

Using design thinking and Facebook to solve flood problems in remote villages of Morocco

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Abstract

Because of climate change, water levels in the Ourika river in Morocco have risen causing damage to infrastructure and the water supply system. Victims of these disasters must find solutions to adapt to these problems. Floods, like most environmental issues, are complex and malicious problems involving many characteristics, variables, increasing their level of

uncertainty. For these problems, there are no rules or list of operations that can facilitate the search of solutions. To solve an environmental problem, its structure and elements need to be defined and redefined in detailed and systemic ways. A creative approach and an effort to understand the short and long term impacts are recommended. How should groups of citizens be accompanied when trying to solve such complex environmental problems? A broad understanding of these problems and a feeling of self-efficacy must be present in problem solvers in order for them to persevere up to the formulation of effective solutions. Two new trends in problem solving inspire the development of approaches to accompany citizens dealing with environmental problems: design thinking and the use of ICT in problem solving. Design thinking, a creative solving approach created by IDEO, is a collaborative way to work during which intuition, abductive thinking, quick prototyping and the consumers' needs are put first. Design thinking which was first used to create industrial products is starting to be applied successfully to improve the quality of the environment. As for ICT, they can now be used to store, share, develop and criticize information and solutions (Facebook, Padlet...). These ICT can be useful for remote groups who want to gather their resources to solve their problems. Design thinking and Facebook were drawn on to accompany ten poorly educated Moroccan women in solving a problem arising from flooding of the Ourika river. The women were taught to use electronic tablets and Facebook. During workshops and through Facebook (when they were separated), women were invited to share their experiences with floods and to find solutions to one of their impacts. Participants quickly mastered these technologies and shared their experience with floods on Facebook with the help of videos and photos. They then chose to together solve the sub-problem of the poor quality of their drinking water, after floods. The thematic analysis of the conversations on Facebook and of the interviews with the participants reveal that design thinking allowed participants to explore many dimensions of the chosen problem and to prototype a certain number of solutions to purify their water. As for Facebook, it was used to share information about the problem (to better define it) and as a communication and brainstorming tool (before and during the water filtration prototype trials). Design thinking and Facebook turned out to be effective tools to pose the water problem more widely, to find solutions adapted to the participants' living conditions and to improve their self-efficacy in problem solving as well as their collaboration.

Keywords: floods, problem solving, design thinking, Facebook, Moroccan women

1. Introduction

Millions of people are currently feeling the impacts of environmental degradation. When confronted by floods or droughts, for example, they must find ways to mitigate risks to their health, their families, and their property. Through the work of subsidised projects, diverse organizations guide those people in solving the problems with which they are faced.

For instance, scientists working with social groups reflect on flood adaptation strategies. All of the contributors aim to help these groups recapture their quality of life and a healthy and viable environment. What is the best approach to facilitate the development of original, effective, and realistic solutions among victims of environmental problems? Indeed, external stakeholders have a poor understanding of the victims' experiences, context or the cultural and material constraints. A collaborative problem-solving approach imposes itself such that the issues must be defined and solved together by the affected persons and their guides. In addition, these complex and malicious problems encompass a wide range of characteristics (causes, area, actors, impacts..., Pruneau and Langis, 2015), interdependent variables (Jonassen, 2000), that change rapidly and increase their level of uncertainty and difficulty (Pourdehnad et al., 2011). For these problems, there are neither rules nor a list of possible actions that might facilitate finding solutions. Environmental problem-solving requires defining and redefining its structure and aspects in both detailed and systematic manners (Irwin, 2000; Thakker, 2012). A creative approach and an effort to understand the short and long

term impacts are recommended (Dos Santos, 2010). Indeed, **creative** problem-solving is vital in tackling global issues such as climate change, pollution, or environmental diseases. As mentioned by United Nations (2015) in their new Sustainable Development Goals (for 2015-2030), different practices are needed in today's world: renewable energy, efficient transportation, healthy cities, resilient agricultural systems, etc. Therefore, it is important to develop collaborative, creative, and effective approaches to help groups in addressing environmental issues.

