**Pedagogical Uses of Design Thinking and Facebook to Help Moroccan Women Adapt to Floods Related to Climate Change**

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**Abstract**

In Ourika, a region of Morocco, floods, aggravated by climate change, carry many wastes that pollute the water of the wadi. Women, victims of this problem, must seek adaptation measures to prevent contaminated water from making their children sick (through consumption or bathing). A design thinking approach and Facebook were chosen to accompany, for three years, 12 Moroccan women little educated in the resolution of the problem of water and waste. Design thinking, which promotes user needs analysis, abduction and rapid prototyping, facilitates the formulation of effective and innovative solutions to human or environmental problems. In Arab rural areas, where women are less empowered, access to ICTs can improve their social status, their leadership and their participation in community and economic development. As for Facebook, this social media has the potential to facilitate the collaborative definition of a problem, the discussion and the development of solutions when the resolvers are at a distance. The purpose of the research was to evaluate the potential of design thinking and Facebook as approaches to education for sustainable development. Using videos, photos and comments, the participants, initiated with tablets and the Internet, shared in a Facebook group their experience of floods and then tried together to improve the problem of the poor quality of the water. Design thinking and Facebook have allowed women to explore several dimensions of the problem: the quality of the water itself and the abundant presence of waste found in the wadi. At workshops and in Facebook exchanges, women were invited to prototype and experiment with hand-held filters for water cleaning and waste reuse techniques, including making compost and jewelry (with plastic bottles). In final interviews, participants were invited to draw and comment on their experiences and impressions of themselves before, during and after the project. A bi-monthly table of women's Facebook publications was also prepared by a researcher and completed by two other researchers. The purpose was to enter participants' actions and inactivity and to qualify and quantify their publications: their presence on the group, the images and videos inserted, the types of comments, the emoticons and the "likes". A theoretical framework based on the objectives of environmental education (awareness, knowledge, state of mind, skills, participation) allowed two researchers to analyze women's Facebook exchanges throughout the project, as well as their remarks during individual interviews closing the project. According to them, the participants improved their «awareness» of the impacts of floods and waste. Their

technological, environmental and geographic «knowledge» has grown as well as their problem-solving «skills». Their «state of mind» evolved from a shy and unconfident attitude towards a feeling of self-efficacy and hope to get out of their financial difficulties, if they worked hard. Women have achieved the goal of «participation» in climate change adaptation by getting involved in effective adaptation measures: operating an electronic flood warning system, making hand-held water filters, making prototypes of compost and recycled jewelry and start their own waste reuse cooperative.

**Keywords:** adaptation to climate change, education for sustainability, Facebook, Morocco, design thinking

## 1. Introduction

Education for adaptation to climate change is a very specific area of environmental education (EE), especially when it comes to working with adults vulnerable to disasters. In 1977, UNESCO and the United Nations Environment Program (UNESCO-UNEP, 1977) identified learning objectives for environmental education. Whether working with students or adults, in EE, it is important to develop their awareness and knowledge (of the environment and problems), their attitudes (conducive to their commitment to improve their milieu), skills (that facilitate their engagement) and their participation, that is, their direct involvement in environmental action (in the field). In education for adaptation to climate change, these five types of objectives also prevail, in particular the one of «participation», since citizens affected by climate change must create and apply themselves adaptations to reduce risks ( floods, droughts ...) that threaten them directly.

How to provide educational support to citizens as they analyze local climate related problems, propose, test and implement adaptations? How to educate citizens to climate change while developing their awareness and knowledge of the problems of their environment, their willingness and ability to act and their tangible involvement in adaptation actions? Cognitively, the challenges of climate change adaptation education are important because of the complexity of the problems caused by climate situations. In addition, the high-level adaptation skills that need to be developed in citizens are numerous: problem-solving, systemic and forward thinking, creativity, communication, knowledge of accommodation and self-efficacy (Pruneau et al., 2012). On the emotional side, people affected by disasters may also feel isolated and helpless, which must be taken into account in this type of education. At the participatory level, citizens may not also have the financial or technological means to take action.

