Cycles of action and reflection as the basis of transformative innovation

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Abstract

Purpose – This paper aims at explaining the design process of a learning model targeting potential entrepreneurs with no technical or business expertise aiming to develop sustainable business models in deprived areas. The case that the paper explores focuses on experiential learning and learning in adulthood to design a learning model that considers context and socio-demographic characteristics, makes clear the interconnections between sustainability principles, entrepreneurship rationale and design methodologies and includes actions and processes of reflection and contextual interaction.

Design/methodology/approach – Following a recursive argument, the paper applies design research methodology (DRM) to systematically design the "transformative innovation model" that Product Co Creation Centers (PC3) from the University of Twente (The Netherlands) has developed.

Findings – Building on Kolb's cycle of experiential learning, the result of applying DRM is a learning cycle of confrontation, observation, practice and application. The proposed learning model is applied to a specific setting in Colombia, allowing to verify and validate whether the learning model leads to the expected outcomes. It is argued that an interdisciplinary approach, a focus on feedback loops and the consideration of the context are important elements for addressing and transforming complex problems related to sustainable development from the bottom-up.

Originality/value – This paper contributes to academic research in management emphasizing a solution-finding approach based on a prescription-driven research process, informed by design science research.

Keywords Sustainability, Transformative learning, Entrepreneurship,
Entrepreneurship and small business management, Feedback loops, Design research methods,
Solution-oriented research

Paper type Research paper

1. Introduction

Sound evidence of environmental degradation, ecosystem depletion and increasing inequality worldwide has motivated world leaders to call for a green economy in the context of sustainable development and poverty eradication (United Nations, 2012, 2015). This implies a more resource-efficient equitable growth, which is able to improve human well-being and social equity, while significantly reducing environmental risks and ecological scarcities (UNEP, 2012). This new economic paradigm has brought about several logics, discourses and practices at the global, national and local level, as well as at different domains, such as the financial, institutional, regulatory and cultural domain (Bailey and Caprotti, 2014).

It has also been argued that grassroots entrepreneurs contribute to the green economy on the ground because they bring about inclusive and resource-efficient technological innovations and promote more inclusive mechanisms to deliver products and services (Pansera and Sarkar, 2016). However, researchers have found that still much support is needed to social and environmental enterprises as the grassroots foundations of the green economy, namely, in the form of access to research organizations to develop and test products and technologies, access to information, access to advisors and mentors, access to finance and access to channels to communicate their success (Creech et al., 2014).

In recent years some initiatives aiming at covering these gaps have emerged, such as Africa Funded (www.africafunded.nl/incubation), BoP Innovation Center (bopinnovationcenter.com), Enablis (www.enablis.org), Global Fairness Initiative (www.globalfairness.org), Green Business Initiative (www.gbi.org.pk), Product Co Creation Centers (www.utwente.nl/en/bms/cstm/research/sus-prod-con/#key-academic-projects-in-progress), SEED (www.seed.uno), Skoll Foundation (www.skoll.org), among others. These initiatives usually provide technical and organizational support, access to broader networks of investors and, sometimes, seed funding in the form of awards.

The authors of this paper take part in one of the initiatives mentioned above, specifically at the Product Co Creation Centers (PC3). PC3 offers a specialized program where deprived potential social entrepreneurs with no technical or business expertise interact with a team of experts to co-create (innovate) products and services from an initial idea to a physical prototype according to a (co-created) sustainable business model (Jauregui-Becker et al., 2013).

PC3 is a joint alliance of three departments at the University of Twente (The Netherlands), i.e. the Department of Design, the Department of Governance and Technology for Sustainability (CSTM) and the Department of Innovation and Entrepreneurship. PC3's interdisciplinary approach aims at enabling local innovation, based on sustainability principles, social entrepreneurship rationale and design methodologies. The research that is carried out throughout this project investigates the development of suitable models to boost the sustainable development of under-privileged regions from the bottom-up. PC3's mission is therefore twofold. On the one hand, it can be regarded as a business pre-incubator which focuses on opportunity recognition, conceptual product development and sustainable business model creation. On the other hand, it seeks to understand the ways in which innovative business models may create, simultaneously, social, environmental and economic value.

