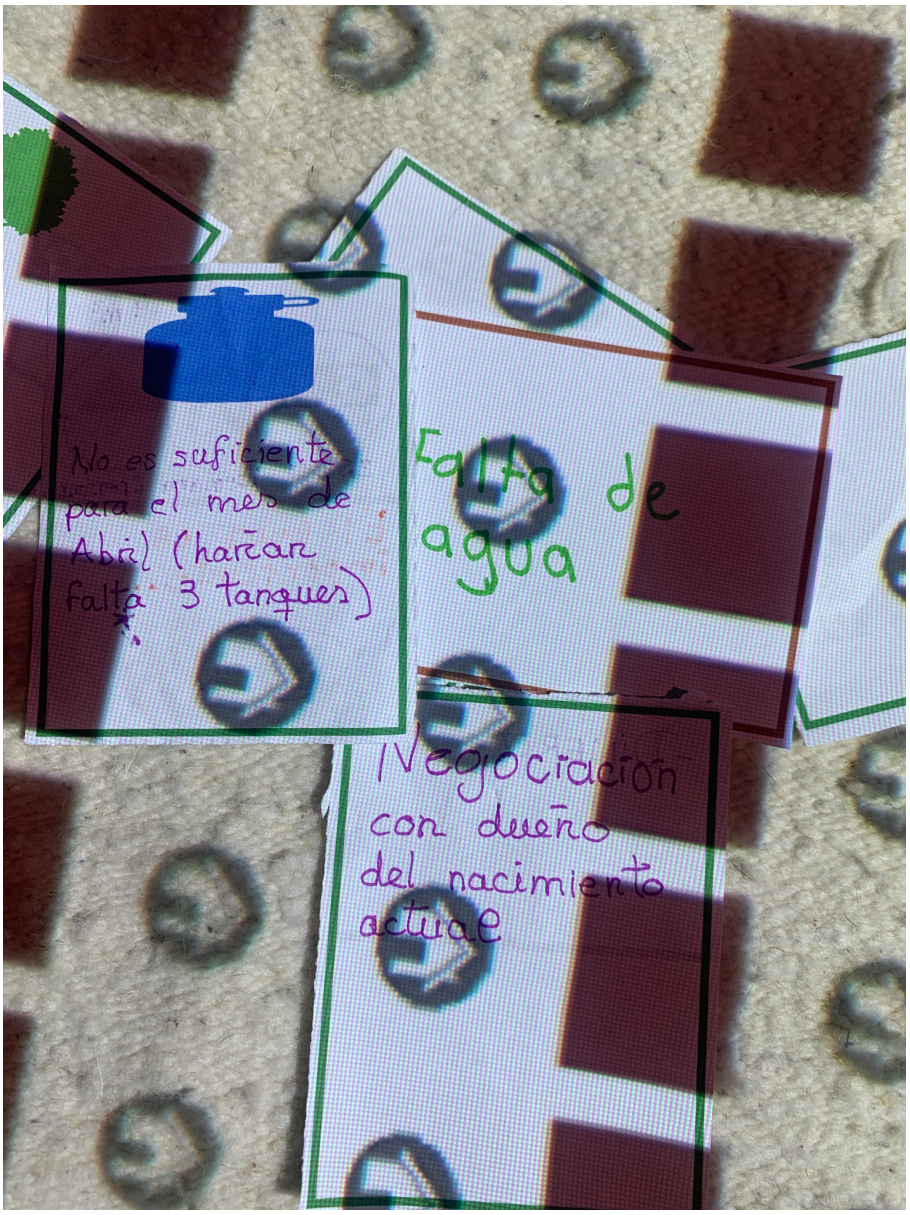

Fig. 15. Solutions identified to solve lack of access to water - Build water tanks

The women were led to discuss the community's problems when the map was complete. Among plastic waste, bad roads and other problems, lack of water was given the highest

importance as during the summer; they do not have enough water to drink, let alone to irrigate their crops. Next, they indicated the houses that could afford large water cans and could not. The discussed solutions to these problems ranged from petitioning the government to install a water line and installing a rainwater tank in each household. Negotiating money, labour units i.e. a standard measure of the amount of work performed by an individual worker in a given period of time, and any additional resources were done through the physical cards that were part of the tabletop game.