It is in the perspective of education to adaption to climate change that women from a rural region of Morocco, victims of floods, were accompanied for three years during the four stages of the adaptation process (Risbey et al., 1999): detection (realizing the need to adapt and choose the elements to adapt to and to ignore); evaluation (determine the consequences of the problematic situation); decision (choose accommodations) and monitoring (observe the effects of selected adaptation measures). The accompaniment of women had pedagogical intentions: to progressively develop their awareness and knowledge of floods and subproblems, their skills (problem solving, communication, etc.), certain attitudes (self-efficacy) and their tangible participation in adaptation actions. To achieve these educational goals, two intervention tools were chosen: design thinking (a creative problem-solving approach created in 2006 by IDEO, an innovation firm) and social media Facebook. The purpose of the research was to evaluate the potential of design thinking and Facebook as approaches to environmental education and co-creation of adaptations to climate change.

This paper reports on the educational experience of the Ourika women and analyzes its results in light of the objectives of EE: awareness, knowledge, attitudes, skills and participation. Theoretical frameworks on design thinking and the use of Facebook in community problem solving are first presented. The methodological tools of the research are then explained. Based on the analysis of the project's final interviews and participants' Facebook postings, the transformation process experienced by these women is then described in terms of action, non-action and other goals of EE. Action here refers to conscious and planned participation in the life of one's community (Chawla, 2008). The results describes how the women evolved in their knowledge (of floods, adaptations, digital tools), in their skills, in empowerment and in their community involvement. Through the educational process, these poorly educated women went from a poorly confident and unaware attitude of the causes and impacts of floods to come to the foundation of a cooperative that reuses local waste carried by floods. Reflections are finally proposed on the potentialities of design thinking and Facebook in education for adaption to climate change.

### 1.1 Design Thinking

To build approaches to support groups who address environmental issues, two types of problem solving process are available: scientific inquiry, with which we discover the laws that govern the reality of the current world and, recently, design thinking, with which a different future is invented (Liedtka, 2000). Scientific inquiry uses inductive and deductive thoughts to solve closed problems, such as searching for the position of a star at a given time. In the scientific approach, the solvers place themselves at a distance from the object of study (Dos Santos, 2010). On the other hand, to solve complex problems, such as finding adaptations to climate change, the addition of another type of thinking is desirable: abductive thinking or considering things that might work. Design thinking, during which the solvers immerse themselves in the environment of the object of study, calls on inductive, deductive and abductive thinking and would be productive in situations of uncertainty. In 2006, IDEO, a design and innovation firm, set up a creative problem-solving approach called design thinking. Since then, this approach of innovation, adopted by many companies, has allowed the creation of original products: ICTs (including the Apple computer mouse); science and engineering articles, etc. IDEO has also inspired the development of many similar approaches: Lab of innovation, strategic design, transformative design, human-centered design ... Design thinking is a creative and collaborative way of working during which intuition matters, solutions are numerous, experimentation happens quickly, failures are perceived as learning and, above all, the needs of users are taken into account (Brown, 2009; Lockwood, 2010). Design thinking applies the designer's sensitivity and methods to solving complex problems. In fact, designers are used to dealing with complex problems by generating various solutions that they test to gradually improve them. In a rigorous process and with specific tools, design thinking uses both creative and analytical modes of reasoning (Lietdka, 2015). It takes place in the following stages: 1. Observation-inspiration: an ethnographic survey is conducted to understand the people affected by the problem and the situation. People are followed in their daily lives to understand their aspirations and unmet needs (bread points). 2. Synthesis: the problem is defined repeatedly and in various ways. The solvers look for information and various perspectives on the problem. The information is synthesized to pose the problem in a few statements, using visual representations. 3. Ideation: many ideas are formulated and a number are chosen. 4. Prototyping: prototypes are quickly constructed, illustrating the proposed ideas in order to share these ideas with others and to assess their potential. 5. Tests: the prototypes are evaluated by looking for the opinions of experts, novices, users. Winning prototypes are refined (Scheer et al.,