In this paper, we attempt to elucidate the process PC3 has gone through to design a replicable model of transformative learning and action, based on design research methodology (DRM) (Blessing and Chakrabarti, 2009) and Kolb's Experiential Learning Approach (Kolb, 1984).

Design methodologies are rarely used in social science research, given the explanatory nature of such research. However, it has been argued that prescription-driven research, based on the paradigm of design sciences, can contribute to finding solutions to problems social scientists care about (Van Aken, 2004). The results of prescription-driven research are field-tested and grounded technological rules to be used as design exemplars of problem-solving by both academics and practitioners (Van Aken, 2004, p. 221). Design methodologies take a heuristic approach, highlighting the insider's perspective rather than the observer's on the problem-solving process. Therefore, prescription-driven research is highly participatory, in the same way action research is (Reason and Bradbury, 2001).

The action research process that we have conducted in the context of a PC3 implementation follows a prescription-driven research aiming at designing and testing a suitable learning model for grassroots innovators interested in developing feasible business models that contribute to sustainable development on the ground. Using Van Aken's words, this research is about uncovering the generative mechanisms that link immaterial interventions such as PC3 with material outcomes such as business models for sustainability[1].

In this process, reflexivity has been an important component for us to find and make transparent the frameworks in which our findings make sense (Engward and Davis, 2015). We have found interesting similarities with the principles that guide circular economy (EMF, 2013), namely, its systems approach, focus on cascades and resilience-building purpose. Even though circular economy advancements have taken place in manufacturing at the corporate level, its rationale is relevant in the design process discussed in this paper because it serves as a metaphor to understanding a new paradigm that consists of moving from linear to circular approaches.

This paper follows a recursive argument. The PC3 program is presented following a step-by-step DRM which stands, at the same time, as its core rationale. First, in Sections 2 and 3, we explain the research rationale, discussing DRM while pointing at its aims and contextual assumptions in the case of PC3. In Section 4, we present the theories of transformative learning in adulthood on which the PC3 model is based. In Section 5, we analyze PC3's transformative learning and action objectives, which leads us to the description of the PC3 learning model. In Section 6, we verify and validate the suggested learning model according to the results we have obtained in the application of the PC3 program in Colombia. Finally, conclusions in Section 7 refer to the PC3 interdisciplinary approach, its transformative learning characteristics and its contributions to promoting sustainable innovation. We will also discuss advantages and limitations of the design approach that we use throughout this paper and suggest some links to circular economy at the local level.

2. Research rationale

This section discusses the DRM proposed by Blessing and Chakrabarti (2009). The DRM has four research stages:

(1) *research clarification*: for finding indicators and formulating a worthwhile research goal;

(2) *descriptive study I*: for describing the existing situation by reviewing the literature and/or an empirical study;

(3) *prescriptive study*: during which a support method is developed (i.e. the PC3 learning model); and

(4) *descriptive study II*: for investigating the impact of such support method.

The aim of the *research clarification* is to determine a set of goals that the intended support method or tool has to fulfill. Also, specific requirements and boundary conditions need to be specified. The first step of applying this methodology to our research is presented in the following section. Here, the general problematic that PC3 intends to solve and the major goals are described.

The purpose of *descriptive study I* is to describe the existing situation. To achieve that, both literature review and empirical research are conducted. The research in this stage focuses on understanding the characteristics of the target audience, determining which the best learning practices are (see Section 4). The *descriptive study I* also defines a set of learning objectives that participants should achieve.

The *prescriptive study* consists of suggesting a solution or support method to the problems described in the first stage. It depends on the outcome of the methodology by applying the results obtained in the *descriptive study I*. In the case of this research, this step results in a comprehensive learning model that describes a set of themes attributed to each learning objective. Additionally, the learning method and protocols are described as well (see Section 5).

Finally, *the descriptive study II* consists of evaluating the results of the *prescriptive study* by applying it in a specific setting, which in the case of this research has taken place in a rural community in Colombia (see Section 6). This *second descriptive study* includes verification and validation processes. The verification consists of assessing whether the learning approach indeed supports the objectives initially suggested. The validation consists of measuring the degree of success after the PC3 implementation process has taken place. Here, success refers to transformative ideas or practices developed throughout the process.