Based on the observations during the negotiations, it was clear that women primarily cared about the survival of all community members. It did not matter if all participants did not have the prerequisite money or labour units to achieve water independence. The women were ready to share their water systems with the ones who could not afford them and were even ready to share money and labour units with others.

In the post-workshop interview, the women talked about the ease of using the tabletop game to articulate the problems they face in the community, visually. They mentioned that several development workers visited their community before, to solve their problems and that they were never consulted on the design and implementation of the solutions. Using OurOS, they felt comfortable designing solutions that better suit their needs . In addition, they demonstrated the need for an interactive tool like OurOS to exhibit the needs of their community and their age-old wisdom constantly being used to solve their problems. Since the Ixil people have inhabited the area for a long time, they have a sense of connectedness with the environment. They understand how they need to treat the environment for their continued survival. Using OurOS, they could visually demonstrate their wisdom to people outside the community and seek help in the way they prefer.

It was observed that participants were initially hesitant to interact with the tabletop game projected on the floor using conventional input devices like a small mouse. With further training and encouragement, the hesitancy eased. The participants highlighted that their hesitancy could have been avoided if they could interact with the tabletop game through physical objects that feel more natural.

Fig. 16. Women keeping a version of OurOS game elements for their own use after completion of play-testing workshops

Workshop 2: Senegal

The second workshop was conducted with the women of Casamance, a rural Senegal community primarily inhabited by the indigenous Diola people.

People of Diola

Casamance, Senegal, hosts a religious minority group called Diola (Jola). They make up only around four percent of Senegal's total population. Traditionally farmers, especially rice cultivators and traders, there has been an increasing tendency for Diola youth to migrate, at least seasonally, to urban centres. Many Diola practise traditional beliefs, while others are Christians, and a smaller number are Muslim. Christians and Muslims often mix those rites with traditional beliefs.

Many Diola sold into slavery in the 17th century were taken to Britain's American colonies, where they were prized for their rice-growing skills. During and since the colonial period, Diola's traditional culture and beliefs were eroded by Islam, Christianity and Western education. During the colonial and early independence period, Casamance was a distant and neglected region under pressure from Wolof's cultural dominance in Senegal (UNHCR 2017, p.1)

Several movements for the independence of Casamance from Senegal developed in the late 1960s and 1970s. A few separatist groups emerged in the early 1980s, spurred on by new government policies that transferred some traditional lands of subsistence farmers in Casamance to northern Muslims of Wolof, Serer or Peuhl ethnicity for use in growing cash crops. In 1982, mostly Diola Casamance separatists formed the Mouvement des Forces Démocratiques de Casamance (MFDC).

From 1981 to 1989, Senegal and The Gambia formed the Senegambia Confederation, which allowed Diolas and others in Casamance to trade out of the Gambian capital, Banjul. However, when the confederation collapsed over Gambian fears of Senegalese dominance, farmers in Casamance were once again required to transport their products for sale to Dakar.

The MFDC developed an armed faction called Attika in 1992, sometimes operating from bases in Guinea-Bissau. In the 1990s, it generally harassed Senegalese security forces and launched attacks on airports. Another faction called Front Sud, primarily composed of Diola youth, laid ambushes for troops and civilians. Sporadic violence between separatists and Senegalese security forces, between many cease-fire agreements, resulted in civilian deaths and frequent refugee flows, usually into Guinea-Bissau and The Gambia. Over the years, the conflict has killed hundreds with thousands displaced. However, Casamance continued to produce most of Senegal's main staple, rice, and crops for domestic consumption and export.

A faction of the MFDC under Salif Sadio opposed a peace agreement reached between its political leadership and the government of Senegal in 2004. In March 2006, this faction fought with the military of Guinea-Bissau, and by July 2006, was fighting in Casamance against the main faction of the MFDC, resulting in the deaths of over 100 rebels. Government troops entered the fray against Sadio's faction the following month. At the end of the year,

President Wade pledged amnesty for the rebels and new development assistance for the region, but low-level violent skirmishes continued throughout 2007. A rebel ambush in December 2007 killed the President’s peace envoy to Casamance. The Diolas of Casamance continued to live with the threat of sporadic violence on land that has increasingly been strewn with landmines.