To build these support processes, the literature offers two types of problem-solving approaches: the scientific approach by which we discover the laws that govern the natural world and, more recently, design thinking with which we invent a different future (Liedtka, 2000). The scientific approach calls upon inductive and deductive reasoning to solve closed problems such as researching the position of a star in a given annual period. In the scientific approach, problem-solvers are distanced from the object of study (Dos Santos, 2010). However, when solving complex problems such as identifying climate change adaptation strategies, it is necessary to add another competence: abductive thinking, which consists of imagining things that could work. Design thinking, during which the problem-solvers immerse themselves in the object of study's environment, calls upon inductive, deductive, and abductive reasoning. It would be productive in situations where there is uncertainty. In 2006, IDEO launched a creative problem-solving approach called *design thinking*. Since then, this approach of innovation, adopted by numerous corporations, fostered the development of efficient and original products: ICT applications (Apple computer mouse); engineering and scientific articles; educational innovation. IDEO also inspired the development of a number of creative problem-solving approaches: the Innovation Lab, Strategic Design, Transformational Design, Human-Centered Design... Design thinking is a creative and collaborative method of working in which intuition plays an important role, solutions are numerous, experimentation happens rapidly, failures are perceived as learning opportunities and, mostly, the needs of consumers are considered (Liedtka and Ogilvie, 2011; Lockwood, 2010). Design thinking applies the sensibilities and methods of the designer to complex problem-solving. Indeed, designers routinely deal with complex problems by generating various options that are progressively refined through testing. As part of a rigorous process, and with the use of well-defined tools, design thinking calls upon both creative and analytical thinking (Liedtka, 2015). It follows a number of defined steps: 1. Observation-inspiration: we conduct an ethnographic study to understand the individuals concerned with the issue and the situation. This is achieved by following them in their daily lives to better grasp their aspirations and unmet needs (pain points). 2. Synthesis: the problem is defined and redefined several times and in different ways. The goal is to uncover information and various perspectives on the problem. The information is synthesised to express the problem in concise statements and with the use of visual aids. 3. Ideation: we generate a number of ideas and select a certain number. 4. Prototyping: we quickly build prototypes to illustrate the proposed ideas and share them with others to evaluate their potential in both form and function. 5. Testing: the prototypes are assessed by gathering the opinions of experts, novices, and users. The winning prototypes are refined (Scheer et al., 2012). 6. Communication: we make the product known (Brown, 2009). Seidel and Fixson (2013) summarise the design thinking process in the following way: extensive research on consumer needs; brainstorming to generate a number of ideas; and, prototyping to test and select the best ideas. The steps in design thinking are not entirely linear since the focus of designers meanders between the problem and the solution while empathy for consumer needs deepens and the best solution is refined. The process – which is first divergent and then convergent – is centered on human needs. Prototypes that are developed quickly and without seeking perfection become “playing fields” that foster discussion and learning about certain solutions (Liedtka, 2015). As such, the problem and the solutions co-evolve (Dorst and Cross, 2011).

Design thinking – initially used to develop commercial products – is now used to foster human flourishing and environmental health. Among movements such as *Design for Life*

(Buchanan, 2001) and *Human-Centered Design*, and NGOs such as *IDEO.org* and *MindLab*, the focus is on developing processes favourable to quality of life and the eradication of poverty. Accompanied by these organizations, individuals grappling with these issues collaborate during some of the design thinking steps (steps 1 and 5, and sometimes more). The positive environmental transformation and humanitarian effort are thus recently at the heart of design. Because of the deductive, inductive, and abductive (imagining what *could* be) reasoning that places demands and potentiates the development of creative solutions, design thinking and its variations (Innovation Labs, Transformational Design...) may be useful as support processes for groups engaged in solving environmental problems (Pruneau and Langis, 2015). Indeed, Pruneau et al. (2014) have typically observed the presence of design thinking among numerous leaders in sustainable development.

Moreover, with design thinking, specialists now have access to technological tools that support citizens in problem-solving at times when they are remote. Indeed, there are current ICTs that might be used during different stages of problem-solving: to share opinions and information about a situation (*Stormboard*, *Narrative Clip*); to summarise information (*Popplet*); to consult experts (*Skype*); to propose and comment on ideas (*Padlet*); to vote (choose among ideas, *Loomio*); to sketch prototypes (*iDroo*); to plan (*Wrike*); and, to communicate (*Facebook*, *Glogster*) (Pruneau and Langis, 2015). Some research has demonstrated the potential of online brainstorming: quick, independent, and simultaneous sharing of ideas; motivation; time to reflect and allow ideas to ripen; creativity... (DeRosa et al., 2007). Digital tools used in design thinking have yet to be properly evaluated with respect to their ability to facilitate problem-solving in general or for environmental problems.