3. Research clarification
This section discusses two components that help us define specific requirements, boundary conditions and a set of goals that the intended support method has to fulfill.

First, the hypothesis on which PC3 is based is derived from research conducted by the Global Entrepreneurship Monitor (GEM), which states that "a large group of people in the *Base of the Pyramid* (BoP) have entrepreneurial skills, but no means to exploit them and develop their own products and businesses" (Jauregui-Becker *et al.*, 2013, p. 10)[2]. This suggests that the potential to innovate and become entrepreneurs must be developed. To do so, PC3 work is based on co-creation methods for structuring collaborative innovations that will enable formal "market creation" (Mezias and Fakhreddin, 2012). The assumption here is that BoP innovators are active designers of the value-exchange structure because of their understanding of native roles, identities and social structures that shape value within this structure.

Second, the sustainable development path has become more complex over time because of the realization of the inherent integrity between social, ecological and technical subsystems (Wangel, 2011). As the first worldwide call toward a more sustainable development (WCED, 1987), its lens has addressed several issues such as nature conservation, ecology, end-of-pipe pollution control, cleaner production, local action and participation, sustainable consumption. Therefore, both interdisciplinary approaches and system thinking are needed to address and understand today's complex sustainability challenges. Such thinking is characterized by:

- its focus on feedbacks;
- the consideration of contexts; and
- a rationale of flexibility and adaptation (Hall and Clark, 2010; Webster, 2014).

This dynamic vision calls for a cyclic rather than a linear understanding of change at any level of society.

To conclude this DRM step, we can thus argue that this research process is about designing a learning model in which co-creation takes place, uses an interdisciplinary approach and promotes systems thinking, enriched by cyclic reflection among co-creators.

4. Descriptive study I: transformative learning in adulthood

In this section, we attempt to describe the existing situation, i.e. the state-of the-art theories of learning in adulthood. To do so, we follow Engeström's (2001, p. 133) central questions about learning activities:

Q1. Who are the subjects of learning, how are they defined and located?

Q2. Why do they learn, what makes them make the effort?

Q3. What do they learn, what are the contents and outcomes of learning?

Q4. How do they learn, what are the key actions or processes of learning?

To answer the first question, PC3's target is innovative individuals living in deprivation. These individuals are young adults with poor formal education, who have already proven their entrepreneurial character, mainly because they have characteristics of leadership, autonomy, self-confidence, resourcefulness, risk-taking, courage, persistence and flexibility (Stevenson and Jarillo, 1990). They live in deprived regions, lacking access to products and services, which undermines their well-being (Prahalad and Hart, 2002).

In relation to the second question, according to theorists of experiential learning, the living experiences of the adult learner are the source of the adult's motivations to learn (Knowles, 1980; Lindeman, 1961; Merriam *et al.*, 2007). PC3 program's participants are active innovators looking for solutions to improve their own and their communities' living conditions. Therefore, the answer to the second question in the case of the PC3 program would be that the lived experience of scarcity, exclusion or insecurity is the driver of these innovators to engage with transformative learning processes.

Third, answering to the question "what do they learn, what are the contents and outcomes of learning?", the PC3 program is an interdisciplinary program that brings together sustainability principles, entrepreneurship rationale and design methodologies. Each one of these three pillars has defined its own learning objectives, based on the teaching experience of PC3 members:

4.1 Design learning objectives

- It applies systems engineering methods to model the problem space in terms of stakeholders, actors, situations and user scenarios with the goal of creating requirements that contextualize sustainability factors to consider in the design of products and services.
- It develops expertise in exploring the solution space through the application of ideation processes that combine brainstorming techniques that encourage both divergent and convergent thinking.
- It helps to learn and develop expertise in applying problem-solving techniques that enable continuous learning cycles as a medium for generating new knowledge.

- It helps to understand and learn techniques to manage and control the development process of product and services between the conceptual design phase up to commercialization.