The separatist struggle in Casamance -- generally of low intensity but with periodic spikes of violence -- remains West Africa's longest-running civil conflict. Unexploded landmines in the fields and the aftermath of forced displacement due to fighting have damaged families' economic and social prospects. In addition, they have contributed to refugee populations in the Gambia and Guinea-Bissau, urban migration, and food insecurity in Casamance itself. In some areas, untended fields have been salinized by seawater; as a result of these factors, despite being Senegal's most prosperous agricultural region, Casamance has also displayed the nation's highest levels of hunger. Moreover, efforts to help those displaced in the region in past decades to either return to their villages and rebuild or permanently resettle are often underfunded, piecemeal and hamstrung by those with vested interests in seeing the conflict drag on.

Thoughts of displaced daughters

Fig. 17. Women in Senegal designing problem cards for their community

The eight women who took part in the workshops had experienced displacement due to the ongoing civil conflict, leading to food insecurity as they moved around the region. At the start of the workshop, it became clear that their planning approach differed from that of the Ixil indigenous women who had been settled in the area for a long time. As the mapping tool was placed on the ground, it subtly indicated to the women that they were required to create a map with a top-down view. The women however went ahead with drawing their houses using a first-person perspective.

Fig. 18. Women in Senegal discussing solutions for their community

In contrast to the women of Ixil, who focused on specific challenges such as water scarcity, the women of Diola, due to their history of displacement and the need to focus on their survival brought attention to a broader systemic issue. They recognized the interconnectedness of food, water, energy, education, and health, all of which they had been grappling with for many years.

Their strategy began with addressing food insecurity as the primary concern. They acknowledged that access to clean water was essential for growing healthy food and promptly discussed and devised a solution for achieving water independence. This involved setting up rainwater harvesting tanks in each household and constructing a community-level pond to serve as a water reservoir for their crops.

Once they had resolved their water access problem through negotiations and discussions facilitated by the game cards, they shifted their focus to planning fruit gardens to meet their basic nutritional requirements and ensure a healthy society. They also prioritized establishing schools for children and ensuring that everyone had access to food, demonstrating their commitment to building a thriving community.

Charter of Development

Rural areas are a complex web of social, political and historical factors and processes in which various actors attempt to achieve outcomes commensurate with their aims (Terluin, 2003). To overcome frequent mismatches that arise in practice between activities and rural development goals and priorities, a key factor is the acquisition of relevant knowledge from local stakeholders, which is usually embedded and tacit. The OurOS game adopts participatory approaches that represent an opportunity to incorporate the perspectives and priorities of the local people, reducing the risks associated with uncertainty and imperfect knowledge. In line with this idea, the European Commission (2014) encourages the Community-Led Local Development (CLLD) approach that focuses on integrated area-based strategies for specific sub-regional territories. This approach is community-led because it is delivered by Local Action Groups (LAG) made of representatives of local public and private actors. In the instance of OurOS, Local Action Groups are primarily composed of women.

The added value of public participation lies in the ability to generate insights for the design of policies fitting the needs of those concerned. This depends on the possibility of sharing and completing the fragmented knowledge made available by each stakeholder to achieve a common view. Public participation or ‘public involvement’ is understood in different forms that vary in participant interaction and involvement level. For example, it could refer to processes that only facilitate a ‘one-way’ flow of information or, in contrast, to more interactive processes that facilitate a ‘two-way’ flow. This last form can provide opportunities for discussion and deliberation and to reach the common ground (Patel et al., 2007).

Interactive participation, such as when the participants can engage directly with each other and the researchers or decision-makers, seeks to enhance the confidence of stakeholders so to

enable them to define, express and analyze their reality without reflecting the opinions of the more robust, more dominant voices (Patel et al., 2007; Wilson, 2013).