2012). 6. Communication: the product is publicized (Brown, 2009). Seidel and Fixson (2013) summarize the process of design thinking as follows: thorough research of user needs; brainstorming to produce multiple ideas; and prototyping to test and choose the best ideas. However, the process is not linear as the designers' attention flows between the problem-space and the solution-space, while the empathy for the needs of the consumer expands and the winning solution is refined. Divergent then convergent, the process is centered on human needs. Prototypes, made quickly and without seeking perfection, act as "playgrounds" to discuss and learn about certain solutions (Liedtka, 2014). Thus, the problem and the solutions co-evolve (Dorst and Cross, 2001).
Design thinking, originally used to create commercial products, is now used to help the human and the environment. In such movements as Design for Life (Buchanan, 2001) and Human-Centered Design, and organizations such as IDEO.org and MindLab, practices that support quality of life are built. The positive transformation of the environment and humanitarian action are newly at the heart of design. Thus, by creating technically and financially feasible innovations that meet human needs, design thinking projects often result in solutions to a better future (von Thienen and Meinel, 2014).

In this research project, the design thinking process was chosen as a support tool for Moroccan women because of the high-level skills it can develop in participants: information seeking, empathy, creativity , communication, collaboration ... (Kho et al., 2015, Raut et al., 2010); and because of its construction of meaningful learning (Scheer et al., 2012).

### 1.2 Social Media and Facebook

In today's world, information and communication technologies (ICTs) are constantly evolving, playing an important role in access to information and its transmission. In developing countries, these technologies offer enormous opportunities and challenges, not only to accelerate their development, but also to fill the gaps and economic inequities between them and developed countries (Mason, 2006). Because of their ability to store, share and disseminate information and knowledge, ICTs have been identified as effective tools for achieving the Millennium Development Goals (MDGs) (Kiondo, 2007). In Africa, awareness of the importance of ICT has increased and the goal is to facilitate access for both women and men. For women and girls, access to ICTs could improve their social, economic and family situations (Palitza, 2007). In addition, the use of ICTs could improve the leadership and participation of rural women in community and economic development activities (United Nations, 2005). In terms of community development, ICTs offer many opportunities such as dynamic dialogues, collaborative actions and initiatives, debates and the creation of communities of practice (Beche, 2012).

Many studies have positioned social media as channels for harnessing communities' knowledge, capital and collective strength (Cheng et al., 2011, Beche 2012). Social media, visited daily by individuals, could offer new ways to organize and facilitate real-time collaboration and self-organization across multiple themes and to achieve a variety of goals (Nakki et al., 2010). These networks would also have the potential to redefine traditional methods of citizen participation, including collaborations on community issues. In times of crisis, social media could also enable previously powerless communities and actors to respond to challenges by collectively participating in solutions (Gaventa, 2006). By posting photos or publications of the crisis incident, "loving" or not, by following a participant, communities may be involved in responses to crises that were once exclusive to the authorities.

Traditionally used as a distraction and communication tool, in September 2017, Facebook was the most popular social media (Newsroom.FB, 2017). Beneficial for interaction, collaboration, information and sharing of resources (Wang et al., 2012), Facebook would also have educational potential (Luckin et al., 2009) The Facebook group is particularly popular and useful for discussions around common interests (Park et al., 2009). In Facebook groups, users form real communities of practice in which they seek to solve a common problem. In these virtual communities built on socio-cultural bases, each member contributes to the promotion of community well-being (Beche, 2012). A Facebook group would therefore have the potential to facilitate collective action, but real actions in the field are crucial factors that strengthen the group's self-efficacy. Actions show the tangible results of the digital discussions (Narozny et al., 2016). However, the use of Facebook, for public participation in community projects, is just beginning to be explored in research.