4.2 Entrepreneurship learning objectives

- It recognizes business opportunities as well as the mechanisms needed to create social and environmental value through these opportunities.
- It appraises the surrounding entrepreneurial ecosystem, which may support/ undermine the product or service development.
- It formulates and evaluates value propositions, both individually and with peers.
- It uses and compares business model canvases.

*4.3 Sustainability learning objectives*

- It includes integrity values all along the business development in the areas of human rights, labor, environment and anti-corruption.
- It identifies the environmental aspects along the product life cycle to prevent negative impacts.
- It selects clean technologies to manufacture/transport products and/or provide services.
- It embeds social inclusiveness within business models.
- It applies system thinking to understand sustainability challenges which go across the business facilities and contribute positively to them.

Finally, in relation to the fourth question about how they learn and what the key actions or processes of learning are, we follow constructivist learning theory, "which understands learning as construction of meaning from experience" (Clark and Rossiter, 2008, p. 63). This meaning-making may occur through reflection (Boud and Walker, 1990; Kolb, 1984; Mezirow, 1991) and through contextual interaction (Hansman, 2001; Lave and Wenger, 1991).

5. Prescriptive study: product co creation centers learning model
According to the elements identified in the previous section, PC3's learning model should consider context and socio-demographic characteristics; should make clear the interconnections between sustainability principles, entrepreneurship rationale and design methodologies; and should include actions and processes of reflection and contextual interaction. In our view, Kolb's Experiential Learning Cycle (Kolb, 1984) suits as the basis for PC3's learning model (Figure 1). According to this cycle, the learner relates to her/his context through concrete experience and active experimentation, embraces new knowledge through abstract conceptualization and consciously reflects on the experience through reflective observation.

PC3's learning model consists of a cycle of confrontation, observation, practice and application. Additionally, it is based on group and collaborative learning, motivated by enquiry with appropriate coaching. Each participant works on a specific sustainability issue and collaboratively with an outsider to the training (we call this person, the *team mate*). Each process within the learning cycle is explained below.
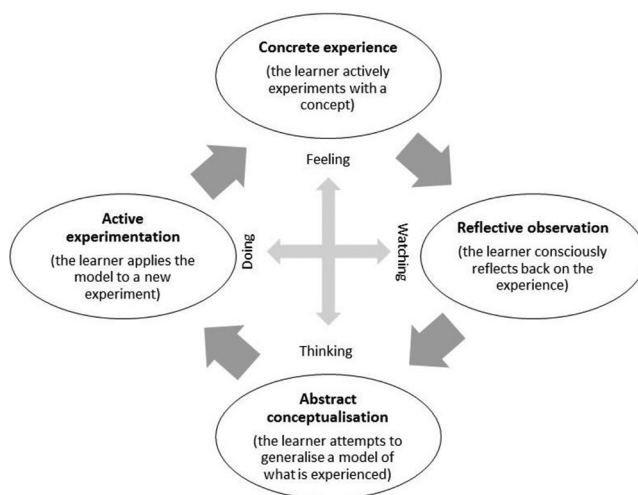
Figure 1.
Kolb's experiential
learning cycle

5.1 Confrontation
When addressing a new topic, PC3's participants are confronted with a real-life challenge they have to solve. They are asked to solve them prior to teaching them how to do it. The goal of doing so is to encourage them to understand what the related problems are, as well as to help them realize that new knowledge is useful for solving these problems. After they have tried to solve the problem, all groups present the challenges they encountered. They are told that the following lecture will show them how to address those challenges.

5.2 Observation
Through a short lecture (e.g. in video format), an instructor presents specific concepts and theories. The focus is set on the "whys" of the content, aiming at achieving a holistic comprehension of the topic rather than merely knowing it. These "whys" are enriched with brief historic facts and causal relationships. Several examples are presented and used to relate the previously identified challenges with solution approaches.

5.3 Practice
A workshop is carried out to have participants practicing how to apply the knowledge gained during the lecture. The problems are solved in groups using poster papers and markers to write down their solutions. To facilitate the application of the taught methods, each of the challenges solved in the workshop is divided into three smaller problem chunks. As a consequence, the workshops are carried out in three phases. The three phases are executed following the same protocol:

- A problem chunk is presented in one presentation sheet to all participants.
- Each group can immediately start working out their solution.
- The facilitator goes from group to group with small hints to keep the participants discussing the solution. At certain point in time, all groups stop and share what they have worked out by sticking their poster paper in the walls of the lecture room.