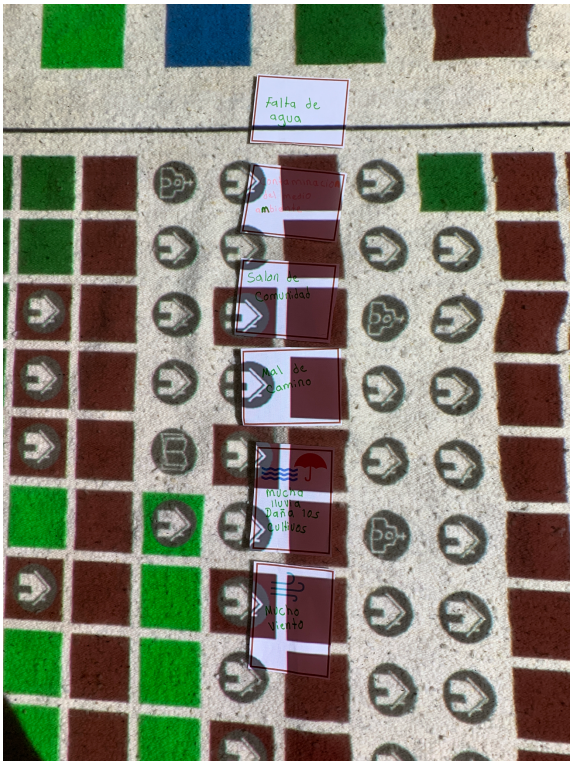

Fig. 19. A preliminary charter built as part of the workshop conducted in Guatemala

This preliminary OurOS charter was captured during a play session with the women from Guatemala. It captures the priorities that the women assigned for their community's problems. It talks about how lack of access to drinking water is their main goal following by environmental pollution, a community meeting room, trash management, flooding and high winds during the rainy season. They created these problem cards based on a common understanding between all the players. Using OurOS, they felt comfortable designing solutions that better suit their needs and they could visually demonstrate their wisdom to people outside the community and seek for help in the way they prefer. This is beneficial for developmental activities as agency for community members is established through this bottom-up approach.

The OurOS charter is a set of guidelines or principles that are collaboratively agreed upon and developed by the participants of the game. It represents a tangible representation of the

participatory approach taken in OurOS, where local stakeholders are given a voice in the decision-making process and are empowered to take ownership of the solutions that are developed. The charter serves as a visual summary of the solutions that the community members have developed during the game and outlines their key priorities, values, and commitments in relation to a specific rural development issue.

Fig. 20. Women in Guatemala negotiating with money and work units to fulfill a solution

During an OurOS play session, the steps taken to identify problems and potential solutions through discussions, negotiations, and decision-making are documented through screen capture for the preliminary user-testing study. These steps are indicative of the potentials of interactive public participation, which aligns participants with what was discussed and how it was discussed, providing valuable context behind every decision to help them wholeheartedly follow the chosen solutions. The charter, which is a photographic capture of the game world when players place problem and solution cards on the table, provides an easy-to-understand graphic depiction of the solutions that all community members can follow. It is their charter,

which they have come up with, that they will use to convince others to work for the common goal and to garner external support.

Observations

Working with stakeholders from diverse backgrounds is essential for a successful rural development project. The workshops clearly show that although the proposed solutions could have been more innovative, they were the people's solutions being worked on for a long time. Costanza-Chock highlights that the critical starting point for any design intervention is engaging with these pre-existing actions and developing a rich understanding of what people are already doing.

Costanza-Chock's design justice framework involves designers working with marginalized design practices, attributing fairly and collaborating with lay people as genuine co-designers and co-owners. By following this framework, when the participating women were given agency, they exhibited a solid connection to OurOS. They did not see it as a random tool that any random developmental organization would use to identify problems. Instead, they saw it as the tool they designed and wished to keep it with them to continue building upon the framework they created.

The OurOS game provides a participatory approach for rural community members to co-design and play a tabletop game to identify problems in their vicinity and establish clear goals for building a sustainable community. The game encourages open and democratic communication, allowing community members to share their perspectives, experiences, and knowledge, which can help identify issues that may not have been evident before. During the game, community members discuss and negotiate potential solutions, enabling them to work towards common goals that address the identified issues. The game's charter serves as a tangible representation of the community's values, priorities, and commitments, outlining the agreed-upon solutions and providing a framework for external support.

By engaging in acts of play and collaboration, communities can counter systems of power that have historically excluded and marginalized them. In the case of the OurOS game, rural community members are empowered to participate in decision-making processes and take

ownership of the solutions that are developed. The game's design justice framework ensures that marginalized design practices are included, and lay people are seen as genuine co-designers and co-owners. Through the game, community members develop a solid connection to the framework they created, enhancing their confidence and overall empowerment. The game also provides opportunities for teamwork, communication, and problem-solving, forming social networks that can support various learning goals, creativity, and communication skills.