In this study involving Moroccan women living in geographically spaced villages, Facebook, and in particular the Facebook group, were chosen because of the education and community involvement benefits mentioned above and because of the limited funds available in the project, allowing only a small number of face-to-face meetings. The design thinking process was enriched by the Facebook group's exchanges when the participants were each in their village. From home, they could continue to define the flood problem, and propose, prototype and evaluate solutions.

## 2. Methods

### 2.1 The Design Thinking-Facebook Experiment

As part of the major project Integrated Management of Water Resources and Payment of Environmental Services (GIREPSE), an exploratory case study was conducted in Morocco with 12 women from the remote and poor region of Ourika. The women, chosen for their minimal reading and writing skills, came from six isolated douars (Aghbalou, Timalizen, Amlougi, Oualmes, Tazitount and Setti Fatma), located more or less 35 km from Marrakech. In this region, people speak Berber and a little Arab. The economy is mainly based on agriculture and livestock farming. Industrial and mining activities, tourism and crafts are also important. Since 2011, the floods of the wadi Ourika have increased in frequency and importance, in connection with climate change. These floods have devastating effects on the landscape, agriculture, human capital, infrastructure and food security. Women, guardians of their families while their husbands work in Marrakech, are facing floods and must protect their families and their property.

The interventions with the women took place over three years, from March 2015 to February 2018. During the project, three minor floods of the Ourika occurred. Over the three years, three women left the project (for personal problems or changes) and two new women were recruited. The design thinking process dictated the activities of the 10 workshops organized with women and a private Facebook group (GIREPSE Women) was used regularly as a networking tool when women were at a distance. As part of the first stage of design thinking (observation-inspiration), individual interviews were first conducted with women to invite them to describe the major problem of floods and their needs in the face of this disaster. A Journey Map, that is to say a visual representation summarizing their experience before, during and after a flood, prepared by two researchers, allowed the construction of the first synthesis of the problem of flooding. The women said that before the floods, they stored forest wood and essential food in case of road closures. They put plastic on the roof of their house to prevent water from seeping in. Some were digging canals in front of the house to change the flow of

the current and prevent water from invading the house. During the floods, they stored the goods in a room that was not subject to immersion and some took refuge with the neighbours with their children. After the floods, they unblocked the rocky roads and encountered problems of drinking water supply. At that time, the water of the wadi, laden with sediment became an alternative of drinking water and was placed in containers for deposit debris towards the bottom. After decantation, the water of the wadi was then consumed or used for various purposes.

In August 2015, during the first two workshops of two days each, with the women gathered, the stages of the design thinking process, observation-inspiration and synthesis, were again applied, animated in Arabic by researchers of the team. The women were invited to comment together on the previously prepared Journey Map reporting their experiences of the flood. They were also trained in the use of tablet computers, the Internet and Facebook. A 3G connection allowed participants to access the Internet on a regular basis, even during floods. They then chose to work on a narrower and therefore easier problem: the quality of their drinking water after the floods. The Facebook exchanges then began, in September 2015, the women communicating with each other and with us, about the floods and the sub-problem of the quality of water. Initially, women were invited to post photos, videos and comments on local floods on Facebook. Subsequently, weekly specific questions were asked of women on Facebook inviting them to define the sub-problem of water quality after the floods: Where? When? Why? What are the impacts? What are the solutions? etc. Women had to observe the problem at home and answer questions with Facebook tools: comments, videos, photos, emoticons, etc. Workshop 3, held in November 2015, brought women back together for one day for the realization of the synthesis (2), ideation (3), prototyping (4) and testing (5) stages of design thinking on the sub -problem of water quality. During this workshop, a summary of the elements of the problem of drinking water and solutions proposed on Facebook was first realized. The water from the wadi collected in the villages was then tested with the women, to check the quality: ph, coliforms, bacteria, etc. The women were then invited to invent prototypes of filters using domestic materials: cloth, coal, plastic bottles, sand, rocks, etc. They had to check the capabilities of these filters to clean the water. After the workshop 3, the Facebook exchanges resumed, from November 2015 to January 2016, planned according to the stages prototyping (4), tests (5) and communication (6) of design thinking. The women tried to build their own filters at home and they shared their essays on Facebook, receiving criticism from their peers. On Facebook, a general assessment concluded the process of prototyping filters.