- The facilitator randomly selects groups and asks them to quickly analyze and share their thoughts. The facilitator also poses questions to all participants and asks them to provide and share their answers with the group.
- The facilitator presents concluding remarks.

5.4 Application
The goal of the final step is to asses if participants are capable of solving a real-life problem by themselves. Here, each participant works with her/his *team mate* to explore ways of applying the new knowledge. They do so by applying specific instruments such as the business model canvas, circular economy tools and design process unit models (Jauregui-Becker *et al.*, 2012). This process is observed by a coach who gives support if needed and enquires the reasons why some decisions are made instead of others.

6. Descriptive study II: product co creation centers transformative innovation model
According to the DRM, *the descriptive study II* consists of evaluating the results of the *prescriptive study* by applying it in a specific setting, which in the case of this research corresponds to the PC3 in Colombia. Based on this case, we will verify and validate whether the learning model leads to the expected outcomes.

6.1 Product co-creation centers in Colombia
The learning model described above was applied in the PC3 program that was conducted in Santa Rosa del Sur (a small town in the rural area of Bolívar in northern Colombia) from April until November 2015. Santa Rosa del Sur exhibits great sustainability challenges: it is a region characterized by long lasting violence and migration. Main economic activities include coca plantations and gold mining in river banks, which bring about environmental degradation and biodiversity loss because of large deforestation and heavy-chemical pollution. Additionally, these economic activities have social consequences such as informal jobs, violence and short-term mentality. However, within this context, there are some community leaders who stand out because of their alternative ideas about the socio-economic future of this region. These leaders have promoted other economic activities based on environmental awareness and community development.

In April 2015, we conducted the first on-site workshop, where we explained the PC3 program to some of these community leaders. After discussing the goals and activities of this program, ten of them voluntarily chose to join it. Throughout the process, four participants dropped out, which means that the findings discussed in this section are based on the information reported by the lasting six participants. Even though six individuals may seem to be too few for research purposes, we consider that the information they have reported is relevant because they represent community organizations that bring together more than four hundred families in the region.

The PC3 training program consisted of a combination of video lectures and virtual workshops. The purpose of video lectures was to give participants information about specific topics (*observation*), while virtual workshops (ten in total) were about collaborative exercises and discussions to apply the information given in the videos to each participant's business model (*confrontation* and *practice*). Before each virtual workshop, participants had worked on specific real-life business challenges with their team mates, applying concepts and instruments from the training (*application*). The training included the basics of design

(the value creation process, the design process and design thinking), entrepreneurship (the 4S model, strategy, marketing, business model, business model canvas, pitching and coaching) and sustainability (sustainable development, environmental management systems, sustainable product design and circular economy). In November 2015, there were two on-site workshops, in which we evaluated the PC3's learning model according to Engëstrom's central questions discussed above.

6.2 Evaluation of product co creation centers learning model

As mentioned above, Engeström (2001, p. 133) suggests four central questions about learning activities: "Who are the subjects of learning, how are they defined and located? Why do they learn, what makes them make the effort? What do they learn, what are the contents and outcomes of learning? How do they learn, what are the key actions or processes of learning?" These questions guided the design process of the PC3's learning model, as it was explained above in Section 4. Now, these questions will be specifically answered for the Colombian case[3].

First, we had stated that PC3's participants should live in deprived contexts and should be young adults with poor formal education, who had already proven their entrepreneurial character. In fact, Colombian participant's age average was 39; they all come from this region, where they have experienced scarce access to basic services, such as health, education, drinking water, sewage, transport and housing. Additionally, when asking them about their profile, we found out that they consider themselves as "innovator", "creative", "entrepreneur", "able to change my environment", "leader" (PP_070415).