Technology can be reimagined to be used by marginalized communities by incorporating a participatory approach that empowers them to co-design and take ownership of the solutions that are developed. This approach ensures that community members' diverse perspectives and knowledge are incorporated, enabling the design of solutions better suited to serve their needs. The OurOS game serves as an example of how technology can be reimagined to be used by marginalized communities. By providing a platform for rural community members to co-design and play a tabletop game, the game promotes open and democratic communication, enhances community members' confidence and overall empowerment, and establishes clear goals for building a sustainable community. Additionally, the game's design justice framework ensures that marginalized design practices are included, and lay people are seen as genuine co-designers and co-owners.

Prioritizing community co-design over development of game tiles became critical when it came to designing solutions that serve the needs of the community. As Design Justice framework highlights, it was essential to involve participant voices in the development of the platform, which aims to promote sustainable communities. By prioritizing community co-design, the research ensures that the needs of the community are taken into account during the development process. This approach involves engaging with community members and seeking their input and feedback throughout the design process. By doing so, the solutions that are developed were more likely to meet the needs of the community and be well-received.

In the case of the OurOS game, involving community members in the design process through co-design and play provides a fun and engaging platform for community members to come together and share their perspectives. Through this process, they can identify issues, negotiate

potential solutions, and work towards common goals that address the identified issues. From the co-design research perspective, this was more important than development and testing of purely technological solutions.

Future Work

OurOS lies at the intersection of physical and digital space. It must stay at the intersection as it simplifies the interaction for rural community participants and helps amplify their knowledge through digitization.

The tool's versatility means that various individuals can use it, all eager to solve their community problems. Moreover, the social network allows OurOS to evolve into a tool that shares knowledge gathered from each rural community. As a result, community members can learn from each other's experiences and knowledge, amplifying their understanding and problem-solving skills.

As the platform evolves, future versions of OurOS must support cross-learning between communities. Every community has unique approaches to solving problems, and sharing them can help other communities find solutions tailored to their specific needs. First, however, the platform must overcome linguistic, cultural, and social barriers that may inhibit cross-learning.

OurOS must be designed to support cross-learning across linguistic, cultural, and social borders using visual aids to support communication, and ensuring that the game mechanics are intuitive and easy to understand. They can be designed to incorporate elements of cultural exchange, such as hosting traditional practices or knowledge by digitizing the hand-drawn cards. These features will ensure that community members can effectively share their knowledge and experiences, regardless of their background or location. This will also help build trust and understanding between communities, creating a culture of collaboration that fosters creativity and innovation. As a result, OurOS has the potential to be a powerful tool for rural communities worldwide, enabling them to share knowledge and work together toward solving their problems.

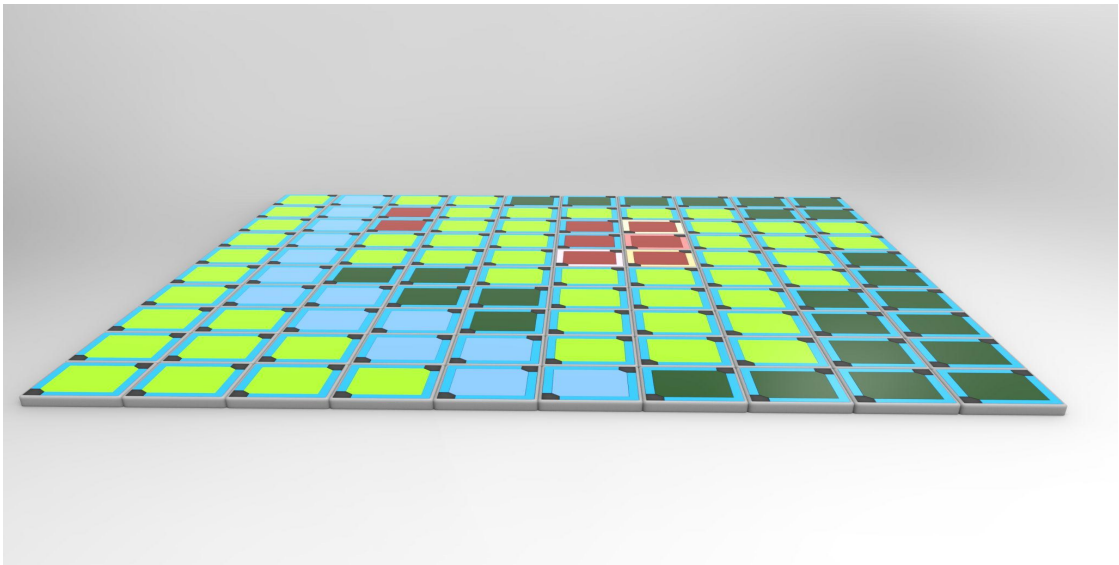

Fig. 21. A digital rendering of OurOS Tiles built as part of future works for real-time data gathering