The strengths of design thinking could indeed be found in its deeper definition of the issue under consideration; in taking real customer needs into account; in its prototyping (which allows for the optimal development of ideas); and, in a better consumer adoption of the solutions found. Given its novelty, design thinking and its enablers have not yet been properly studied, particularly in collaborative environmental problem-solving. It is thus within the scope of this reflection on accompanying citizens facing environmental problems that an exploratory case study was led in Morocco with low education rural women grappling with devastating floods. Leveraging design thinking and Facebook as a networking tool, ten women from the Ourika region were accompanied in their research on adapting to the frequent flooding of the river. The two research questions that were asked were the following:

- *How could design thinking help groups define and solve environmental problems with which they are faced?*
- *How could Facebook facilitate collaborative environmental problem-solving?*

2. Methods

To answer the research questions within the context of the major GIREPSE (*Gestion intégrée des Ressources en Eau & paiement des services environnementaux*) project, an exploratory case study in Morocco was carried out with 10 women from the remote and impoverished Ourika region. The women were selected based on their reading and writing abilities (minimal) and hailed from six remote villages (Aghbalou, Timalizen, Amlougi, Oualmes, Tazitount and Setti Fatma) located in the Ourika region, approximately 35 kms from Marrakech. The regional economy in Ourika is based primarily on agriculture and livestock breeding. Industry and mining, tourism, and the arts also make up an important part of the labour force. Over the past few years, floods of the Ourika wadi have increased in frequency and intensity in conjunction with climate change. These floods have devastating effects on the landscape, agriculture, human capital (injuries, deaths), infrastructure (roads, bridges), and food security (water, food). The women, who are the family guardians while

their husbands work in Marrakech, are often tasked with confronting the floods and protecting their families and property.

The interventions with the women took place over a period of seven months, during which two minor floods of the Ourika occurred. The design thinking approach dictated the activities organised with the women, and Facebook was used for networking while we were away from the women. During the first two phases of design thinking (*observation-inspiration* and *synthesis*), individual interviews were conducted with the women to capture their descriptions of the major flooding problem and their needs in the face of disaster. A *Journey Map* visually representing their daily life before, during, and after a flood was prepared by our team of researchers. In preparing for floods, the women said they stored wood and food staples (wheat, oil, vegetables...) to avoid a shortage in the case of road closures. They lay plastic on the roof of their houses and filled the holes with dirt to prevent water leakage. Some dug small canals in front of the house to divert the current and prevent water from invading the house. During flooding, they moved family belongings to a room that was less prone to immersion, and some took their children and sought refuge with neighbours or acquaintances. Following the floods, they cleared the roads covered in rocks and dealt with problems in the water supply. Indeed, the sediment-laden water was placed in plastic jugs so the debris could settle at the bottom. After settling, the water was then consumed or used for other domestic purposes.

During the two initial two-day workshops with the 10 women in August 2015, the *observation-inspiration* and *synthesis* phases of design thinking were put to the test and facilitated in Arabic by a researcher from our team. The women were encouraged to complete the previously prepared *Journey Map* together and share their experiences of the flood. They were also trained on how to use tablets and Facebook. Next they chose to work on a smaller problem that was easier to solve: the quality of their drinking water following a flood. The exchanges on Facebook stretched from September to November with communication flowing through the social network between the women and our team about the underlying problem of post-flood drinking water. At the outset, the women were asked to post pictures, videos, and comments on Facebook about flooding (in general). Next, the women were asked specific questions in order to define the underlying problem of water quality after flooding: *Where? When? Why? Impacts? Solutions?* etc. The women were to observe the problem in their village and answer the questions using the tools available on Facebook: comments, videos, pictures... The women met again for the third workshop, held on one day in November 2015, to complete the *synthesis, ideation, prototyping, and testing* phases of design thinking on the issue of water quality. During this workshop, a summary of the facets of the drinking water problem and solutions proposed on Facebook was completed. Water collected from the wadi in the villages was then tested with the women for its quality: pH, coliform, bacteria, etc. The women were also invited to invent filter prototypes by using materials available in or around their homes: fabric, coal, plastic bottles, sand, rocks... They were also required to verify the filter's ability to purify the water. Following the third workshop, the Facebook exchanges resumed from November to January and planned according to the *prototyping, testing, and communication* stages of design thinking. The women tried to construct their own filters at home and shared their trials on Facebook so they could receive feedback from their peers. On Facebook, an overall assessment of the solutions identified concluded the exercise.