Second, from the discussion above we know that the living experiences of the adult learner are the source of the adult's motivations to learn (Knowles, 1980; Lindeman, 1961; Merriam *et al.*, 2007). In the Colombian case, participants reported that their motivations to join and stay in the program were mainly related to the responsibility they were given by the families they represent to learn new concepts and ideas, so then they could work together on the development of the region (W1_301015). This is clearly seen in the following quote:

> (I'm motivated by) the transformative power of knowledge. We, the people who are here, have a responsibility, because we're leaders of many families of farmers. This knowledge is not to keep it with us, it's to be shared and used for the community's well-being. We can use this knowledge to bring our ideas forward. (W1_301015)

We could argue, therefore, that the answer to Engeström's (2001, p. 133) question *what makes them make the effort* is related to the living experience of being a community leader, having the opportunity to engage with new knowledge through the PC3 program.

Third, in relation to the question about what they learn, which includes contents and outcomes of learning, each of the pillars of the PC3 program (sustainability principles, entrepreneurship rationale and design methodologies) has its own learning objectives. Table I summarizes what participants reported they had learned throughout the process (W1_301015). Their answers were classified according to each learning objective, resulting in a frequency analysis[4].

From Table I, it can be argued that all learning objectives were met to some extent. From the design perspective, the main learning was related to understanding the problem space and exploring the solution space. The contribution of this rationale to business development, together with the achievement of the entrepreneurship learning model related to opportunity recognition and social and environmental value creation, suggests the emergence of innovative business models able to meet social and environmental needs.

Contents	Learning objectives	High	Medium	Low	Not mentioned
			Frequency		
Design	Apply systems engineering methods to model the problem space in terms of stakeholders, actors, situations and user scenarios with the goal of creating requirements that contextualize sustainability factors to consider in the design of products and services	✓			
	Develop expertise in exploring the solution space through the application of ideation processes that combine brainstorming techniques that encourage both divergent and convergent thinking	✓			
	Learn and develop expertise in applying problem-solving techniques that enable continuous learning cycles as a medium for generating new knowledge		✓		
	Understand and learn techniques to manage and control the development process of product and services between the conceptual design phase up to commercialization			✓	
Entrepreneurship	Recognize business opportunities as well as the mechanisms needed to create social and environmental value through these opportunities	✓			
	Appraise the surrounding entrepreneurial ecosystem, which may support/ undermine the product or service development	✓			
	Formulate and evaluate value propositions, both individually and with peers		✓		
	Use and compare business model canvases		✓		
Sustainability	Include integrity values all along the business development in the areas of human rights, labor, environment and anti-corruption	✓			
	Identify the environmental aspects along the product life cycle to prevent negative impacts	✓			
	Select clean technologies to manufacture/transport products and/or provide services			✓	
	Embed social inclusiveness within business models		✓		
	Apply system thinking to understand sustainability challenges which go across the business facilities and contribute positively to them			✓	

Table I.
Accomplishment of
learning objectives

Being able to appraise the surrounding business ecosystem and its effect on the product/service development was another entrepreneurial learning objective which was highly achieved. It was complemented with the sustainability perspective, which looks at the ways the product/service development affects the social and environmental landscape. Finally, the usefulness of the product life cycle concept was understood by all participants.

The learning objectives that were only achieved by the minority of the participants were related to the management and control of the development process of products (from the conceptual design to commercialization), the familiarity with clean technologies and the application of system thinking.

Thus, these results verify that the learning model that was used indeed supports the objectives initially defined.

Besides the learning objectives, PC3 has considered itself to be successful when it develops transformative ideas or practices throughout the process. In the Colombian case we have found evidence of transformative learning. Participants reported that this program has helped them to think differently about businesses and about the problems they face; they feel more confident about promoting values of justice and environmental care within businesses; they believe that the sort of business models that they have developed through the PC3 program are a pioneering effort to improve people's well-being in the region (W1_301015; OBS_031115_7).