OurOS, a hybrid physical and digital game, can incorporate real-time data gathering and host interactive multimedia content that could be a powerful tool for community engagement and problem-solving. The game could incorporate tactile elements that interface between the physical and digital worlds. The game could incorporate sensors or other technology to gather data on environmental or social issues in the community, such as air or water quality or community health indicators. This data could then be visualized in real-time within the game, providing players with a better understanding of the issues and helping to inform their decision-making.

Fig. 22. Prototypes of OurOS Tiles built for real-time data gathering and sharing

Game tiles were created as an original prototypes as they facilitate real-time data gathering. However, as the thesis research prioritizes participatory field testing, the game times were not fully developed and the focus was directed toward co-creating the OurOS platform. These tiles function through a decentralized mesh network with an LCD display indicating different natural resources. The tiles can detect their location relative to neighbouring tiles and record all movements within the game. This creates a system where all movements and actions taken by the game tiles are accurately tracked and recorded. With an external camera to record the interaction of players with the physical problem, solution and resource cards, the players can contribute to the game digitally.

Together, these features could help OurOS scale to work with several rural communities simultaneously. Communities would be able to talk to each other through OurOS to share problems and to co-design solutions with the experience of other communities. This could allow for more extensive data collection and analysis by the rural communities, strengthening their data ownership.

Conclusion

Co-design workshops that are participatory and user-centered involve stakeholders in the early phases of any design process. The emphasis is on designing with people rather than designing for them, and the workshops are a tool for discovering and exploring opportunities. Design practitioners facilitate co-design workshops by guiding participants through the design process and leveraging their expertise in the topic. In this research, the co-design workshops are designed to include all stakeholders in exploring solutions in an informal space where participants recreate their environment using game tiles. Participants identify their challenges and aspirations for a developed community space, and each challenge and aspiration is translated into a playable game card that requires contributions from the participants. The participants are the specialists and experts of their own experience and environment. They participate in ongoing dialogues and discussions with other co-creators while identifying challenges and designing the game elements over several sessions.

The success of a rural development project requires such methodology while working with various stakeholders at multiple levels. OurOS, co-designed through workshops with rural community members, is at the intersection of physical and digital space and has the potential to be a powerful tool for rural communities worldwide. By following the design justice framework of Costanza-Chock and engaging with pre-existing knowledge of the community members, OurOS can better legitimize decisions that positively affect the democratization of problem-solving and the sustainability of plans. Furthermore, through play, OurOS can effectively promote collaboration and provide opportunities for teamwork, communication, and problem-solving by forming social networks.

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APPENDICES

Appendix A: Pre-Tabletop Game Development survey

Research creation involves exploring the stages of making, and this survey (audio-recorded) aims to understand how environmental, infrastructural and social factors influence game mechanics

Participant ID:

1. What is your relationship with the environment?
2. What are the current social norms in the community?
3. What is the status of the infrastructure in your community?
4. Do you feel the community members work collaboratively?
5. Do you think there is dependency among people in the community?
6. Have you played any games before? If so, what kind?

Appendix B: Post-Tabletop Game Development survey

This 60 min in-person interview (audio-recorded) will be conducted after tabletop game development to understand the collaborative action in the community and overall learnings.

Participant ID:

1. What did you find yourself enjoying most during your process? Why?
2. How long did it take to learn to use the game tiles?
3. How did the tabletop game impact your understanding of your environment?
4. What motivated you to think about solutions?
5. Do you understand others' points of view toward a problem or solution?
6. Do you feel you can collaborate with others to identify and solve problems?

7. What would you change in the tabletop game?
8. Do you think the activity was helpful? In what ways?

Appendix C: Village Profile Survey on Socio-economic conditions for the OurOS Game Research

Appendix D: Village Profile Survey on Socio-economic conditions for the OurOS Game Research

HAND FILL AND UPLOAD TO PORTAL

Data must be collected from the village headman/representative in presence of other members of the village.

To identify the overall socio-economic status of the Study Area including social structure, infrastructure, agriculture, education, health, access to resources and community organizations.
To understand the extent of problems identified and state of common action in addressing those problems.