Subsequently, as prescribed in design thinking (an iterative process), a return to the definition of the problem (observation-inspiration) was carried out during a workshop in March 2016. The question asked was: How could we prevent the water of the wadi from being contaminated? A new ideation phase followed and the participants proposed the following solutions: search for better water sources, treat well water with adequate amounts of chlorine, sensitize neighbours to avoid dumping their waste in the river, build solid pipelines, place wells away from flood areas, better clean water, and reuse waste to reduce its amount, including composting leftover food. The solution "to sensitize the neighbors not to throw their waste in the river" was then experimented at home, by the women, without much success. On Facebook, an analysis of domestic waste followed, with women invited to publish photos of their household waste on the group. Among the waste exposed online, the group found the significant presence of food and plastic bottles. The project team then decided to provide the women with composters and teach them how to make compost (in September 2016). As the compost matured, the women asked questions on Facebook for advice and to know if the compost was

ready. At the same time, photos of plastic bottle reuse ideas were placed on the Facebook group, first by our team and then by two women more skilled with the Internet. Various themes of possible recovery have been explored: reuse of bottles for the garden, decoration, art, jewelry or as utilitarian containers. Women reacted to the possibility of applying these solutions at home and for the next workshop (April 2017), they chose to create, prototypes of jewelry, candy boxes and under-plates made with plastic bottles. The jewels have been their favorite prototypes. As a result of the workshop, they responded positively to our invitation to start a women's cooperative specializing in waste recovery, the products of which would be jewelry and compost. During a workshop (August 2017), they tested their prototype jewelry by consulting the people of a community of Ourika to collect their opinions and suggestions about their first creations. In October 2017, a first exhibition and sale of jewelry of the cooperative was organized in Rabat and five women were able to participate. The Facebook group was used to plan the event by providing tips on visitor reception and jewelry arrangement. During the exhibition, the prototypes of jewelry were again commented by the customers and the women published on Facebook the prototypes of the best-selling jewels. During this month, the Regional Directorate of the Environment of the Marrakech-Safi region provided and installed in two of the women's houses a fast composter to help the cooperative to accelerate its production. In November 2017, the women took charge of their cooperative and registered by themselves at a local fair in Marrakech. On Facebook, they posted photos of their jewelry assortment at the fair.

Previous lines briefly summarize GIREPSE's three-year-old women's design thinking-Facebook experience. It is important here to specify how the four researchers animated the Facebook group. In the first year, the publications of the facilitators, in Arabic, were about two per week whereas in the other two years, the publications of the facilitators reached an average of one per day (in French translated later into Arabic). Various ways to motivate women have been used on Facebook: to promote images and not texts, to use short texts, to participate ourselves in the prototyping of jewelry, to project success images of the cooperative, to inform them about Moroccan cooperatives, to talk about the risks of waste in the environment, to republish women's handicrafts as cover images, to write individually to women to encourage them, to recall the project's environmental objectives, etc.