In order to address the two research questions during the design thinking process, individual and group interviews were conducted with the women, and their use of Facebook was analysed. During the interviews, the women were asked open-ended questions. Here are some examples: *Tell me about your experience with Facebook since the beginning of the GIREPSE project. What do you like about the Facebook group? What value do you feel is added by using tablets for the GIREPSE project? How do you feel the Facebook group helps in solving the problem of drinking water following floods?* etc. The data was subjected to a

thematic analysis carried out by two researchers, both individually and together. The emerging themes represented the women's views on the water problem, the quality of their solutions (using fluidity, originality, and effectiveness as criteria), the knowledge they have acquired, their emotions, their participation (active or not) in networking, their types of communication, their empowerment, and their collaboration.

3. Results and Discussion

First of all, it should be noted that the effects of the selected method (design thinking) along with Facebook might be difficult to differentiate as they are complementary tools. Table 1 shows qualitative and quantitative data on the women's participation in the Facebook network.

Table 1. Women's participation in the Facebook network

Month/ week	Total number of posts	Type of activity on the Facebook group (pictures, videos, text...)	Average number of comments per post	Average number of "likes" per post
August				
Week 1	3	Pictures and videos	2	4
Week 2	19	Pictures and videos	2	5
Week 3 up to the 31st	17	Pictures, videos, and text	1	12
September				
Week 1	3	Pictures, videos, and text	6	15
Week 2	4	Pictures, videos, and text	8	3
Week 3	4	Pictures, videos, and text	5	3
Week 4	13	Pictures, videos, and text	4	7
October				
Week 1	3	Pictures and text	9	3
Week 2	2	Text	10	3
Week 3	1	Text	25	4
Week 4	1	Text	10	3
November				
Week 1	1	Text	6	5
Week 2	2	Text	9	2
Week 3	Workshop in Morocco	Workshop in Morocco	Workshop in Morocco	Workshop in Morocco
Week 4	8	Text and pictures	1	5
December				
Week 1	1	Text	2	4
Week 2	3	Text, videos	6	3
Week 3	5	Pictures and videos	3	4
Week 4 up to the 31st	4	Text and pictures	4	3

January				
Week 1	10	Text, pictures, and videos	5	3
Week 2	9	Pictures and videos	5	6
Week 3	6	Pictures and videos	3	3
Week 4	5	Text and pictures	5	5

As demonstrated in Table 1, these women with low levels of formal education were for the most part able to take advantage of various tools available on Facebook – pictures, videos, text, comments, “likes” – and did so regularly. The posts with pictures and videos showing the reality of the two major floods were very popular.

During individual and group interviews, the women shared with us that the input from the other women and the facilitators helped them learn a number of things: learning how to use tablets and Facebook; gaining a detailed understanding of the problem with water quality; knowing what was happening with water in other villages; becoming aware of the poor quality of water they consume; having solutions; being able to choose better water sources; learning how to purify and conserve their water; and, gaining an awareness of what is happening in their country and in the world. With respect to communication, they mentioned feeling less isolated and part of a friendly network sharing news about themselves while collaborating on adapting to flood conditions. Indeed, when a flood is about to occur, women living upstream warn those living downstream of the incoming flood. The women also privately share their views on a range of local issues. On an emotional level and linked with empowerment, they mention how much they enjoy sharing their ideas with the group and being heard. They also state feeling motivated and capable of getting involved in solving other problems, such as the polluting behaviours of fellow citizens who toss their household refuse into the Ourika and ruptured drinking water pipes during floods. They would also like to pursue the approach initiated by the group to improve flood adaptation. Lastly, they enjoy sharing what they have learned with their families, friends, and fellow citizens from the village.

We noticed a growth in the way in which the women discussed and understood the major flooding problem and underlying water quality issue after a flood occurs. They now identify various aspects about the nature of the problem (the Why): “The floods arrive suddenly and take away everything in their path.” “The heavy rains and floods destroy the drinking water pipes in the villages.” “Water becomes unavailable. We must drink dirty water from the wadi or find other sources.” “After the floods, the water is highly polluted. Its colour and odour change.” “The traditional methods (purifying water by adding chlorinated water and allowing it to settle) are ineffective.” They are aware of several impacts due to flooding: “Despite its poor quality, residents use well-water for drinking and cooking. After consuming it, some residents – especially children and the elderly – suffer from fever, diarrhea, kidney and stomach infections, allergies...” They know about new causes of poor quality drinking water: “The floods carry rocks and sediment which dirty the water.” “People toss garbage on the riverbank. It is worse during tourist season and near restaurants. The garbage mixes in with the flood water.” Finally, they have a lot more to say about the aftermath of a flood: “After a flood, the water remains polluted for a week or more depending on the weather conditions.” “The pipes are left broken for about fifteen days.” “The water is dirty even after the pipes are repaired.”