Finally, in relation to the fourth question about how they learn, we have mentioned that we follow constructivist learning theory, "which understands learning as construction of meaning from experience" (Clark and Rossiter, 2008, p. 63). The constructivist literature discusses that this meaning-making may occur through reflection (Boud and Walker, 1990; Kolb, 1984; Mezirow, 1991) and through contextual interaction (Hansman, 2001; Lave and Wenger, 1991). According to our findings, the latter is the case for PC3. Each participant had a team mate throughout the program, with whom they had to discuss and create new solutions to a specific real-life business challenge. This interaction allowed them realize the value of the new knowledge and at the same time strengthened their role as innovative leaders (W1_301015; OBS_291015_5; OBS_041115_9). An example of meaning-making through contextual interaction can be found in the following quote:

> In this region the mind-set of doing business is complicated; people want easy money. But I say to them [my team-mates] that I've realized that a business is like a young tree: at the beginning you don't get fruit; you have to water and fertilize it; but after looking after it properly, you will indeed harvest fruit. (OBS_291015_1)

So far, we have answered Engëstrom's central questions about learning activities, based on the results obtained in the application of the PC3 program in Colombia. The purpose of this has been to describe a new situation (*Descriptive study II*) after the application of a suggested solution (*Prescriptive study*). After following all four steps defined by the DRM (Blessing and Chakrabarti, 2009), we can conclude that the learning model we suggested, i.e. a cycle of confrontation, observation, practice and application, is indeed a possible solution for PC3. In the following section we summarize this process and discuss advantages and limitations of this approach.

7. Conclusions
The interdisciplinary approach of the PC3 program, based on transformative learning goals for grassroots innovators in contexts of deprivation was described under the four steps of the DRM with the intention to grasp constructivist implications when

carrying out such program. The experiential learning cycle suggested by Kolb (1984) provided a useful framework to analyze the PC3 learning model. The integration of both, DRM and Kolb's cycle, resulted in what we have defined as the "PC3 transformative innovation model", which consists of a cycle of four steps, i.e. confrontation, observation, practice and application. This is an innovative educational model for entrepreneurs interested in contributing to sustainable development because it is interdisciplinary and builds on real-life experience and sustainability challenges of grassroots innovators, which could be applied to similar programs such as the ones mentioned in the introductory section.

According to the empirical evidence gathered in this paper, its focus on cycles of action and reflection, feedback loops and its consideration of the context are useful for addressing and transforming complex problems related to sustainable development from the bottom-up. We see here an opportunity for testing new economic paradigms on the ground, where entrepreneurs' rationale can be moved from linear toward more circular approaches. We consider that a systems approach, a focus on cascades and resilience-building purpose are adequate for addressing the sort of sustainability challenges that individuals like PC3's participants deal with.

The empirical evidence analyzed here has, additionally, enabled us to prove a possible solution to meet PC3's goals, following the DRM. We have, therefore, met the initial objective of designing a learning model where potential entrepreneurs with no technical or business expertise co-create (innovate) products and sustainable business models (Jauregui-Becker *et al.*, 2013). Thus, this paper is a contribution to academic research in management with an emphasis on solution finding (Van Aken, 2004).

Even though further research is needed, the integration of DRM and Kolb's cycle might constitute the basis of a technological rule related to promoting social and environmental entrepreneurship at the grassroots level. In other words, the solution-focus approach that we have used in our research (i.e. prescription-driven research) has proved to contribute to the discussion of how to support grassroots innovators as building blocks of the green economy at the local level. This will need to be explored in more and varied empirical cases.

Notes

1. Here, immaterial interventions refer to sense-making interventions. "[. . .] management is about communication with others in the immaterial domain of language games (Wittgenstein, 1953) in order to mobilize those others to act in the material domain of action to produce as good as possible intended material outcomes" (Van Aken, 2004 p. 241).

2. Prahalad and Hart (2002) have used the term "the bottom of the economic pyramid" (*BoP*) to refer to more than 4 billion people who live on less than $2 per day, whom the formal market of goods and services does not reach.

3. Data in this section are referenced according to the authors' coding system.

4. Each learning objective was translated into specific questions which were answered individually and discussed in groups in the workshop. The responses were translated back into the learning objectives and the frequency analysis was undertaken. The ranking should be read as follows: High frequency means that the totality of participants met that objective. Medium frequency means that the majority (more than half) met that objective. Low frequency means that the minority (less than half) met that objective. And not mentioned means that no one met that objective.

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