Survey Date and Time	
Enumerator	
Village name	
District	

Section A:General Information on the Village

1	Participant ID						
4	Lineage of the village headman						
5	Lineage of the villagers	Matriarchal	Patriarchal	Both			
6	Population	Male		Female		Total	
7	Is the population increasing for the last 5 years?	Yes	No	No change			
8	Number of households in the village						
9	Ethnic group of the villagers		all	majority	some		
			some	minority			
			some	minority			

10 Religion of the villagers

	some	minority
	some	minority
	some	minority
	some	majority
	some	minority
	some	minority

11 Origin/history of the village

12 How far are the following facilities?

Primary School	In the village	kms from the village
Secondary School	In the village	kms from the village
Clinic	In the village	kms from the village
Market	In the village	kms from the village
Nearest Transport	In the village	kms from the village
Grinding mill	In the village	kms from the village

13 How many households have electricity at home?

All	Majority	Some	Few	None

14 What is the source of drinking water for the villagers?

15 How many boreholes are there in the village?		
16 How many shallow wells are there in the village?		
17 Are there problems on drinking water?	yes	No

18 If yes, please specify the problems

19 What are the main problems of the village?

20 What did people do to address the problems mentioned in Q19?

Section B: Land Use, Forestry and Agriculture

	Quantity	Unit
1 Village area		
Total village area		

Farmland		
Forest/woodlot		
Grazing area		
Non-arable land		
Others		

2 Does the village have a village/community forest? Yes | No

3 If yes for Q2, Area of the forest

4 If yes for Q2, what kind of trees?

5 If yes for Q2, How is the forest used by the villagers?

6 If yes for Q2, How is the forest managed? Committee | Rules | Penalty | Etc

7 If no for Q2, Was there a village/community forest before? Yes | No

8 If yes for Q7, How did the village/community forest disappear?

9 Is land erosion or landslide observed in the village?

Yes	No

10 If yes for Q9. how does it happen?

11 What are the crops mainly cultivated in the rainy season?

a	
b	
c	
d	
e	
f	
g	
h	
i	

12 What are the crops mainly cultivated in the dry season?

a	
b	

c	
d	
e	
f	
g	
h	
i	

13 How many households keep livestock?

a	Cattle		households
b	Goats		households
c	Pigs		households
d	Chickens		households
e	Others (specify:	)	households
f	Others (specify:	)	households
g	Others (specify:	)	households
h	Others (specify:	)	households
i	Others (specify:	)	households

14 What are the main problems of farming in your village?

15 Is flooding a problem in the rainy season?

Yes	No

16 If yes to Q15, what kind of damages do you have?

17 What did people do to address the problems mentioned in Q14?

Section C: Health and Education

1 What are the common diseases in the village? How many people have died in the last 3 years? How many people were severely affected in the last 3 years?

a			deaths		severely affected
b			deaths		severely affected
c			deaths		severely affected
d			deaths		severely affected
e			deaths		severely affected
f			deaths		severely affected

g			deaths		severely affected
h			deaths		severely affected
i			deaths		severely affected

2	How often people use healthcare facilities?	Frequently	Rarely	Never
3	Have there been any health related projects implemented in the village?	Yes	No	

4 If yes to Q3, what were they?

5	If yes to Q3, are the projects still active?	Yes	No	

6 If no to Q5, why were they discontinued?

7	Population of children		Boys		Girls
8	Population of school going children		Boys		Girls
9	How often do children go to school	Daily	2-3 times a week	One a week	Others

10 What are the problems faced by children not going to school?

11 What did people do to address the problems mentioned in Q10?

Section D: Organizations and Community Activities

1 What kind of organizations do you have in you village? Are they active?

a		Active	Moderate	Inactive
b		Active	Moderate	Inactive
c		Active	Moderate	Inactive
d		Active	Moderate	Inactive
e		Active	Moderate	Inactive

2 Is there (or was there) any project implemented in the village? (Apart from ones mentioned in Section C, Q3)	Yes	No

3 If yes to Q2, what were they?

4 Do villagers form a group to apply for loans?	Yes	No

5 If yes to Q4, which organizations do they receive loan from?

a	
b	

c	
d	
e	

6 If yes to Q4, what is the main use of loans?

7 What kind of communal activities are (or were) the villagers engaged in?

Signature of Enumerator