This growth in their understanding of the problem-space seemed to directly influence the solutions they proposed on Facebook. Here are a few examples: “Find better water sources.” “Build a water storage structure to ensure delivery to residences.” “Treat well-water with appropriate quantities of chlorinated water.” “Raise awareness so people stop dumping garbage in the river.” “Build solid pipelines.” “Build wells far from the river and flood zones.” “Filter the water before it reaches the tap.” We notice that some of their solutions are aiming

to eliminate causes of the problem (proactive adaptation) while others are in reaction to the impacts of the problem (reactive adaptation), which demonstrates a deepened understanding of the problem that needs to be addressed.

In meeting the challenge of purifying contaminated water using handicraft filters made from household materials, the women built prototypes that turned out to be moderately effective (according to us). The prototypes built by the women made the water a lot clearer but did not necessarily eliminate coliform and bacteria. Here is an illustration of a typical filter built by the women using a plastic bottle, a sieve, coal, sand, stones, and fabric (see Figure 1).

Figure 1: Example of a filter prototype built by the participants



In this case, it turned out to be a significant challenge, given the poor variety of filtering materials available in the Ourika houses and given the limited scientific knowledge of the participants. However, the women claimed to be satisfied with the new filtration methods since, prior to this, they would simply let the water settle and consume it immediately, which was making the children sick. When the water becomes polluted during future floods, they claim that they will use these types of filters and these raw materials to purify the water. The filters as constructed do not entirely satisfy the research team but seem to please the study's participants.

4. Conclusions

In conclusion, we can assert that the approach used (design thinking + Facebook) allowed the women to define the major flooding issue and the underlying water quality problem in broad and detailed terms, based on their own needs. While not necessarily original, the solutions proposed by the women were varied (fluidity), realistic, and with a level of efficacy (according to them). The tablets and Facebook fostered the creation of a social network that was strong, engaging, and effective in defining and solving a local problem in a collaborative way. The women came out of isolation, learned to communicate their ideas, felt like others were listening, and collaborated well. Thanks to the social network and workshops, they learned a number of things such as the flow and precise locations of the floods, the causes, the impacts (both short and long term), the ways in which other women managed water, the quality of the water they consumed, as well as techniques to purify and conserve drinking water. Prototyping water filters seems to have motivated them to learn and act locally. The approach in general modified their water consumption behaviours. They established proactive and reactive adaptations to flooding: better choice of water sources; better water

filtering; building a support network; and, warning others when floods are arriving. Finally, the project fostered a sense of self-efficacy among the participants: they believe that together, they can make a difference in their way of life.

To deal with floods and their impacts, the women will need to gradually address other underlying problems related to flooding: ruptures in drinking water pipes; the behaviour of citizens who toss their garbage into the river; the possibility of deviating the water flow so that flooding bypasses villages... all of which demonstrate the significant complexity of environmental problems and the tremendous challenges when trying to adapt to extreme weather events caused by climate change. This project reinforces our opinion that solving problems linked to climate change requires a mentoring approach that is detailed, creative, and engaging that stretches over a long period of time since new underlying problems appear while trying to solve the primary one. Given the difficulty in solving environmental problems, design thinking facilitated by a Facebook group as demonstrated appears to provide good results and fosters numerous solutions, which are not perfectly effective, but improve the women's ability to adapt to flooding. According to us, in a country where women are largely unrecognised for their ability to solve problems, the combination of design thinking and Facebook allows the women to express themselves and be heard. However, we believe that the empowerment of our female participants still requires more time to be fully realised and perceived by their peers.

In this case study, Facebook was primarily used as a communication tool to share opinions, information, and solutions related to one issue. Future research should focus on discovering ways to leverage Facebook for other uses linked to problem-solving: summarising information, consulting experts, voting (choosing among different ideas), and planning tangible on-site adaptation strategies. This would bolster all steps of design thinking, which may result in original and more effective solutions. To increase creativity, other online brainstorming tools (*Padlet, Popplet, Mind 42, Loomio...*) might be used favorably in solving environmental problems, which was not possible in the current research given the novice ICT abilities of our participants.

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