**2.2 Data Collection and Analysis**

During the design thinking process facilitated by Facebook, individual interviews with women (in the middle and at the end of the project) and their Facebook postings were exploited. The purpose of the research was to evaluate the potential of design thinking and Facebook as approaches to environmental education and for co-creation of adaptations to climate change. The first individual interviews were conducted after the first year (after the construction of the water filters) while the second interviews took place in the last year of the project. The analysis of the first individual interviews is not the subject of this article because these results were published in Pruneau et al. (2016). This article discusses the final interviews in which the interviewees were invited to draw and comment on their experiences and impressions of themselves before, during and after GIREPSE Women. Here open questions were first asked to women: Draw yourself as you saw yourself before the GIREPSE project! ... Draw yourself as you see yourself now that you are involved in the GIREPSE project (tablets, Internet, cooperative, Facebook group ...). If you think you've changed, take the time to draw the changes you made! ... Draw yourself as you foresee yourself in the future, after the GIREPSE project. Draw the

changes you think you will be making (for yourself, for your community, for the GIREPSE women's group, the cooperative)! Explicit interviews with open-ended questions followed the drawings, inviting women to explain their representations. Similar interviews were also conducted with three stakeholders from the major GIREPSE project. The interview data were analyzed using conceptualizing categories by two researchers who worked individually and then in confrontation. The objectives of the EE, as defined by UNESCO-UNEP (1977), served as broad categories and various themes emerged from the broad categories. For the Facebook group, a bi-monthly table of women's publications was first prepared. In the table, it was a question of entering, for each period of two months, the actions and the non-actions (inactivities, absence of reactions) in person and on line of the participants and to qualify and to quantify their types of publication: their presence on the group, the images and videos inserted, the types of comments, the emoticons and the "likes". A 10-page compiled table thus reduced the data to make sense of it and then compiled a shortened summary of women's participation. The chart was done by a researcher and then readjusted or completed by two other researchers.

## 3. Results and Discussion

### 3.1 Women's Participation and Non-Participation in their Community and on the Facebook group

Since participation is considered an important learning outcome in EE, this is how we analyzed the presence or absence of it during GIREPSE Women project. Despite the personal occupations of each, a core of 8 women remained active throughout the three years of the project. About 75% of them actively participated in the workshops, providing elements of the problems, proposing solutions and experimenting and testing prototypes. In their environment, they carried out actions: filming the floods, their causes and their impacts; sensitize their neighbours to the harmful presence of waste; create and use an alert system to warn communities of a flood; test their soil; study the composition of their household waste; make compost; make jewelry and utility objects with plastic bottles; start a cooperative; apply compost; sell jewelry; experiment with a high-speed composter; register for and participate in a craft fair; propose other avenues and products for the cooperative. Through these actions, periods of passivity have been observed. Women were less involved in times when they had less confidence in their abilities, in times when they met personal limits (having a child, being sick ...), with the late arrival of jewelry materials or when too much time passed between the on-site workshops. At all these times, it was necessary to make use of the means of motivation mentioned above.

Online, the majority of women watched the animators' publications until the formation of the cooperative. Subsequently, members of the cooperative were more present online than participants who had not joined the cooperative. Given the language limitations of women writing, their comments on Facebook remained very short and in small numbers: a brief opinion, many "thanks", short answers and several "likes" and other emoticons. The direct publications in Arabic of the facilitators elicited more comments than the French publications translated into Arabic in a short time. Women have often used images to express themselves on Facebook and sometimes videos filmed with their tablet. Facebook's "personal conversation" feature has been used extensively as well as the Whatsapp digital tool for exchanging news and information.

### 3.2 Women's Impressions of their Experience

Women spontaneously described some aspects of their experience before, and during, the GIREPSE Women Project. They also talked about how they saw each other as a result of the project. We categorized their remarks according to the objectives of the EE: awareness, knowledge, state of mind (attitudes), skills and participation.

**Awareness:** Before the project, women said they were aware of the nuisance of floods, which they associated with natural causes and not with climate change. They knew that there was a lot of waste in their village and that their environment was not quite healthy, nor their quality of life. During the project, they say they have become aware of various dimensions of floods, waste and the impacts of these two problems on health. They know that it is important to reduce this waste.

**Knowledge:** Before the project, they admitted that they could barely read and write in Arabic and that they knew little about technology, the Internet and tablets (except for two of them who could express themselves few in this language and who had previously used cell phones or a computer). They had not heard about climate change, waste reuse and flood adaptations. Their knowledge of the other villages of Ourika and Moroccan cities was very limited because they had never or almost never been there. They had few friends or acquaintances outside their village (except for one of them who was studying in Marrakech). During the project, they say they have known other regions, people and cultures and made new friends in Ourika and even in other countries (thanks to the Internet). They learned to reuse waste, and to make filter water, compost and jewelry. They better understand the variability of floods from year to year as well as their impacts. They have some means to get out of their misery.

**State of mind:** Before the project, they perceived themselves as shy, unconfident and inactive in their daily lives. They used their time to take care of their families and to listen to television. They felt caught in a "blur", not knowing how to get out of their misery. During the project, they say they have gained greater self-confidence and pride because of their participation in the project and the founding of the cooperative and because they help the environment. They say they like to learn. In the future, they believe that the cooperative will succeed if they work hard. They are keen to go to school, find a job, learn to read and write better, learn about ICTs, get married, improve co-ops and diversify their products. They feel solidarity with their community, want to take care of the environment and pass on this habit to their children.

**Skills:** Before the project, they did not know how to use ICTs. During this, they say they learned to use an electronic tablet, to search the Internet (for images, recipes, drugs, jewelry ideas, solutions to environmental problems ...), to use new ICTs (YouTube, Whatsapp ...), to solve problems and to make crafts. They say they have also learned to communicate in Arabic and a little in French.

**Participation:** Before the project, they said that they applied limited adaptations to floods: to fly, to unblock the roads, to protect their property from water ... During the project, as mentioned above, they have carried out many actions in their region and in a wider geographical area than before. Many of their actions are adaptive: creating their own water filters; using an alert system; reducing waste through composting, jewelry and neighbourhood awareness; start a recovery cooperative, etc. Online, they have watched and sometimes commented on the publications of the facilitators and their colleagues, they have joined other Facebook groups (according to their interests); they have created their own Facebook groups (among others to publicize their products), etc. The women also admitted that their presence and participation in the Facebook group, although constant, had been diminished by their language limitations. Facilitators interviewed also explained that

women's lack of confidence and their lifestyle habits had limited the pace and consistency of their community actions and their involvement in the development of the cooperative.

## 4. Conclusions

Women's environmental and technological learning, the increase of their self-esteem and social capital, their many participatory experiences and their current online presence risk changing their living conditions and their adaptation to floods. It is certain that learning in environmental education and adaptation to climate change has been achieved. In light of these findings, it can be argued that participating women went through at least the first four stages of the change process described by Rochlkepartain (2001): 1) receptivity (cultivating openness to change); 2) consciousness (emphasize the possibility of change); 3) mobilization (organizing for change); 4) action (implement the change). As for the fifth stage of Rochlkepartain's process, namely continuity (making sure that change becomes a way of life), it will be necessary to observe whether the sense of self-efficacy and determination of women as well as the prevailing political, economic and cultural conditions favour the continuation of the cooperative and the reduction of vulnerability to floods in the Ourika.

In this project, design thinking seems to have helped to broaden the description of the flood and waste problems, according to the needs of the participants. During the iterative stages of design thinking, several solutions have been proposed, tested and implemented in the field and various learning has been observed in women. Facebook, meanwhile, has been used as a tool for learning, problem definition, ideation, building self-efficacy, planning, prototyping and decision-making. Facebook has also expanded geographic and time boundaries. Women have been in contact with ideas from around the world and thanks to continued work on Facebook, they have had more time than workshops to analyze problems and find solutions. Facebook has provided updates, links, images (sometimes in real time), and empathy with disasters and those affected by them. So Facebook could personalize disasters and risks. Facebook seems to have the potential to provoke participation and interactive communication related to environmental problems.

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